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Data Available for the Measurement of Output per Man-Hour

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Introduction

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IN VIEW of the importance of productivity statistics in many areas of investigation, questions have been raised as to the adequacy of the available measures and the needed improvements in basic data. Pertinent analyses such as the report of the Joint Economic Committee of the President,¹ the more recent report of the National Accounts Review Committee,² and numerous internal memoranda of various agencies have been concerned more with the general improvement of basic statistical sources than with the specific area of productivity measurement. Therefore, the Interagency Productivity Committee of the Bureau of the Budget concluded that a more intensive examination of productivity data was required. This report is an outgrowth of that decision.

Part I of this report defines the major types of productivity measures, discusses the general problems attendant on their construction, as well as the kinds of data required, and summarizes the available data by sectors. Part II presents a comprehensive compilation of the data available by industries. From these tabulations it is hoped that specific gaps may be readily ascertained. The tabulations are not exhaustive since the study was limited to regularly published, readily available sources. Sampling techniques and sampling errors have not been evaluated. Also, since my primary purpose is to indicate weaknesses in the available data, the positive value of the existing series is not discussed.

¹ *Statistical Gaps*, Report of the Joint Committee on the Economic Report, 1948; *Employment and Unemployment Statistics*, Hearings before the Joint Committee on the Economic Report, 1955; *Economic Statistics*, Hearings before the Joint Committee on the Economic Report, 1954.

² *The National Accounts of the United States*, Hearings before the Subcommittee on Economic Statistics, October 29-30, 1957.

Productivity: Concepts and Data Requirements

A productivity measure is the ratio between output and input both specifically and comparably defined. The ratio can be expressed in terms of selected inputs or all inputs combined. However, the measures which have been most generally used are those which relate output to man-hours, sometimes known as labor productivity.

Measures of aggregate output per man-hour fall into three general categories. First, there are the physical productivity measures which show changes in the labor time required to produce a fixed composite of goods and services. These measure changes in technical efficiency alone. Second, there are the gross productivity measures which take into account shifts in the relative importance of component sectors with different levels of output per man-hour, as well as changes in output per man-hour within sectors. Third, there are the net output per man-hour measures which reflect, in addition to changes in physical productivity and shifts between sectors, changes in material requirements per unit of output. Since they reflect the effect of changes in resource allocation, the gross and net measures may record changes even when there is no movement in the productivity of component sectors. Each of the categories specified requires different kinds of data.

Data for the measurement of physical productivity should include the physical quantities of the various goods produced and the unit man-hours required in their production. However, only rarely is such information available for all commodities in an industry on a continuous basis. Where unit man-hours are not available, physical quantities are combined using weights which are assumed to be proportional to this variable. In order of preference, substitute weights which would be used are unit labor cost, unit value added, and unit value. In practice, these weights have been used in the reverse order at the commodity level. In combining industries, man-hour weights are used.

Gross productivity measures generally are derived by deflating production values by appropriate price indexes. The latter should be sufficiently detailed to relate to the value of output in question. Deflated value series are sometimes used as approximations of physical productivity measures.

Net output productivity measures, the third category, are based upon aggregates of dollar value added. These measures require the same data as the gross output measures and also information on materials and services consumed, with appropriate deflators.

Output

AGGREGATE MEASURES

Because of expedients adopted to fill gaps in the data, none of the current output series can be defined as purely physical, gross, or net measures.

Annual production indexes have been developed by the Bureau of Labor Statistics for manufacturing and by the Federal Reserve Board for manufacturing and mining (with different weighting systems), using quantity data wherever possible. Both series, with variations, include industries where output change is estimated from materials consumed and deflated shipments. The FRB also uses man-hours (adjusted for estimated productivity change). The BLS estimates that the industries for which data other than physical quantities were used represent almost 30 per cent of the production workers in the industries included in 1947. The FRB estimates that 38 per cent of the value added of its annual indexes represents data other than quantities produced and shipped.

There is no single series based entirely on the concept of gross output using deflated values of production. However, deflated value measures are important because they can be computed on an industry basis for a larger proportion of the total economy than can either of the other two output measures. They are used mainly as substitutes for parts of the other two types of series.

The closest approximation to a net output measure for the entire private economy is the estimate of constant dollars GNP prepared by the National Income Division of the Department of Commerce. This estimate includes the market value of all final goods and services. Since intermediate products are excluded, the duplication inherent in an aggregation of industry gross output is eliminated. The method of approach consists of estimating the deflated value of final product consumption. However, departures in certain sectors are necessary because current expenditures data or appropriate deflators are lacking.³ For example, the current value of personal consumption expenditures for some service industries is estimated from wage payments deflated by a price index or, more generally, by an index of wage rates. The resulting real value essentially reflects the movement of employment and does not take into account possible changes in productivity. On aggregation, therefore, the total real GNP includes values which are inappropriate for measuring output per man-hour.

³ George Jaszi, "The Statistical Foundations of the Gross National Product," *Review of Economics and Statistics*, May 1956. See also *National Economic Accounts of the U.S.*, Joint Economic Committee, Cong. of the U.S., 1957.

Since the GNP estimates are derived from the product side without explicit recognition of the industry of origin, they do not permit analysis of the relative trends in component sectors. For this purpose, estimates of net output per sector are needed. Most such estimates represent industry gross output measures combined with net output weights because net output data are not available. However, for agriculture and manufacturing it has been possible to derive deflated net output as a residual after deducting deflated materials consumed from deflated shipments.⁴ The net output index of manufacturing is not conceptually identical to GNP originating in manufacturing but is an approximation. The deviations are the direct result of data deficiencies.

BASIC DATA, BY SECTORS

It is difficult to summarize the deficiencies of the output data because they are attributable to such varied factors as lack of homogeneity of product or service, lack of over-all control totals, a diversity of sources, and conceptual problems of output definition. Nevertheless, it appears that the quantity and quality of the data available depends upon the level of detail which is presented separately. Most aggregations are built up from data collected from smaller units. For example, a sector physical production index cannot be constructed without first creating indexes for the component industries for which data are available, and making imputations where necessary. However, the presentation is not always in the required detail because data are nonexistent, sample estimates of smaller aggregates are considered unreliable, or funds are not available for publication. Of course, when the analysis is broadened to include the total economy, weaknesses which may be of great concern in the analysis of smaller aggregates tend to cancel out.

A review of the industry coverage of different kinds of output data by major sectors follows. A discussion of the quality of the data available is deferred until Part II.

Agriculture. Information on the quantity and value of production is available for major crop and livestock activities for total United States, by geographic regions, and by states. Thus, measures of gross output on almost any conceivable basis are possible. Information is similarly available for gross farm income and expenditures and net farm income. Price indexes are available for deflating both gross income and expenditures and, therefore, for deriving net output. The estimates of gross and net income, like the production estimates, are

⁴ Jack Alterman and Eva Jacobs, "Estimates of Real Product in the United States by Industrial Sector, 1947-55," and Almarin Phillips, "A Review of Three Estimates of Industry Output," this volume.

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generally derived from survey samples and tied to the agricultural census every five years. There are, however, areas for which sample data are not available, and here only broad approximations are possible.

Mining. Coverage here is substantially complete. Data are available in four-digit industry detail from the quinquennial Census of Minerals Industries on the quantity and value of ore produced, value of shipments, minerals received for preparation, supplies, fuel and electrical energy, and value added.

For intercensal years, data are available from the Regular Commodity Canvasses and the Accident Analysis Canvasses of the Bureau of Mines. Data from the former source include the quantity and value of production and/or shipments on a commodity basis (wherever made). These data are generally published in the *Minerals Yearbook*, although for major minerals they are available monthly or quarterly. The statistics are compiled from complete canvasses, and are, therefore, less than benchmark only in that they may be tested against Census data periodically. A reconciliation between Census and *Minerals Yearbook* data is difficult because of the large amount of mining occurring in other sectors of the economy—up to 25 per cent in the case of total nonmetallic minerals except fuels, and for specific industries, a much higher percentage. The 1954 Census includes partial data on mining operations in nonmining industries.

The Accident Analysis Canvass results in quantity data on a modified four-digit industry basis for all mining except petroleum and natural gas. This series covers only crude ore produced, but is comparable to the employment and man-hour series published by the Bureau of Mines. This material is not now published, but it is readily available.

Manufacturing. Table 1 is a frequency distribution showing the extent to which quantity data are available in the Census of Manufactures.

TABLE 1
Percentage of Total Output Covered by Quantity Data, Manufacturing Industries

Coverage	Number of Industries	Percentage of Employment
Total	446	100.0
Per cent		
75-100	171	46.9
50-74	59	14.2
25-49	36	7.5
0-24 ^a	180	33.4

^a Includes zero coverage of 155 industries, 29.6 per cent of employment.

Source: Value of shipments for which quantity data are available divided by the total value of shipments, both on a wherever-made basis, as reported in the 1954 *Census of Manufactures*.

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For industries responsible for 60 per cent of total manufacturing employment, half the value of total output is covered by quantity data. For industries representing almost 30 per cent of total employment, no quantity data are available.

Except where there are problems of disclosure or extensive duplication in the figures, value data from the *1954 Census of Manufactures* are available for all industries. Although shipments are reported in some cases and production in others, either may be derived by adjusting for the net change in inventories.

The 1954 Census also presents data on total materials consumed, for all industries. For some industries a commodity breakdown is also included, while for others, commodity data are available only if the industry consumes an important material. Table 2 presents ratios

TABLE 2
Percentage of Total Materials Consumed Covered by Commodity Data, Manufacturing Industries

Coverage	Number of Industries	Percentage of Employment
Total	446	100.0
Per cent		
75-100	43	18
50-74	64	17
25-49	87	17
0-24 ^a	250	48

^a Includes zero coverage of 206 industries, 39 per cent of employment.

Source: Value of individual products consumed for which quantity or value data are available, divided by the total value of materials consumed, as reported in the *1954 Census of Manufactures*.

which indicate the portion of total materials consumed in an industry, for which some commodity detail is available. For industries representing 34 per cent of manufacturing employment, no materials distribution is available from the primary sources.

TABLE 3
Number of Manufacturing Industries Covered by Less than Benchmark Quantity Data

Time Period	Number of Industries	Percentage of	
		Employment	Value Added
Monthly	83	42	41
Quarterly	9	4	4
Annually	65	32	31

Annual data on the value of industry shipments and inventories are available from the Annual Survey of Manufactures on a basis comparable to the Census. Only insignificant amounts of value data are available for lesser periods. Table 3 indicates the availability of less than benchmark quantity data. The figures are not additive since

data are available several ways for certain industries. However, some coverage is available for about 100 four-digit industries representing about 59 per cent of both value added and employment. Such data as are available for less than annual periods have a limited value. The coverage is uncertain and it is from widely different sources and for nonuniform time periods.

Noncommodity Sectors. The industries here can be grouped according to the types of data available. First, there are the industries which are included in the *1954 Census of Business*, namely, wholesale and retail trade and service. The Censuses of Business provide benchmarks for sales or receipts of these industries, which constituted more than one-quarter of total private employment in 1954. For interim periods, sample survey data are collected by the Census Bureau for trade but not for services. The Internal Revenue Service has recently begun publishing current estimates of annual gross receipts for trade and services derived from a sample of income tax returns.⁵

The second group of industries are those for which data are collected by regulatory agencies. These include the utilities, transportation, banking and insurance, and accounting which together accounted for about 13 per cent of total private employment in 1954. Annual and less than annual data in this area are fairly plentiful. However, problems arise in adapting these data to production index use when the regulated segment of an industry is not representative of the whole. Some of the information collected is neither tabulated nor published because of lack of resources or because it is not usable for the agency's purposes. Such data might help to fill gaps in the statistical measures.

