Measures of Industrial Production and Final Demand

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Since the early 1920's, economists at the Federal Reserve have been developing monthly measures of activity and prices in the commodity sector of the economy with a view to analyzing the more crucial influences in the over-all economic situation. The compilation of such industry-type information has facilitated comparisons among economic time series similarly organized to study interrelationships of demand and supply for different types of commodities and utilization of labor and capital.

Market groupings of these industry data have been developed for major categories of consumer goods, equipment, and materials, as well as for many subdivisions of these categories to provide links between final demand, commodity prices, and industrial activity. Such market groupings of Bureau of Labor Statistics wholesale price indexes were compiled in 1937–41 for analysis of economy-wide price fluctuations. During World War II a market grouping of industrial production indexes was developed for studying cyclical and growth trends in consumption and investment.

At that time, the extent of the diversion of industrial resources for war purposes proved to be of critical importance in appraising developments in the private economy and in anticipating postwar economic changes. For example, direct comparisons of physical quantity series on consumer goods output showed more reduction during the war and thus the likelihood of