The remaining industries, covering about 15 per cent of total private employment, include real estate, contract construction, and services not covered by the Census. In general, data for this group are nonexistent, irregular, or otherwise seriously deficient. The publication of IRS gross receipts data has provided a better basis for estimating the annual output value of some of these industries but the problem of securing adequate deflators and less-than-annual data remains.

Price Indexes

In order to deflate gross or net value series, appropriate price indexes are needed. Several price series are compiled by the government but none are collected specifically for deriving real production indexes. As a result, problems of classification, reconciliation,

⁵ *Business Indicators*, Internal Revenue Service, April 1958.

weights, etc., arise when the existing price data are adapted to this purpose.

Some limitations common to most price indexes are not readily overcome. For example, it is generally impossible to express in commodity specifications all of the changing qualitative aspects of the goods priced. To the extent that price indexes fail to allow for improvements in quality they are overstated and, if used for deflation, they result in an understatement of the real output value. When quality deterioration occurs, the opposite tendencies prevail.

WHOLESALE PRICE INDEX

The index most frequently used for deflating value of shipments data is the BLS Wholesale Price Index. While this series is perhaps the best single source of deflators, it has several limitations for use in deriving production indexes.

Since it is not feasible to collect prices for every grade, size, style, or even every kind of commodity, the WPI contains a large degree of imputation, both within and between product classes. An analysis of the extent of imputation is extremely difficult, because the definition of the term is not always consistent. For example, the extent of imputation could be taken to refer only to those commodity classes for which no single product is priced. It could also be considered to refer to all products which are not directly priced regardless of commodity classification. The BLS employs the first definition. Ratios thus computed are shown in Part II.⁶

The proportion of imputations for a commodity group or industry is not by itself an indication of the accuracy of a given index, since the imputed values may be valid. However, imputed weights should reflect the price determining factors for individual commodities and these may be difficult to appraise. For example, is the price of copper base alloy pipes and tubes moved by the price of yellow brass sheets or by that of copper water tubing? Not enough analysis has been done to permit an over-all evaluation in this area.

There are also important groups of commodities for which no data are collected because it is too difficult to price or even define a typical item. The problem commodities are generally "custom built," and include special industry machinery, elaborate machine tools, airplanes, locomotives, and ships. Under the present WPI system, the price index for the whole machinery and motive power group is imputed to these products—an unsatisfactory expedient for any but the most aggregative kind of analysis. An alternative has been to determine indexes for these products by pricing inputs, a method

⁶ See Tables 6 and 8.

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which faces conceptual obstacles and misses the effect of productivity changes in assembling. Frequently too, there are insufficient data on some of the components, such as material input quantities and profit margins.

The WPI embodies quoted, rather than actual prices, and the two may differ. In times of material shortages, premiums may raise actual prices above the published levels with the result that the index is understated. When supplies are plentiful, the index may be overstated because of the prevalence of discounts. When either of these conditions is widespread and the differentials are measurable, some correction is generally applied. However, since there is usually a lag between the development and recognition of price differentials, they continue to have an effect on short-run changes in deflated output.

Research with an interesting potential for evaluating the WPI was undertaken in connection with the BLS-Census-FRB benchmark production indexes for 1947-54. Unit values from Census data were computed for all commodities for which quantity data were available for 1947 and 1954. The unit value index of those commodities which are priced for the WPI was compared with the WPI for the same commodities. This analysis was not completed because of limitations of research resources, but there were indications that product mix shifts rather than reporting errors in the Census data or lack of representativeness in the BLS sample were responsible for many of the discrepancies noted.

INDUSTRY PRICE INDEXES

During 1953, to meet the needs of the appraisal phase of the 1947 input-output project, the BLS began arranging the WPI commodity indexes into industry price indexes. The procedure involved coding each WPI commodity with its corresponding Census commodity classification and assigning its weight to the producing industries. A tabulation was prepared which showed for each industry the component commodities and indexes, their respective weights, the proportion of total shipments covered by direct pricing, and the combined index. In addition to achieving a useful set of industry indexes, this procedure brought out clearly those industries for which no commodity was directly priced. It also made explicit all the imputations in the WPI weighting system so that it could be readily determined which price movement was being imputed to which commodity.

These industry indexes are limited in that only the primary products of each industry are included. Also, weights are available only for the Census year, so that the indexes are base year weighted. When

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an index of value is deflated by a base weighted price index, the resultant production index is currently weighted, although an aggregate index would be base-weighted in terms of the component industry production indexes. A conceptually desirable base year weighted production index, therefore, cannot be derived with these data. Further investigation is required before the significance of the resulting biases, if any, can be evaluated.

Table 4 shows the coverage available as a result of the 1947 interindustry price tabulations. The industry series are now being

TABLE 4
Percentage of Total Shipments Covered by Direct Pricing, Manufacturing Industries, 1947

Price Coverage Ratios	Number of Industries	Percentage of Value Added
Total	446	100
Per cent		
75-100	110	29
50-74	72	19
25-49	57	17
0-24 ^a	207	35

^a Includes zero coverage of 187 industries, 29 per cent of value added.

Source: BLS wholesale price indexes by industry.

continued through 1956. The extended indexes will incorporate the weights of the 1954 Census. While the over-all coverage will not be significantly altered (no substantial improvement is expected in those areas where pricing is most difficult), large differences could occur in individual industries because of changes in classification between the 1947 and 1954 Censuses.

CONSUMER PRICE INDEX

In the noncommodity producing area, the Consumer Price Index is the major source of price data. It is officially described as measuring "the average change in retail prices of goods, rents and services customarily purchased by city wage-earner and clerical-worker families." These prices may not be representative of all purchases but there has been no over-all study of whether the price movements of goods and services purchased by higher income groups or persons living in rural areas show significant differences.

In deflating the value of commodities in personal consumption expenditures, the CPI is frequently combined with the Department of Agriculture series on prices paid by farmers, to achieve a broader representation of economic groups. The latter series is not conceptually consistent with the CPI since it does not deal with commodities with standard specifications but with products of the kind and

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quality most commonly purchased. These are not necessarily the same through time. How much of the difference between the two series is attributable to technical differences and how much to the distinction between economic groups is not known.

The criticism of "quoted prices" levied against the WPI is in some respects also applicable here. Changes in buying habits and shifts to discount houses or other low mark-up retail outlets are not immediately reflected in the index. Over the short-run this may lead to an upward bias.

UNCOVERED AREAS

For those industries whose output is almost entirely purchased by business, such as advertising, legal, engineering, and accounting services, no price data are available. For those industries whose output is shared by business and households, such as telephone, telegraph, gas and electric, and laundry services, where a CPI is available it has been used to represent the price movement of the entire output of the industry.

Employment and Hours

TOTAL NONFARM

Employment. Primary data are available from the Current Population Surveys of the Census Bureau (CPS) and the employment surveys of the Bureau of Labor Statistics. CPS data are published in the Monthly and Annual *Report of the Labor Force* (MRLF and ARLF) and the BLS data in *Employment and Earnings*, which is also published monthly.

The BLS employment series are available at a level roughly corresponding to the three-digit Standard Industrial Classification code. However, some three-digit groups are omitted from the detail and it is, therefore, not possible to derive complete productivity data on this basis. Four-digit data are available only where the four-digit industry comprises the entire three-digit classification (e.g., SIC Industry 291, which consists entirely of SIC Industry 2911—Petroleum Refining).

The Census Bureau and the BLS attempt to measure different universes of total employment. Their concepts differ and they employ different sampling techniques and estimating procedures, resulting in considerable variation in findings for comparable sectors.

The CPS estimates are based upon personal interviews of a household sample selected in accordance with a probability design while BLS statistics are derived largely from a modified cut-off sample which includes all firms with a specified level of employment. The

cut-off point is set separately for each industry and the criteria for its determination are that the sample should "represent a substantial proportion of total employment in an industry" as well as "provide an appropriate standard of accuracy." In a few industries, special sample designs and procedures are used.

Essentially, the Current Population Surveys count persons while the BLS surveys count jobs. Thus, in the ARLF estimates, a worker is counted only once—in the industry of his major employment. In the BLS figures, a worker is counted more than once if he held more than one job covered by the sample. Some analysts have estimated that the number of persons holding two or more nonagricultural jobs might at times range between 750,000 and 1,000,000 persons. However, a more recent study suggests that these figures are understated.⁷ Since the importance of multiple job holdings varies during the year, the difference between the CPS and BLS monthly estimates will fluctuate seasonally.

The ARLF estimates are based upon a labor force concept and include all persons aged fourteen or more, including paid industry employees, proprietors, unpaid family workers, and household domestics. The BLS estimates refer only to paid industry employees. The ARLF estimates include "persons with a job but not at work" because of "vacations, illness, industrial disputes, bad weather" or other voluntary reasons. The BLS estimates include only those absent workers who are paid for their time off.

A complete reconciliation between the two series has never been effected. The small discrepancy which remains after taking account of all known differences could come from errors in the population and benchmark estimates against which the respective sample estimates are checked, or from errors in enumeration or reporting.

Another source of employment data is the Commerce Department. The National Income Division of the Office of Business Economics publishes three employment series: (1) "Average Number of Full and Part-time Employees," (2) "Number of Full-time Equivalent Employees" (two half-time employees equaling one full-time employee), and (3) "Number of Persons Engaged in Production." These estimates are conceptually consistent with the national income and GNP estimates. They are based almost entirely on secondary sources, usually Unemployment Insurance data. Estimates of proprietors, which along with wage and salary employees represent "persons engaged in production," are derived during Census years from the Industrial and Population Census and for intercensal years, from an

⁷ *Employment and Unemployment Statistics*, Hearings before the Joint Committee on the Economic Report, November 7-8, 1955, p. 28.

estimated factor based on business population data developed by the National Income Division.

For selected years, the Census of Manufactures provides estimates of total employment for all four-digit manufacturing industries except where the information might be identified with a specific establishment. Between censuses, the Annual Survey of Manufactures provides a continuous and consistent source of data. These Census Bureau estimates are almost identical in character to those of the BLS. Nevertheless, significant differences have appeared in the manufacturing series of both agencies, especially at the three-digit industry level. The reasons, while under frequent study, have not been determined. The compensating nature of the differences between individual industries is more indicative of the effect of random factors than of a bias in either method of estimating.

The administrative reports of the Bureau of Employment Security and the Social Security Board, are still other sources of data. While these figures are not used directly for constructing employment estimates, they are an important element in the estimating systems of both the BLS and the Census of Manufactures.

Table 5 provides a recapitulation of these various sources of data and their characteristics.

Hours. The surveys of the BLS and the Census Bureau also provide data on average weekly hours. The BLS series theoretically covers all hours paid for regardless of work stoppages, absenteeism, vacations, sick leave, and overtime. Although the data are obtained from the employment sample previously described, all respondents do not report man-hours and the effective coverage is somewhat less.

The CPS estimates include only the hours of persons actually at work during the survey week. Conceptually, this is the greatest difference between this series and the BLS but it may be obscured by statistical discrepancies. The CPS hours are obtained from the same sample as the employment figures but since they are limited to time spent on the job, coverage is more restricted. The Census and Annual Survey of Manufactures provides data on man-hours for production workers in all four-digit manufacturing industries. This series covers all hours paid for (including overtime) providing the employee is at the plant. Except for work stoppages, this concept approximates that of the CPS.

Since the BLS collects only the hours of production and nonsupervisory employees, any estimate of total hours for an industry must assume that the workweek of other employees fluctuates directly with that of the included workers, or else that it is constantly maintained. Since the CPS average hours reflect only employees actually at

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work, the employment base must be adjusted to exclude persons with a job but not at work.

Total man-hours for the economy cannot be directly derived by combining the hours and employment estimates. Estimates of average weekly hours are not published for certain industries in the noncommodity producing area. For manufacturing, average weekly hours are

TABLE 5
Sources of Nonfarm Employment Data and Their Characteristics

Item	BLS	Annual Survey and Census of Manufactures	CPS	U.I.	BOASI
Concept	Jobs	Jobs	Persons	Jobs	Jobs
Reporting unit	Establishment	Establishment	Household	Firm	Firm ^a
Coverage	All paid persons	All paid persons	Persons over 14, including unpaid	All paid persons	All paid persons
Type of survey	Mail survey	Mail survey	Personal interview	Administrative report	Administrative report
Reporting period	Monthly	Annually ^b	Monthly	Quarterly	First Quarter
Type of sample	Modified cut off	Probability sample	Probability sample	All firms	All firms
Survey period	Pay period ending nearest 15th of month	Week ending 15th of Mar., May, Aug., Nov. ^c	Week including 12th of month	Week ending nearest 15th of every month	Week ending nearest 15th of March
Level of aggregation	SIC 3-digit	SIC 4-digit	^d	3-digit ^e SSB	3-digit ^e SSB

^a Except manufacturing, which is generally on an establishment basis.

^b The Annual Surveys cover non-Census years. Censuses of Manufactures have occurred in selected years 1947, 1954, 1958, etc.

^c Except seasonal industries, which include period ending nearest the fifteenth of each month.

^d Not available.

^e Approximation.

available for about 191 four-digit industries which account for 68 per cent of total manufacturing employment but the employment estimates are generally available only on a three-digit level.

Farm. Securing a satisfactory measure of labor input for the farm sector is uniquely difficult. The farm house is both the living quarters and the place of employment of the farm family. Over two-thirds of the farm work force consists of proprietors and unpaid family workers

who alternate between farm and household chores. Records are not generally available to furnish a basis for separation. Therefore, the time spent on farm work by the major portion of the work force can not be determined by conventional methods, and the available measures of employment and man-hours reflect considerable subjective judgment. In some cases, consistency with the definition of employment in other sectors becomes an important criterion for allocation of work time.

Employment. Data are available from the Census Population Survey and the Agricultural Research Service of the Department of Agriculture. Employment data from the latter source are published monthly under the title *Farm Labor*.

The CPS estimate of farm employment has the same characteristics as the nonfarm estimate included in its reports on the labor force, i.e., it is based on personal interviews with a probability sample of farm households, and the survey week includes the twelfth of the month. The ARS estimate is based on a mail survey of a non-cross-section sample of 20,000-25,000 farmers. The survey week is the last complete calendar week in the month.

Both series cover farm operators and hired workers who spend at least one hour of the survey week on farm work. Unpaid family workers are included only if they spend at least fifteen hours on farm work. This cut-off point may result in the exclusion of substantial amounts of labor from the estimates. A survey covering the month of August 1951 revealed 1.5 million workers in this category, one-half of whom worked fourteen hours a week.⁸

The ARS estimates include all employed children; the CPS excludes those under fourteen years of age. The ARS counts jobs, while the CPS counts persons. These differences in concept and coverage, along with statistical differences, cause variations in the level and short-run behavior of the two series.

Hours. Average weekly hours from the CPS reports are the only data available. Although the basis for the estimate is identical to that for the CPS estimates of hours for other sectors, the peculiar problems of measuring employment render an estimate of total man-hours (derived as the product of average employment times average hours) less satisfactory here than elsewhere.

The number of children not counted by the CPS may number nearly one million during certain seasons. If the workday were eight hours, eight million hours could thus be lost from the estimate in a single day. Multiple job holders also present greater difficulties in the

⁸ "Farm Employment," unpublished memorandum, Bureau of the Census, 1951.

farm sector than the nonfarm sector largely because of their relatively greater number. The number of persons holding jobs on farms, but who work most of their hours in other industries, fluctuates between one-half and one million persons at different times of the year. The farm hours of these workers are classified in the nonfarm sector while the hours farm workers spend in secondary employment are credited to the farm sector. Data are not available for a statistical determination of the net effect of multiple job holding on total farm man-hours.

In order to develop estimates of total man-hours in the farm sector, the USDA has derived a "man-hour requirements" series. It is derived from benchmark estimates of the number of hours of direct labor required by an average adult male worker to cultivate an acre or produce a unit of livestock or livestock products. The benchmark estimates are from farm management studies, and are made for crop and livestock activities by separate areas within states. Total direct man-hours required are derived as the product of average requirements times the number of acres of crop or units of livestock. The hours of indirect labor are separately estimated and added. The estimates are summarized for states, regions, and the total economy. For nonbenchmark years, the estimates are derived from changes in acreage or livestock units modified to take into account changes in yield and changes in methods of production. The series is thus independent of employment estimates. It is essentially an adaptation of the standard labor unit procedure of cost accounting, although less precise.

It has been said that the taking account of the impact of technological change and yield between benchmark years builds into the series a predetermined productivity estimate. This is not true for benchmark years, and to the extent that the series is adjusted to benchmark levels the influence of such "circularity" is minimized over the long run.

Comparability between Output and Man-Hours

With few exceptions the estimates of output and man-hours are obtained from different sources. Consequently, in order to derive meaningful productivity measures, it is important to evaluate the extent to which these separate measures are consistent with each other, bearing in mind that the problem of comparability lessens as the level of comparison broadens.

When output and employment are to be related, the classification basis for reporting the two sets of data should be the same. Despite tremendous strides toward attainment of a uniform system of classification codes, not all data sources use the system, and the assignment

DATA FOR MEASUREMENT OF OUTPUT PER MAN-HOUR

of establishments to industries is made at different points in time, with different purposes in mind. Variations in classification may account for a large part of the observed differences between Census and BLS employment data. Similar variations occur between output and employment data.

One of the basic problems in reconciling industry output and man-hour data is the "wherever made" versus the "establishment" form of classification. Output data in manufacturing generally include total shipments or production of products primary to a particular industry wherever they happen to be made, while input data include hours employed in the production of both primary and secondary products in establishments classified within a particular industry. The following diagram indicates the nature of the problem.

	Given Industry	Other Industries
Primary Products	A	C
Secondary Products	B	

Physical output data are generally available on the basis of AC while man-hours always relate to AB.

Because of this situation, changes in the total output of products primary to an industry are not necessarily associated with changes in the labor input of that industry. Classifying employment and man-hours on a basis comparable to output is usually impractical. It might be possible to adjust output data to man-hours data but this would require an extensive retabulation of Census data which might create other problems. Fortunately, a high percentage of most commodities is generally produced within the primary industry, while secondary production in an industry is usually a very small proportion of total output.⁹

Where the deflated value of industry shipments is used as the industry measure of output, there is another problem. Although the value data are on an establishment basis, the price indexes refer to primary products wherever made.

Another difficulty sometimes arises because output data are reported on a company basis while input data are reported on an establishment basis. Since company activities may cover more than one industry or major sector, the two measures may not correspond.

Employees in central offices and auxiliaries who service all the

⁹This is discussed further in Part II, where the appropriate product specialization ratios are provided.

establishments of a firm, such as personnel administrators, purchasing agents, warehousing and storage employees, repair and maintenance men, and research and development employees, present another problem since the establishments which they service are not necessarily classified in the same industry. Treatment of these employees varies according to the source of employment data. The Census of Manufactures includes data on the total number of central office employees, but makes no attempt to distribute them to particular industries. The BLS includes such employees in the industry which constitutes the major portion of the company's activities. In either case, the employment and output aggregates are inconsistent.

Problems of comparability also arise from the treatment of expenditures for scientific research and development, which represent a steadily rising percentage of total economic activity. The results of such outlays are inherently uncertain and usually intangible. When a patent does result, industry may capitalize the associated research expenditure and amortize it over the life of this asset. When research is unsuccessful, it is charged against current account. As a result, the value of research output is excluded from most output measures. On the other hand, the hours of research and development employees are included in the man-hour aggregates embodied in over-all productivity estimates. One solution would be to remove the hours of research employees from the estimates of total man-hours. However, this procedure would involve collecting more refined information, since the hours of research employees are not presently identifiable. Another solution would be to capitalize total private expenditure for research and development and include it as part of gross private domestic investment.

A similar problem occurs in industries in which establishments customarily perform their own construction work. The output measures of these industries do not include the value of this construction but the hours of the force account construction employees are included in man-hours. From the data currently collected it is not possible to separate the force account hours. While all industries are affected by this inconsistency to some degree, it is particularly troublesome in industries such as railroads and utilities where the amount of such construction is significant.

The production of purely military products in an industry which normally produces civilian goods, may create another problem. The usual tabulations of production data do not include military items, while the time applied to their production are included in man-hour statistics. Adjustments are made to avoid a downward bias in productivity estimates when military production is rising. This applies

only to physical productivity indexes because value data generally include the value of military production.

Recommendations

Certain recommendations concerning steps that may be taken to improve the collection of data follow from the preceding review. With regard to output data, it is suggested that censuses be taken at regular and predictable intervals. Not only does this source provide benchmarks for many statistical series, but in many cases it provides the only information available. The benchmarks, in turn, provide the basis for evaluating methods of extrapolation. Surveys of nonmanufacturing sectors for intercensal years should be of such quality, in terms of sampling procedure, that they could be related to the censuses to form reliable continuing series. A third suggestion is that the Annual Survey of Manufactures be tested empirically in a census year by tabulating data for the Survey sample separately within the Census universe.

For benchmark years, additional physical quantity data should be collected in the Census of Manufactures, where feasible. Quantity data collected on an annual basis should conform to Census quantity data both in coverage and classification. Key monthly quantity data should be collected for more industries. It would be helpful if the value of purchased services were tabulated from data presently available on income tax returns, and if additional data on materials consumed were collected in the Census of Manufactures to provide the basis for improving net output measures. The final recommendation concerning output data is that the cost of goods sold be collected for both wholesale and retail trade. If such direct reporting is not considered feasible, margins can be derived from income tax returns. If the latter alternative is to be adopted, a regular sampling procedure must be instituted. Margin data would also be useful in adjusting producer prices to purchaser prices.

On the subject of price data, it is suggested that the sources of consumer price information be expanded to include coverage of additional segments of the population, more consumer items, and additional retail outlets. Industry indexes might profitably be computed from the Wholesale Price Index and, with respect to the latter, prices might be collected at the wholesale level to supplement prices currently obtained from manufacturers. Prices might also be collected for categories not now covered by the WPI, including business services and special types of purchases such as those made by government.

Coming to employment and man-hours data, it is suggested that estimates be provided, at least at the two-digit level, for employment in the services sector and for average hours in the transportation, finance, communications, and services sectors. Hours worked consistent with published hours paid need to be collected (a program designed to accomplish this objective is already underway). Hours of nonproduction workers should be collected; also the hours of force account employees in those industries where they represent a significant proportion of total employment, e.g., telephone and electric and gas utilities. Further, it would be helpful if occasional surveys were made of farm labor to determine hours worked on farms by persons under fourteen years of age and those whose major employment is in the nonfarm sector.

Implementing these suggestions would involve methodological problems and further work would have to be done to solve the measurement problems in certain industries where, because of lack of homogeneity and the custom-made nature of the products, quantity and price data cannot be obtained directly. In such instances it would be necessary to study alternative methods of measurement, for example the possibility of deriving quantity figures by the use of weight, area, or materials consumption information, and obtaining prices on the basis of hypothetical or standardized products. Appraisal of these and other possibilities might be assisted by plant level studies. Recommendations resulting from such a study would be a guide to all users of these data.

Industry Data

This section summarizes for each industry the sources and extent of the data available for deriving production and productivity indexes. Included is information on output quantities and values, and employment and man-hours. Price data, usable with value data to yield gross output measures, are noted, along with materials consumed data which constitute a vital element in the construction of net output measures. The information was prepared in the finest industry levels practical, generally in terms of the Standard Industrial Classification (SIC). Measures of the relative importance of each industry are provided to aid students in assessing the significance of data gaps. A distinction is made between benchmark and nonbenchmark periods. Data for the former is, by definition, derived from a Census covering the general subject matter of an industry. Data for other than benchmark periods comes from sample surveys or extrapolations.

The commodity producing sectors—agriculture, mining, and

manufacturing, and the noncommodity producing sectors are analyzed separately. The information for manufacturing, mining, and services is presented in tabular form. The information for the remaining sectors is given narrative form because the variety of sources, the difficulty of ascertaining coverage ratios, and/or the alternative ways of defining and measuring output, made tabulation impractical.

Commodity Producing Sectors

MANUFACTURING

Table 6 provides information on the data available for years when a complete census of manufactures was taken and interim periods. Only a sample page of the table is reproduced here. It is believed that the complete table, with all the four-digit industry detail would not be of interest to the general reader. However, anyone who is interested in the specific industries may obtain copies of the complete table upon request to the author.

The availability of quantity data is expressed in terms coverage of ratios which relate the value of primary products wherever made, for which quantity data are available, to the like value total. Ideally, the ratios should relate the value of primary and secondary products for which there is quantity data to the total value of industry shipments. However, since quantity data are available only on the basis of primary products wherever made, this was the determining factor.

Production indexes based on quantity data by implication impute the movement of an industry's primary products to its secondary products, and assume that the movement of primary products wherever made is the same as that of primary products actually made within the industry. As an indication of the significance of these imputations, data are provided for each industry showing the importance of primary products in relation to total shipments (specialization ratio), and the importance of primary products made "at home" in relation to primary products, wherever made.

Coverage is virtually complete in the case of output value, so only the form of the data available is shown. Coverage ratios are used, however, to indicate the extent to which imputation is employed in developing a price index of an industry's primary products. When examined in conjunction with the industry specialization ratio, some indication of the validity of the price index as a deflator can be obtained.

While the data for manufacturing are generally plentiful, there remain areas that could be improved. A summary of industries

MEASUREMENT OF REAL OUTPUTS AND INPUTS

TABLE 6
Productivity Data for Manufacturing Industries

INDUSTRY CODE			RELATIVE IMPORTANCE		QUANTITY DATA						
					Benchmark Periods				Nonbenchmark Periods		
					Per cent of Coverage		Primary Products				
2-Digit (1)	3-Digit (2)	4-Digit (3)	2-Digit (4)	3-4-Digit (5)	1947-1954 (6)	1954 Only (7)	Per cent Industry Specialization (8)	Per cent Industry Coverage (9)	Form of Data and Frequency of Publication (10)	Approximate Coverage (11)	
20			8.7	100.0	84						
	201			14.4	98				P,M		
		2011		10.4	99		98	87			
		2013		2.5	96		83	28			
		2015		1.5	97		96	97			
	202			16.8	92					86.1	
		2021		1.0	100.0		74	77	P,M		
		2022		.7	96		83	74	P,M		
		2023		1.3	44	99	82	68			
		2024		2.5	93		93	70			
		2025		.4	88		90	56			
		2026		.7	95		82	94			
		2027		10.3			82	94			
	203			9.7	23				P,A	96.0	
		2031		.5	20	100	96	94			
		2032		.1	88		97	91			
		2033		6.2			90	94	P,A		
		2034		.4			95	97	P,A		
		2035		1.1	86		80	75	P,A		
		2036		.3	79		94	95			
		2037		1.1			88	84	P,A		
	204			9.1	89						
		2041		2.4	85		94	84	C,M		
		2042		4.4	95		95	90			
		2043		1.3	97		77	80			
		2044		.3	98		99	100			
		2045		.8			71	45			
	205			14.8	96						
		2051		11.7	96		98	99			
		2052		3.0	100		97	93			

DATA FOR MEASUREMENT OF OUTPUT PER MAN-HOUR

TABLE 6 (concluded)

VALUE DATA	MATERIALS CONSUMED	PRICE INDEXES		EMPLOYMENT		MAN-HOURS	
		Source	Per cent Direct Pricing	Relative Importance	Source		Source
Form Available (12)	Per cent of Commodity Coverage (13)	(14)	(15)	2-Digit (16)	3-4-Digit (17)	(18)	(19)
	71			10.5	100.0	C,L,S	C,L
	90				18.9	C,L,S	C,L
S	92	WPI	91		13.4	C	C
S	80	"	85		2.7	C	C
S	86	"	72		2.8	C	C
	79				17.2	C,L,S	C,L
S	78	"	99		1.3	C	C
S	88	"	99		.8	C	C
S	73	"	97		.8	C	C,L
S	60	"	96		2.2	C	C,L
S	76	"	67		.4	C	C
S	} 81				.9	C	C
S						10.8	C
	34				12.0	C,L,S	C,L
P	58	"	100		.9	C	C,L
P	76	"	100		.1	C	C
P	35	"	71		7.3	C	C
P		"	81		.4	C	C
P	10	"	26		1.3	C	C
P	34	"			.7		
P	54	"	57		1.3	C	C
	76				6.6	C,L,S	C,L
S	88	"	87		1.8	C	C,L
S	70	"	2		3.6	C	C,L
S	47	"	71		.7	C	C
S	92	"	82		.2	C	C
S	46	"	28		.3	C	C
	58				17.7	C,L,S	C,L
S	59	"	41		15.0	C	C,L
S	54	"	97		2.7	C	C,L

Notes to Table 6 on the following page.

MEASUREMENT OF REAL OUTPUTS AND INPUTS

- Cols. 1-3: Based on the *1954 Census of Manufactures*. This code is a variant of the SIC system. Most of the differences between the two represent combinations at the four-digit level (see the *1954 Census of Manufactures*, Vol. II, Pts. 1 and 2, for details).
- Col. 4: The ratio of national income originating in each two-digit industry to total national income originating in manufacturing, as computed from Table 13 in the *Survey of Current Business*, July 1957.
- Col. 5: The ratio of value added of each four-digit industry to the value added of the corresponding two-digit industry, computed from data in the *1954 Census of Manufactures*. Since national income data are not available below the two-digit level, these ratios are used as an approximation thereto.
- Col. 6: The 1954 value of primary products, wherever made, for which quantity data are available on a comparable basis in 1947 and 1954, divided by the 1954 value of shipments for all primary products wherever made. The two-digit and three-digit totals are weighted by value added.
- Col. 7: The value of primary products, wherever made, for which quantity data are available in 1954, divided by the 1954 value of shipments for all primary products, wherever made. This ratio indicates the amount of quantity data available in 1954 for those industries for which the benchmark ratio is less than 50 per cent.
- Col. 8: Ratio of an industry's shipments of its primary products to its shipments of all products.
- Col. 9: Ratio of an industry's shipments of its primary products to the value of shipments of these products, wherever made.
- Col. 10: Legend indicates form of data available and frequency of availability: production (P), consumption (C), shipments (S), annually (A), quarterly (Q), monthly (M). Data are from *Facts for Industry* and other sources, a complete list of which is available separately.
- Col. 11: Ratio of the value of products for which quantity data were currently available to the total value of industry shipments as of 1947.
- Col. 12: Legend indicates that the data are available in the form of production (P) or shipments (S), the latter requiring adjustment for inventory change to obtain production.
- Col. 13: The proportion of the total value of materials consumed by each industry for which some commodity distribution data are available. Computed from data in Table 7, *1954 Census of Manufactures*, Vol. II, Industry Statistics. The base of the ratio does not include fuels which are available for most industries. Contract services are also omitted.
- Col. 14: WPI is the Wholesale Price Index, CPI, the Consumer Price Index.
- Col. 15: Ratio of the value of each industry's primary products, wherever made, which are directly priced, to total in 1947. Asterisk indicates lack of comparability between the 1947 and 1954 industry classifications.
- Col. 16: Ratio of total employment in an industry to total employment in manufacturing.
- Col. 17: Ratio of employment in each four-digit industry to employment in the corresponding two-digit industry.
- Col. 18: Legend indicates that data are available from one or more of the following sources: Census Bureau, *Census of Manufactures* (C), Bureau of Labor Statistics, *Employment and Earnings* (L), Bureau of Employment Security, *Employment and Wages* (S).
- Col. 19: Legend indicates that data are available from the Census Bureau (C) and/or the Bureau of Labor Statistics (L), in the same publications, as above.

lacking or weak in benchmark data is presented in Table 7. In order to describe the extent of lack of data briefly and quantitatively, the material was summarized on a two- and three-digit basis and an arbitrary standard of 50 per cent or less was adopted to indicate poor coverage.

TABLE 7

Summary of Gaps in Data for Manufacturing Industries

INDUSTRY	SIC CODE	Kind of Data											
		Quantity ^a		Price ^b		Materials Consumed ^c		Materials Consumed		Materials Consumed			
		Number of Industries	3-Digit Code	Per Cent of 2-Digit Value Added	Number of Industries	3-Digit Code	Per Cent of 2-Digit Shipments	Number of Industries	3-Digit Code	Per Cent of 2-Digit Materials Consumed	Number of Industries	3-Digit Code	Per Cent of 2-Digit Materials Consumed
Total Manufacturing		72			84			102					
Nondurables		24			35			49					
Food	20	1	203	$\frac{10}{10}$	3	202 204 207	$\frac{32}{17}$ 12 4	4	203 207 208 209	$\frac{29}{8}$ 3 6 12			
Tobacco	21	3	212 213 214	$\frac{31}{17}$ 8 7	1	214	$\frac{33}{-}$	4	211 ^d 212 ^d 213 ^d 214 ^d	$\frac{100}{44}$ 8 4 45			

^a Coverage is defined as the value of "Q" items divided by the value of "Q+N" items as established by the Census-FRB Benchmark Project.

^b Coverage is defined as the value of shipments of "directly priced" items divided by total wherever made shipments.

^c Coverage is defined as the value of materials identifiable by commodity divided by total materials, parts, containers, and supplies of the industry.

^d Totals may not add because of rounding.

TABLE 7 (continued)

THREE-DIGIT INDUSTRIES WITH DATA COVERING LESS THAN 50 PER CENT OF THE INDUSTRY

INDUSTRY	SIC CODE	Kind of Data						Per Cent of 2-Digit Materials Consumed			
		Quantity ^a	Price ^b	Materials Consumed		Materials Consumed					
		Number of Industries	3-Digit Code	Per Cent of 2-Digit Value Added	Number of Industries	3-Digit Code	Per Cent of 2-Digit Shipments	Number of Industries	3-Digit Code	Per Cent of 2-Digit Materials Consumed	
Textiles	22	1		8	3		12	6		75	
			227	8			2		221 ^d	12	
							9			222 ^d	13
							1			223 ^d	34
										226 ^d	1
										228	7
								229	7		
Apparel	23	2		14	3		25	9		100	
			237 ^d	2			6		231 ^d	9	
			239	12			5		232 ^d	21	
							14		233 ^d	28	
									234 ^d	10	
									235 ^d	1	
								236 ^d	6		
								237 ^d	3		
								238 ^d	5		
								239 ^d	18		
Paper and pulp	26	—		—	5		94	—		—	
							261				
							264				
							265 ^d				
							267				
					269				15		

TABLE 7 (continued)

THREE-DIGIT INDUSTRIES WITH DATA COVERING LESS THAN 50 PER CENT OF THE INDUSTRY										
INDUSTRY	SIC CODE	Kind of Data								
		Quantity ^a	Price ^b	Materials Consumed ^c				Per Cent of 2-Digit Materials Consumed		
		Number of Industries	3-Digit Code	Per Cent of 2-Digit Value Added	Number of Industries	3-Digit Code	Per Cent of 2-Digit Shipments	Number of Industries	3-Digit Code	Per Cent of 2-Digit Materials Consumed
Printing and publishing	27	7		53	9		100	3		8
			273 ^d	9			32		274	2
			274 ^d	2			15		278	3
			275 ^d	22			9		279 ^d	2
			276 ^d	9			2			
			277 ^d	2			23			
			278 ^d	3			10			
			279 ^d	6			2			
							3			
							5			
Chemicals	28	5		78	4		57	8		93
			281 ^d	15			13		281	8
			282	34			33		282	31
			283 ^d	14			1		283	7
			287 ^d	3			11		284	8
			289	12					285 ^d	11
									286	1
									288 ^d	18
							289	9		

^a Coverage is defined as the value of "Q" items divided by the value of "Q+N" items as established by the Census-FRB Benchmark Project.

^b Coverage is defined as the value of shipments of "directly priced" items divided by total wherever made shipments.

^c Coverage is defined as the value of materials identifiable by commodity divided by total materials, parts, containers, and supplies of the industry.

^d Totals may not add because of rounding.

TABLE 7 (continued)

INDUSTRY	SIC CODE	THREE-DIGIT INDUSTRIES WITH DATA COVERING LESS THAN 50 PER CENT OF THE INDUSTRY									
		Kind of Data					Materials Consumed				
		Quantity ^a	Price ^b								
		Number of Industries	3-Digit Code	Per Cent of 2-Digit Value Added	Number of Industries	3-Digit Code	Per Cent of 2-Digit Shipments	Number of Industries	3-Digit Code	Per Cent of 2-Digit Materials Consumed	
Petroleum and coal products	29	1	299	$\frac{4}{4}$	2	295 299 ^a	$\frac{6}{4}$	2	295	$\frac{4}{3}$	
Rubber	30	—	—	—	1	309	$\frac{45}{45}$	4	301 302 303 } 309 }	$\frac{100}{55}$ 3 41	
Leather	31	3	312 ^a 314 319	$\frac{64}{2}$ 60 2	3	316 317 319 ^a	$\frac{14}{—}$	8	311 ^d 312 ^d 313 ^d 314 ^d 315 ^d 316 ^d 317 ^d 319 ^d	$\frac{100}{23}$ 2 9 52 1 5 7 1	

^a Coverage is defined as the value of "Q" items divided by the value of "Q+N" items as established by the Census-FRB Benchmark Project.

^b Coverage is defined as the value of shipments of "directly priced" items divided by total wherever made shipments.

TABLE 7 (continued)

INDUSTRY	SIC CODE	THREE-DIGIT INDUSTRIES WITH DATA COVERING LESS THAN 50 PER CENT OF THE INDUSTRY									
		Kind of Data					Materials Consumed ^c				
		Quantity ^a	Price ^b	Number of Industries	Per Cent of 2-Digit Value Added	Number of Industries	3-Digit Code	Per Cent of 2-Digit Shipments	Number of Industries	3-Digit Code	Per Cent of 2-Digit Materials Consumed
Durables		48									
Lumber	24	4		3	50	3	241 ^d	26	—	—	—
					12		244 ^d	11			
					22		249 ^d	7			
					7			9			
					9						
Furniture	25	5		5	32	5	251	94	5	252	28
					8		253 ^d	—		253	5
					6		254 ^d			254	9
					12		256			256	8
					6		259 ^d			259	1
					1						
Stone clay and glass	32	5		3	50	3	322	45	9	321	100
					18		323	17		322	5
					5		326	6		323	16
					7		328 ^d	3		324 ^d	9
					3		329	19		325 ^d	8
					17					326 ^d	5
										327 ^d	26
										328 ^d	3
										329	24

^c Coverage is defined as the value of materials identifiable by commodity divided by total materials, parts, containers, and supplies of the industry.

^d Totals may not add because of rounding.

TABLE 7 (continued)

INDUSTRY	SIC CODE	Kind of Data											
		Quantity ^a		Price ^b		Materials Consumed ^c		Per Cent of		Per Cent of			
		Number of Industries	3-Digit Code	Per Cent of 2-Digit Value Added	Number of Industries	3-Digit Code	Per Cent of 2-Digit Shipments	Number of Industries	3-Digit Code	Number of Industries	3-Digit Code	Per Cent of 2-Digit Materials Consumed	
Electrical machinery	36	4		87			95	6				96	
			361	38		361	34		361			361	30
			363 ^d	2		362	6		362			362	6
			366	43		363	2		364			364	4
			369	4		364 ^d	5		365 ^d			365 ^d	2
Transportation equipment	37	3		51	5		40	6				100	
			372 ^d	45		372 ^d	33		371			371	71
			373 ^d	6		373 ^d	3		372			372	24
			379 ^d	1		374	3		373			373	2
						375 ^d	0		374			374	2
				379 ^d	0		375			375	—		
							379 ^d			379 ^d	—		

^a Coverage is defined as the value of "Q" items divided by the value of "Q+N" items as established by the Census-FRB Benchmark Project.

^b Coverage is defined as the value of shipments of "directly priced" items divided by total wherever made shipments.

^c Coverage is defined as the value of materials identifiable by commodity divided by total materials, parts, containers, and supplies of the industry.

^d Totals may not add because of rounding.

TABLE 7 (concluded)

THREE-DIGIT INDUSTRIES WITH DATA COVERING LESS THAN 50 PER CENT OF THE INDUSTRY											
INDUSTRY	SIC CODE	Kind of Data									
		Quantity ^a		Price ^b		Materials Consumed ^c					
		Number of Industries	3-Digit Code	Per Cent of 2-Digit Value Added	Number of Industries	3-Digit Code	Per Cent of 2-Digit Shipments	Number of Industries	3-Digit Code	Per Cent of 2-Digit Materials Consumed	
Inst. and related	38	4		59	6		86	7		100	
			381 ^d	17		381 ^d	17		381	18	
			382 ^d	26		382 ^d	24		382	21	
			383 ^d	4		383 ^d	3		383 ^d	2	
			384 ^d	13		385 ^d	5		384 ^d	17	
						386 ^d	26		385 ^d	4	
						387	11		386	25	
									387	14	
Misc. Mfg.	39	8		61	8		93	8		74	
			391 ^d	7		391	11		391	11	
			393	2		393	3		393 ^d	3	
			394	11		394	18		394 ^d	18	
			395	4		396	11		395 ^d	6	
			396	7		397 ^d	24		396	10	
			397 ^d	13		398	12		398	13	
			398	7		399	14		399 ^d	13	
			399 ^d	9							

^a Coverage is defined as the value of "Q" items divided by the value of "Q+N" items as established by the Census-FRB Benchmark Project.

^b Coverage is defined as the value of shipments of "directly priced" items divided by total wherever made shipments.

^c Coverage is defined as the value of materials identifiable by commodity divided by total materials, parts, containers, and supplies of the industry.

^d Totals may not add because of rounding.

DATA FOR MEASUREMENT OF OUTPUT PER MAN-HOUR

For periods other than benchmark data on value of production, shipments, inventories, materials consumed, employment, and man-hours are available from the Annual Survey of Manufactures for the same industries as in the Census of Manufactures. Where the standard error of a survey estimate is considered too large or the estimates otherwise fail to meet a general consistency review, the data are not published. Such cases are limited in number and vary from year to year. Moreover, the data are generally made available upon request.

The availability and coverage of the Wholesale Price Index is the same on a monthly basis as on an annual basis. The same is true of the BLS employment and man-hour estimates.

The situation is different with regard to quantity data. Of the 446 Census four-digit industries, quantity data are available for only 151. Table 6, columns 10 and 11, indicates the characteristics and frequency of nonbenchmark data.

AGRICULTURE

Only the crop and livestock output of farms is included here. Agricultural services and forestry are included in other sectors.

Output. The quinquennial Census of Agriculture provides the benchmark data for constructing gross output measures. The data available include acreage, yield, and production of crops, and the inventory number of livestock.

For intercensal years, quantity and value data are available from a variety of sources within the Department of Agriculture. *Agriculture Handbook No. 118*, published during 1956, lists seventy-six separate statistical reports, each dealing with some phase of farm commodity activity.¹⁰ The data are based upon sample estimates which are checked against a number of other sources such as State Farm Censuses. The estimates range from semi-monthly to annual, depending on the importance of the commodity. They are generally available for states, areas, and for the United States.

The net output of farms is defined as the sum of cash receipts from farm marketings, the value of home consumption, the rental value of farm dwellings, and government payments, less the value of purchased intermediate products consumed. Data for these estimates are available in the *Farm Income Situation* published monthly and summarized annually by the Agricultural Research Service of the Department of Agriculture. Coverage is complete. The ARS estimates have been rearranged to accord with national accounting definitions by the

¹⁰ Major Statistical Series of the U.S. Department of Agriculture, Vol. 8, 1956, pp. 10-11.

MEASUREMENT OF REAL OUTPUTS AND INPUTS

OBE to obtain farm national product and income, now published regularly.

Prices. Two indexes of farm prices are published monthly by the Department of Agriculture in the Agricultural Marketing Service report, *Agricultural Prices*. These are the "Index of Prices Received by Farmers" and the "Index of Prices Paid by Farmers." The former is linked from two base weighted indexes of "average" prices received by farmers and measured at the first point of sale out of the farmer's hand. It covers fifty-two farm commodities which account for more than 90 per cent of total farm output.

The Index of Prices Paid by Farmers (the "parity index") measures the average change in the prices of a representative selection of commodities and services generally bought by farmers, along with interest, taxes, and wage rates. The basic information is collected primarily by direct mail from dealers who service farm communities. For some larger items, such as automobiles, the personal interview method is used. Three hundred forty-four commodities were included in the revised index of 1953. In general, these commodities account for at least one-half of the total expenditure for a major commodity group, such as food and tobacco. Data are not available to determine coverage as a per cent of total expenditure for all commodities.

Employment and Hours. The labor input data of farms is described in detail in the first part of this report.

MINING

Table 8 sets forth data available on mining. Since benchmark data from the *1954 Census of Mineral Industries* are available on value of output, materials consumed, and employment and man-hours for virtually all industry classifications, only the availability of quantity data is noted under this heading.

DATA FOR MEASUREMENT OF OUTPUT PER MAN-HOUR

TABLE 8
Productivity Data for Mining Industries

Industry Code					Relative Importance	Output	Price Indexes Coverage ^b	Employment and Man-hours (Nonbenchmark) ^c		
2-Digit (1)	3-Digit (2)	4-Digit (3)	2-Digit (4)	3-4-Digit (5)	Quantity Benchmark ^a	Quantity and Value Non-benchmark (7)	(8)	BES ^d (9)	BLS (10)	BM (11)
10			15.0	100.0						
	101	1011		40.5	P,S	X	100.0	X	X	X
	102	1021		31.1	P	X		X	X	X
	103			10.0				X	X	X
		1032		.3	P	X				
		1033		.7	P	X				
		1034		9.0	P					
	104			3.3		X		X		
		1042		2.0	P ^e	X				
		1043		.3	P,S	X				X
		1044		1.0	P	X				
	105	1051		1.2	P	X	(100.0)	X		
	106			10.0				X		
		1062		1.7	P	X				X
		1064		3.8	P	X				X
		1063	}	4.5		X				X
		1069								
	108	1081		2.5						
	109			1.4				X		
		1092		.3	P	X				
		1093		1.0		X				
		1094								X
		1099		.1		X				
11			3.3	100.0				X		
	111			100.0					X	X
		1111		84.9	P	X	100.0			
		1112		14.8						
		1113		.3						
12			23.5	100.0						
	121			100.0			100.0	X	X	X
		1211		98.4	P	X		X		
		1212		.7	P	X		X		
		1213		.9						
13			44.5	100.0				X		
	131			79.9			100.0	X	X	X
		1312		74.8	S	X		X		
		1313		5.1	P	X				
		1314			P,S	X				
13										
		1315			P,S	X				
	133			14.6				X		
		1331		8.1						
		1332		.1						
		1339		6.3						
14			13.7	100.0				X	X	
	141			1.3		X		X		

MEASUREMENT OF REAL OUTPUTS AND INPUTS

(TABLE 8 concluded)

Industry Code			Relative Importance		Output		Price Indexes Coverage ^b	Employment and Man-Hours (Nonbenchmark) ^c		
2-Digit (1)	3-Digit (2)	4-Digit (3)	2-Digit (4)	3-4-Digit (5)	Quantity Benchmark ^a	Value Non-benchmark (7)	(8)	BES ^d (9)	BLS (10)	BM (11)
		1412		.2	S	X				
		1413		.4	S	X				
		1415		.2	S	X				
		1417		.4	S	X				
		1416)		.1	S	X				
	142	1419)								
		1422		28.5			50.6	X		
		1423		20.1	S	X		X		
		1424		1.9	S	X				
		1425		.4	S	X				
		1426		.3	S	X				
		1427		2.9	S	X				
		1429		1.9	S	X				
	144			.9	S					
		1441		30.2						
	145			30.2	S	X	66.4	X		
		1452		6.6		X		X		
		1453		1.4	*S	X				
		1454		1.5	*S	X				
		1455		.4	*S	X				
		1456		2.1	*S	X				
		1457		.3	*S	X				
		1459		.1	*S	X				
	146			.8	*S					
		1462		.4	P					
		1469			P	X				
	147			.4	P	X				
		1472		28.8						
		1473		1.2	*S	X				X
		1474		1.3	*S	X				X
		1475		.8	*S	X				X
		1476		7.0	*S	X	100.0			X
		1477		5.3	*S	X	(100.0)			X
		1479		2.5	*S	X	100.0			X
14				10.5						
	148			.4						
		1481		.4						
	149			3.8				X		
		1492			P	X		X		
		1493		.5	P	X				
		1494		.3	P	X				
		1495		.4	P	X				
		1496		.2	P	X				X
		1497		.2		X				
		1498		.8	P	X				
		1499		1.4						

Notes to Table 8 on following page.

DATA FOR MEASUREMENT OF OUTPUT PER MAN-HOUR

^a Benchmark (Census of Minerals Industries) data on the value of shipments are available for all three-digit industries and all four-digit industries except 1094. Such data generally represent the gross value of primary and secondary minerals physically transferred, contract work done, and the value of products purchased and resold without further processing. Some duplication is present but where it is significant, a net shipments figure is published.

Benchmark data on value added are similarly available except for industries 1094, 1314, and 1315. Value added here represents the sum of the value of shipments and capital expenditures less the sum of intermediate products consumed and purchased machinery. This definition differs from that used in manufacturing in that it includes the difference between capital expenditures and purchased machinery.

Benchmark data are similarly available on supplies (including the cost of products purchased wholly for resale), fuel, and energy, except for industries 146 and 1462.

^b Coverage ratios apply to both benchmark and nonbenchmark periods.

^c Benchmark data on production and development employees, all other employees, and working and total proprietors are available for all three- and four-digit industries with the exception that "other employees" are not available for industry 1462. Man-hours of production and development employees who were at the establishment are available for all three- and four-digit industries.

^d Employment data only.

^e Production defined as the quantity of placer materials washed.

^f Gold and silver, other than placer gold, combined.

^g No separation of "dimension" stone or "crushed and broken" stone.

Cols. 1-3: Based on the SIC system.

Col. 4: Ratio of national income originating in each two-digit industry to total national income originating in mining, as computed from Table 13 in *Survey of Current Business*, July 1957.

Col. 5: Ratio of value added of each four-digit industry to the value added of the corresponding two-digit industry. Data are derived from the *1954 Census of Mineral Industries*.

Col. 6: Legend indicates whether the data are in units of production (P) or shipments (S). When preceded by an asterisk, "S" refers to net shipments. Source is the *1954 Census of Mineral Industries*.

Col. 7: Derived from the regular Commodity Canvasses of the Bureau of Mines and published in the *Minerals Yearbook*. Data are on a wherever-made basis. Production data are also obtained by the Bureau of Mines from the Accident Analysis Canvasses. These data are not published but are generally available upon request.

Col. 8: Portion of the value of each industry's primary products, wherever made, which are directly priced. Parentheses indicate that the data represent the average value of output from the *Minerals Yearbook*. Otherwise, the source is the BLS Wholesale Price Index.

Col. 9: Bureau of Employment Security data published quarterly in *Employment and Wages*. Included are the total number of wage-earners employed by firms subject to unemployment insurance payments.

Col. 10: BLS data published monthly in *Employment and Earnings*. For a full description, see Part I, section on nonfarm employment.

Col. 11: Bureau of Mines data derived from the Accident Analysis Canvasses and published periodically in Information Circulars and in Mineral Industry Surveys. Employment refers to workers engaged in production, development, maintenance and repair work, supervisory and technical personnel, and office workers.

MEASUREMENT OF REAL OUTPUTS AND INPUTS

Noncommodity Sectors

SERVICES

Table 9 provides information about the sources and extent of the data available for the construction of productivity measures in this area. The entire table is not published but is available upon request. The major gaps in this area consist of current value data for households and nonprofit institutions, cost of materials and purchased services for all sectors, price indexes for certain consumer services, price indexes for business services, and employment and man-hours in at least two-digit detail.

TABLE 9
Productivity Data for the Services Sector

Industry Code			Relative Importance	Output (Receipts)	Price Index	Employment	Man-hours				
2-Digit (1)	3-Digit (2)	4-Digit (3)	2-Digit (4)	3-4-Digit (5)	Census (Benchmark) (6)	IRS (Annual) (7)	CPI (8)	Census (9)	BLS (10)	BES (11)	(12)
70			6.8			X			X		
	701			(90.3)				X		X	
		7011		87.7	X			X			a
		7012		2.6	X			X			
	702	702(1)								X	
	703			(9.7)				X		X	
		7031		8.6	X			X			
		7032		1.1	X			X			
	704									X	
		7041									
		7042									
72			13.9			X					b
	721			(39.0)		X ^c	X	X	X	X	a
		7211		28.5	X			X			
		7212		.9	X			X			
		7213		5.4	X			X			
		7214		.6	X			X			
		7291		.9	X			X			
	722			27.7		X ^c	X	X	X	X	a
		7221		27.0	X			X			
		7222		.7	X			X			
	723			(3.4)	X	X		X		X	
		7231									
		7232									
	724			(18.4)		X		X		X	
		7241		7.1	X		X	X			
		7242		10.8	X		X	X			
		7243		.6	X			X			
	725	725(1)		1.7	X		X	X		X	
	726			4.7	X	X		X		X	
		7262									
		7263									

Notes to Table 9 on the following page.

DATA FOR MEASUREMENT OF OUTPUT PER MAN-HOUR

^a BLS publishes estimates for the entire services and miscellaneous group and a few component industries.

^b Unpublished estimates of average weekly hours worked from the Current Population Survey may be obtained from the Census.

^c 721 and 722 combined.

Cols. 1-3: Based on the 1945 SIC. This classification does not always coincide with the system used in the sources but differences have been reconciled wherever possible.

Col. 4: The ratio of national income originating in each two-digit industry to the total national income of the services sector, as given in Table 13, *Survey of Current Business*, July 1955.

Col. 5: Ratio of employment (full workweek) in those three- and four-digit industries for which such data are available in the *Census of Business* to employment in the corresponding two-digit industry. Employment in noncensus industries is not available on a four-digit basis. Value added figures are not available below the two-digit level.

Col. 6: *1954 Census of Business*.

Col. 7: Gross receipts of proprietorships, partnerships, and corporations are available in the Internal Revenue Service publication, *Business Indicators, 1956-57*. These data are to be published annually on a fiscal year basis. Since the classification system is not specified, there may be inconsistencies in the content of the groups which are not recognizable from the industry names. Less than annual output data are not available.

Col. 8: An entry here indicates that some form of this service is represented by an industry in the BLS, Consumer Price Index. These item indexes are calculated quarterly only. There are no indexes for the business services component.

Col. 9: *1954 Census of Business*.

Col. 10: BLS in *Employment and Earnings* provides an estimate of employment for the total services and miscellaneous sector plus four component industries which account for about 10 per cent of employment in the sector. The BLS sector also includes a few industries not part of the SIC sector.

Col. 11: BES, *Employment and Wages*, quarterly.

CONSTRUCTION

(SIC 15-17, relative importance 6 per cent of total private national income).

OUTPUT. Defined as the value of work put in place. There is no quantity measure that adequately covers all of the components of the industry. Available are data on new construction, including the value of major additions and alterations, and force account construction (BLS and the Business and Defense Services Administration jointly—monthly); also, estimates including the value of maintenance and repairs (BDSA—annually). These estimates are based on mixed sources of varying degrees of adequacy. Particularly important is the lack of a reliable basis for estimating the value of alterations and repairs to structures. It is estimated that at least 20 per cent of the total value of new construction as now computed is based largely on judgment. When particular adjustments are made, such as the allocation of work completed to certain time periods, or the inclusion of an allowance for undercoverage and underestimation in the

MEASUREMENT OF REAL OUTPUTS AND INPUTS

source data, this ratio is even higher. Both agencies responsible for the current estimates have made numerous suggestions for improvement.

PRICE INDEX. None. The constant dollar value of output series published by the BDSA is derived through the use of a cost index. This index is inappropriate as a price deflator and statistically unreliable in several respects.

EMPLOYMENT. Contract construction with some three-digit breakdown (BLS—monthly). Contract construction by three-digit groups (BES). These estimates are not consistent with the output estimates in that the former includes only contract construction while the latter includes contract and force account construction. Also, unlike the constant dollar output series, the employment figures include maintenance and repairs.

MAN-HOURS. Contract construction, average weekly hours of non-supervisory employees (BLS).

MATERIALS CONSUMED. There is no over-all estimate but scattered data are available for a few segments of the industry.

TRANSPORTATION

Railroads—SIC 40, relative importance 45 per cent (here and in the following cases, the reference is to the proportion of sector income originating in a given industry).

OUTPUT. Ton miles and passenger miles for Class I, II, and III roads (ICC—monthly). These items account for about 94 per cent of total revenue. Also available, total revenue of Class I, II, and III roads with breakdown by type of revenue (ICC—monthly). Note: ICC data published in *Transport Statistics, Part I*, unless otherwise specified.

PRICE INDEXES. Annual freight carload traffic rate index based on 1 per cent way-bill sample (ICC Statement R1-1). Such carload traffic accounts for 97 per cent of freight revenue. Also available, railroad passenger fares, coach (CPI—quarterly).

EMPLOYMENT. All employees, by class of work—executive, professional and clerical, maintenance and transportation (ICC—monthly).

MAN-HOURS. Class I roads—total time paid for, service hours including stand-by and held-over time (ICC).

MATERIALS CONSUMED. Quantity and value of fuel and power, Class I carriers (ICC—monthly). Value is about 20 per cent of operating expense less wages and depreciation. Total of other materials may be approximated from total expenses as shown by subtracting wages, taxes, etc.

DATA FOR MEASUREMENT OF OUTPUT PER MAN-HOUR

TRANSPORTATION

(Local railways and buslines—SIC 41, relative importance 10 per cent.)

OUTPUT. Total and revenue passengers carried by type of transit (passenger miles not available). Also, operating revenue by type of transit and passenger revenue. The American Transit Association (ATA) provides monthly and annual data based on reports from companies representing 80-90 per cent of the industry.

PRICE INDEXES. Streetcar and bus fares (CPI—quarterly). Fares, average cash rate (ATA—monthly).

EMPLOYMENT. Group as a whole (BLS); three-digit groups (BES); by type of transit (ATA).

MAN-HOURS. Average weekly hours for the industry as a whole (BLS).

MATERIALS CONSUMED. Breakdown of operating materials constituting 50 per cent of total expenditures for materials, including maintenance items.

TRANSPORTATION

(Trucking and warehousing—SIC 42, relative importance 27 per cent; trucking, local and long distance—SIC 421.)

OUTPUT. Local ton miles not available. Total intercity ton miles (ICC-annual estimate based on sample data from the Bureau of Public Roads). This estimate includes ton miles of private trucks which are not in this industry. Intercity ton miles are reported annually to the ICC by carriers whose revenue accounts for about 70 per cent of the total intercity revenue of regulated carriers. Tons of freight carried by Class I intercity carriers (ICC—quarterly). Total revenue and revenue of unregulated carriers (largely local and exempt) not available. Unregulated carriers were estimated to account for 40 per cent of total industry revenue in 1947 (see Interindustry report). Only the revenue of Class I regulated carriers is compiled, although all Classes report quarterly. Class I revenue is estimated to be 80 per cent of the total of Classes I, II, and III.

PRICE INDEX. None.

EMPLOYMENT. Including warehousing (BLS); Class I carriers only, although all file (ICC); by three-digit industry group (BES—quarterly).

MAN-HOURS. BLS—not available. ICC—some reported but not compiled.

MEASUREMENT OF REAL OUTPUTS AND INPUTS

MATERIALS CONSUMED. Motor oil and fuel, tires and tubes for regulated carriers.

TRANSPORTATION

(Trucking and warehousing, warehousing and storage—
SIC 422-429.)

OUTPUT. By three-digit industry (BES); as part of the combined estimate for trucking and warehousing (BLS). There are no satisfactory data, either annual or less than annual, for industries which include farm product storage, refrigerated warehousing, footlockers, household goods warehousing, and special and general warehousing. While scattered data on quantities of commodities stored are published, such figures do not take into account the storage period and thus do not completely reflect the output of the industry.

TRANSPORTATION

(Highway transportation n.e.c.—SIC 43.)

OUTPUT. Intercity bus passenger miles (ICC). Estimate is based on passenger miles reported by Class I carriers plus additional data gathered from the Bureau of Public Roads and special studies. Carriers reporting miles constitute about 60 per cent of total industry based on operating revenue.

Bus miles and passengers carried by long haul and short haul carriers are reported in McGraw-Hill's publication *Bus Transportation* but use of these would not take account of change in length of trip within these categories. Data on school bus operation are compiled by the Department of Health, Education, and Welfare.

Operating revenues for long and short haul bus operators (McGraw-Hill, *Bus Transportation*). Operating revenue of Class I carriers (ICC Statement Q-750—quarterly). Revenue of Class II and III carriers reported but not published.

PRICE INDEX. None.

EMPLOYMENT. Buslines, except local only (BLS—monthly); buslines, except local (*Bus Transportation*—annually); Class I carriers only, though others report (ICC); by three-digit industry for the total sector (BES—quarterly).

MAN-HOURS. Class I, total hours paid, by hourly employees (ICC).

MATERIALS CONSUMED. Specified items which can be deflated constitute about 30 per cent of operating expenses less compensation and depreciation. These are available for Class I Intercity buses only (ICC—annually).

DATA FOR MEASUREMENT OF OUTPUT PER MAN-HOUR

TRANSPORTATION

(Water transportation—SIC 44, relative importance 6 per cent; ocean-borne foreign transportation—SIC 441.)

OUTPUT. Tons of exports and imports, dry cargo and tanker, carried by United States operated (U.S. and foreign flag) vessels (OBE, on the basis of Census data—quarterly). These data do not take account of changes in length of haul, or commodity shifts within the dry cargo category. Additional data, including detailed commodity statistics by trade area and flag of vessel (Census Bureau—monthly, and the Department of the Army, Corps of Engineers). Ton miles are not available.

Number of passengers arriving at and departing from the United States, by flag of vessel and travel area (Department of Justice, Immigration and Naturalization—on a fiscal year basis). Passenger miles, not available.

There are no reported total revenue data for the industry as a whole. Carriers belonging to conference groups file financial reports with the Maritime Commission. It has been estimated that these carriers carried 70 per cent of the total revenue freight in 1947. However, the sample appears to be biased in favor of freight carriers.

Ocean freight revenue of United States carriers (U.S. and foreign flag ships: OBE—quarterly). These estimates are made on the basis of a questionnaire (Form BE-30) sent to United States operators. Response varies for the different types of operators but is estimated at between 50 and 60 per cent of the total. Also available, passenger revenue (OBE—quarterly, on the basis of passenger data described above). Average fares and shipboard expenditures are obtained from questionnaires given to arriving and departing passengers.

PRICE INDEX. Certain freight rates, so-called conference rates, and others, must be filed with the Maritime Administration. While a coverage ratio cannot be computed, the MA feels that the filed rates cover a substantial portion of the freight carried by United States carriers.

EMPLOYMENT. As part of "Other transportation and services" (BLS—monthly); for this industry (BES).

MAN-HOURS. None.

MATERIALS CONSUMED. None.

TRANSPORTATION

(Water transportation other than ocean: coastwise—SIC 442; Great Lakes—SIC 443; inland waterways—SIC 444.)

OUTPUT. Tons of freight by commodity and area (Dept. of the

MEASUREMENT OF REAL OUTPUTS AND INPUTS

Army, Corps of Engineers, *Waterborne Commerce of the U.S.*—annually). Tons of freight reported quarterly to the ICC by Class A, B, and C carriers constitute only 12 per cent of the total, since bulk carriers and private carriers are not subject to regulation. Number of passengers carried reported quarterly to the ICC by carriers accounting for about 85 per cent of passenger revenue. Passenger miles are available only for domestic waterways, published in ICC statement No. 580. Total revenue, not available.

PRICE INDEX. Revenue per ton by commodity and area of trade may be computed from ICC data but these data are not representative of exempt bulk carriers of commodities such as coal, iron ore, petroleum products, and wheat.

EMPLOYMENT. As part of estimate for "other transportation and services" (BLS); by three-digit group (BES); large regulated carriers only (ICC).

MAN-HOURS. None.

MATERIALS CONSUMED. Consumption of fuel by Class A and B carriers (ICC). More detailed expense items are reported but not compiled.

TRANSPORTATION

(Air Transportation, common carrier—SIC 451, relative importance 5 per cent. This industry consists of carriers subject to Civil Aeronautics Board regulation.)

OUTPUT. Passenger miles, ton miles of freight, express and mail for domestic and international operations (CAB, *Air Carrier Traffic Statistics*—monthly and annual reports). Also, revenues by type of carrier and class of revenue (*Air Carrier Financial Statistics*—quarterly reports).

PRICE INDEX. None.

EMPLOYMENT. Air transportation, common carrier (BLS); air transportation (BES).

MAN-HOURS. None.

MATERIALS CONSUMED. Fuel reported to the CAB.

COMMUNICATIONS AND PUBLIC UTILITIES

(Telecommunications—SIC 48, relative importance 41 per cent; telephone—SIC 481.)

OUTPUT. Number of local and toll calls (FCC—monthly). This breakdown, if consistent, would permit taking account of shifts in distance of calls. However, with the continuing enlargement of local calling areas, there is no such consistency and the number of calls inadequately reflects the quantitative output of the industry.

DATA FOR MEASUREMENT OF OUTPUT PER MAN-HOUR

Revenues by source are reported to FCC. Revenue from calls accounts for about 90 per cent of total operating revenue.

PRICE INDEX. "Residential telephone services" (CPI—quarterly). Includes sales and excise taxes. Price data for business use, long-distance calls, intrastate or interstate, are not available.

EMPLOYMENT. Monthly (BLS and BES); by class of employee (FCC).

HOURS. Average weekly hours (BLS); scheduled weekly hours (FCC).

MATERIALS CONSUMED. None.

COMMUNICATIONS AND PUBLIC UTILITIES

(Telecommunications; telegraph communication—SIC 482.)

Virtually the entire industry is subject to FCC regulation and required to file annual reports. In addition, the large carriers, representing most of the revenue of the industry, file monthly reports. Annual summaries for the principal carriers, representing over 90 per cent of total revenues, are published in *Statistics of the Communications Industry in the U.S.*

OUTPUT. Number of messages transmitted by the domestic telegraph industry and words transmitted by transoceanic and marine communication facilities are reported. Number of words is the preferable measure but is not available for the domestic telegraph sector which accounts for 80 per cent of message revenue.

TRANSPORTATION

(Oil pipelines—SIC 46, relative importance 2 per cent.)

OUTPUT. Ton miles of all pipelines (ICC, based on reports to that agency and the Bureau of Mines). Barrel mile data by type of pipeline and type of oil which permit the computation of a weighted index are not available. For the regulated sector, barrel miles are reported to the ICC for trunklines but barrels only are reported for gathering lines. Trunklines are responsible for about 70 per cent of the revenues of the industry. These data include the pipeline departments of oil companies. Insofar as they are operated as separate establishments their inclusion is consistent with the employment data. Also available, data on barrels originated and received by large pipelines (ICC quarterly in Statement Q-600).

Revenues are reported quarterly by establishments regulated by the ICC, which account for 85-90 per cent of total revenue of the industry.

PRICE INDEX. None.

MEASUREMENT OF REAL OUTPUTS AND INPUTS

EMPLOYMENT. As part of "other transportation" (BLS), regulated pipelines (ICC).

MAN-HOURS. None.

MATERIALS CONSUMED. None.

TRANSPORTATION

(Services incidental to transportation—SIC 47, 428, 438, 446, 452, 458, relative importance 6 per cent.)

These industries consist of miscellaneous services such as forwarding and arrangement of transportation and terminal facilities and services associated with freight, passenger, water transportation, and air transportation.

OUTPUT. No current data are available for this group except for some revenues reported to ICC by a minor part of the total.

EMPLOYMENT. As part of "other transportation and services" (BLS); by three-digit group (BES).

HOURS. None.

Revenues of principal carriers by type of revenue are published. All carriers report.

PRICE INDEX. None.

EMPLOYMENT. Monthly (BLS); for principal carriers by class of employee, except officials and assistants (FCC).

HOURS. Domestic employees, excluding messengers, average weekly hours (BLS). Scheduled weekly hours by class of employee (FCC).

MATERIALS CONSUMED. None.

COMMUNICATIONS AND PUBLIC UTILITIES

(Public utilities—SIC 49, relative importance 53 per cent; electric light and power—SIC 491; gas—SIC 492; electric light and gas utilities combined—SIC 493.)

OUTPUT. Kilowatt hours of electric power sold by class of consumer for Class A and B private utilities (Federal Power Commission—monthly and annually). Additional data for public utilities (FPC and the Edison Electric Institute).

Terms of gas by type of gas and class of consumer for all gas utilities, private and public (American Gas Association, *Gas Facts*). The public portion is estimated to be 4 per cent of the total. Comparable revenues are available from the same sources.

PRICE INDEX. BLS, in connection with the Consumer Price Index publishes a monthly price index for two items of electricity, and price indexes for gas for space heating and for other uses. Wholesale price indexes are available for two classes of electric light and power and one of natural gas.

DATA FOR MEASUREMENT OF OUTPUT PER MAN-HOUR

EMPLOYMENT. Total employment in gas and electric utilities (BLS). Employment in the separate activities is not available because many establishments engage in both activities, making it difficult to allocate the employment associated with each. BLS publishes separate estimates for establishments whose output consists solely of gas or electric power, and an estimate for the combination establishments.

An estimate of total gas utility employment, including an estimate for the gas portion of combined establishments (AGA, *Gas Facts*). More intensive analysis of the procedures and classification bases of both series would be required before it could be determined whether an estimate of electric utility employment could be derived by subtraction from the BLS total.

HOURS. Average weekly hours on the same basis as employment (BLS).

MATERIALS CONSUMED. Major items of fuel consumption are summarized for electric power by the FPC and in *Gas Facts* for gas utilities.

COMMUNICATIONS AND PUBLIC UTILITIES

(Public utilities; water supply and sanitary services—
SIC 494, 495, 496, 497.)

OUTPUT. Gross receipts for the group as a whole available beginning 1956-57 (IRS, *Business Indicators*). Less than annual data not available.

PRICE INDEX. Residential water rates (CPI). No price indexes for the remainder.

EMPLOYMENT. For the group as a whole (BLS); for three-digit industries (BES).

HOURS. None.

TRADE

(Wholesale trade—SIC 50-51, relative importance 33
per cent.)

In the *1954 Census of Business*, data are presented for different kinds of wholesale business in accordance with the Standard Industrial Classification. Wholesale trade is treated here as one sector because time limitations preclude a detailed analysis.

Undercoverage within the defined limits of the Census is not significant here.

OUTPUT. Sales by type of operation, kind of business and commodity line (Census). Also available are sales of durables and non-durables (OBE in the *Survey of Current Business*—monthly). The

MEASUREMENT OF REAL OUTPUTS AND INPUTS

latter estimates represent primarily a blow-up of the estimated monthly sales of merchant wholesalers prepared by the Census Bureau from a sample survey. The Census estimates and standard errors of estimate are published in the monthly *Wholesale Trade Report*. Merchant wholesalers accounted for over 50 per cent of sales and 65 per cent of employment in wholesale trade in 1954. Estimates for other wholesalers are based on less reliable data. Commodity line sales are not collected, which raises problems of deflation since each kind of business may handle a variety of commodities.

Output may also be defined as margin. To determine margins one must have either cost of good sold to deduct from sales, or estimates of operating expense plus profit (the conceptual equivalent). Operating expense is reported for the Census but not profit.

Year end inventories at cost (Census). Monthly inventories (OBE in the *Survey of Current Business*—monthly).

PRICE INDEXES. The WPI is generally a producer's price index and does not reflect the effect of changes in wholesale margins. Commodity gaps in the WPI are indicated under the discussion of manufacturing industries.

EMPLOYMENT. Paid employees and active proprietors of unincorporated businesses, by kind of operation and kind of business (Census). Total wholesale and some three-digit detail but kind of business breakdown not the same as Census (BLS).

MAN-HOURS. Average weekly hours, some three-digit detail (BLS).

MATERIALS CONSUMED. None.

TRADE

(Retail trade—SIC 52-59, relative importance 67 per cent.)

In the *1954 Census of Business*, data are presented by kind of business in accordance with the Standard Industrial Classification. Retail trade is treated here as a unit because of time limitations.

Census of Business data have been historically understated. However, some improvement was made in the 1954 Census as the result of a new system of enumeration designed to obtain data from establishments previously unrecognizable as retail establishments and establishments that were not in operation by the end of the year.

OUTPUT. It is difficult to use Census sales data for deriving an output index by deflation because the value of sales includes sales and excise taxes which have to be removed by an independent estimate. Also commodity line sales are not reported. Classification by kind of business is made on the basis of the major commodity line.

DATA FOR MEASUREMENT OF OUTPUT PER MAN-HOUR

Since each kind of business may sell a wide variety of commodities, deflation by a price index restricted to the major commodity line would imply that the price movements of all the commodities sold by that business were the same.

The Monthly Retail Trade Report, published by the Census Bureau, contains estimates of total sales and sales for selected kinds of business, based on sample surveys. It is considered generally adequate for use in intercensal years, but is subject to the same limitations as the Census.

Commonly used indicators of output (such as the volume of goods distributed weighted by constant dollar gross margins) are not completely satisfactory. The output of trade for productivity analyses should reflect the amount of services rendered to customers in the distribution of goods. Weighting by a constant dollar gross margin implies that the quantity of services associated with a particular commodity is constant. The rise in discount houses and self-service establishments suggests a decrease in the amount of service associated with particular groups of commodities, although services in the form of store and location facilities, are steadily increasing.

Since "cost of goods sold" data are not collected for the Census or the survey, it is not possible to compute accurate industry margins.

Inventories were not collected for the 1954 Census. However, monthly inventories are estimated by OBE on the basis of unpublished estimates prepared by the Census Bureau from sample data. The sample has been revised recently to provide a reliable estimate for all retail establishments.

PRICE INDEXES. Many consumer price indexes comparable in name to Census kind of business classifications are available monthly or quarterly from the BLS. These may not be appropriate because of the inconsistency of commodity price indexes for variegated business sales, and the general limitations of CPI prices as described earlier.

Indexes are also available from Department of Agriculture's AMS series on Prices Paid by Farmers but these reflect changes in quality and are not conceptually desirable deflators.

EMPLOYMENT. By kind of store (BLS—monthly); by three-digit group (BES—monthly); paid employees and proprietors (Census).

MAN-HOURS. Average weekly hours of employees; eating and drinking places excluded (BLS—monthly).

MATERIALS CONSUMED. None.

MEASUREMENT OF REAL OUTPUTS AND INPUTS

FINANCE, INSURANCE, AND REAL ESTATE

(Banking and other financial institutions; Banking—SIC 60, relative importance 16 per cent; credit agencies other than banks—SIC 61, 6 per cent; securities and commodity brokers, dealers, exchanges—SIC 62, 1 per cent.)

OUTPUT. The problem here is less one of data availability than of defining output to reflect the volume of services performed. There are several indicators which can be used, e.g., number of checks, number of accounts, volume of debits, and the volume of loans and investments. However, no one of these reflects total activity and there are many difficulties involved in developing a suitable weighting system.

In the National Income Accounts and in the BLS interindustry study this sector was considered to consist of financial intermediaries performing an investment function for individuals. Under this definition income from lending activities is received by individuals outside the banking sector and is not part of banking output. For purposes of productivity measurement this concept would not be suitable because output should, among other things, reflect the role of the labor input involved in lending activities.

Once a suitable output indicator is selected it may require deflation and the definition of an appropriate price index presents equally difficult problems.

In general, there is a considerable amount of annual and less than annual data available from agencies such as the Federal Deposit Insurance Corporation, the Federal Reserve Board, and the Securities and Exchange Commission. For personal credit institutions there is no central source of data. For this group and some miscellaneous minor groups, the only over-all data available are from Internal Revenue statistics.

EMPLOYMENT. Separate estimates for groups 60 and 62 (BLS). Note—Group 61 included with real estate.

HOURS. An unpublished estimate of average weekly hours for the whole finance, insurance, and real estate sector is available monthly in the Census Current Population Survey.

FINANCE, INSURANCE, AND REAL ESTATE

[Insurance—SIC 63, relative importance 17 per cent
(including agents and combination offices).]

OUTPUT. Because of the differing nature of their activities, the life insurance sector and the nonlife sector require different measures of output. It is difficult to define the output of the former so as to reflect

the volume of services. In the National Income Accounts, claims and premiums are disregarded and output is defined as total expenses. However, since the bulk of insurance operating expenses are wages which in real terms move as labor input does, productivity based on this output measure is by implication constant. Possible alternative measures include the value of insurance in force and the value of premiums collected, both of which are published. But, further clarification of the concepts in this area is necessary before a determination can be made.

In the nonlife sector, investment activity and the resultant income is minor. The services provided may be considered as purely insurance services which are related to premiums and claims. As measured in the input-output study, gross output consisted of total premiums earned. This measure is more closely related to the productive activity of employees. Data concerning premiums and claims by type of insurance are published in *Spectator Yearbook* and *Best's Aggregates and Averages*.

PRICE INDEXES. Automobile and hospitalization insurance (CPI).

EMPLOYMENT. Including agents (BLS); by three-digit groups (BES).

HOURS. Average weekly hours, includes agents (BLS).

FINANCE, INSURANCE, AND REAL ESTATE

(Real estate—SIC 65, relative importance 62 per cent;
real estate operators—SIC 651.)

OUTPUT. Data here, which consist of the value of rents received by real estate owners and lessors, are inadequate. The industry is made up of numerous individuals who do not consider themselves in the real estate business, as well as corporations and individuals who conduct regular real estate operations. The most important source of direct data is income tax returns but gross rents reported to IRS are not tabulated. Even such aggregations would require adjustment for under-coverage resulting from poor recordkeeping or incomplete reporting which, in view of the nature of this industry, is probably significant.

Indirect methods have been used to estimate the missing rents received figures for the nonfarm portion of this sector. The procedure involves resort to a wide variety of sources and the use of fragmentary or obsolete data. Inconsistencies in the data used for extrapolating the number of dwelling units from the Census benchmarks and lack of current average rental values have impeded a satisfactory approximation of the value of nonfarm residential rents. Further complications arise when the value is defined in terms of space rental rather than total rents received or paid. If the output of

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the industry is taken to include the rental value of owner occupied homes, the limitations of data are intensified.

REAL ESTATE

(Agents, etc., title abstract companies, subdividers, and operation builders—SIC 653-656.)

OUTPUT. No reliable data.

PRICE INDEX. Residential rent (CPI). Nonresidential rent and other sectors not available.

INTERMEDIATE COSTS. Rent-breakdown of costs for individuals is not available. Corporate sector obtained from income tax returns.

EMPLOYMENT. As part of "other finance agencies and real estate" (BLS); by three-digit industry (BES).

MAN-HOURS. None.

The nature of this industry prevents a valid comparison of output and employment (or man-hours) and derivation of a productivity ratio. If output is defined as including an imputation for owner occupied homes, there is no equivalent input factor since there is no way of measuring and reporting the hours spent by owners in managing and maintaining their properties. Even without the imputation, the corresponding labor input is not accounted for. Only a small proportion of rented property is managed and maintained by paid employees whose employment would be reported. The hours spent by owners in managing rented property are not accounted for.

RADIO AND TV BROADCASTING

(SIC 77, relative importance 12 per cent.)

OUTPUT. Revenues of all broadcasters broken down by type of revenue, sale of time and talent (FCC).

PRICE INDEX. None available for the time portion, and price of the talent portion would not be measurable.

EMPLOYMENT AND MAN-HOURS. Employment is reported to the FCC, and is available from the BES.

BLS has no separate estimate for employment or hours.

C O M M E N T

RAYMOND T. BOWMAN, Bureau of the Budget

Leon Greenberg and his colleagues are owed a considerable debt for the painstaking way in which they have catalogued the available data, related it to productivity measurement problems, and highlighted its weaknesses. In the years ahead, it should be possible to use this

information to strengthen the basic sources of productivity data and fill in the more important gaps.

There are three guiding principles which must now be evoked more positively in the organization and development of economic data.

1. Data needs must be defined more specifically in terms of clearly recognized analytical purposes.
2. The interrelationships involved in the analysis must be more clearly set forth and the data better integrated for these purposes.
3. Better quality control of data collection processes is needed and more attention must be paid to respondent and interviewer biases. The timing and content of tabulations must better accord with user requirements.

A better understanding of the theoretical and practical aspects of measurement in relation to the uses of the data is also necessary. Only thus can more reliable guides for the improvement of data and the construction of statistical series be secured.

It is important to recognize that productivity measurements cannot in themselves provide all the information economists need to explain wage, price, and output relationships. When made for the economy as a whole, they represent little more than special per capita output series. When such measurements are developed for the several industrial sectors in a manner consistent with the economy's total output, information is added concerning the extent to which the overall change in unit labor output is associated with shifts in the relative importance of different industries as contrasted with changes intra industry. But even within industries there may be shifts in capital intensity or in scale as well as in technology so that changes in productivity, thus defined, can be variously explained.

When more basic deductions are involved, such as the determination of fundamental relationships between input and output so that functional product shares can be imputed, more difficult problems are encountered. These problems cannot be met by improvements in statistical sources and methodology alone; improvements in theoretical and conceptual formulations are also needed.

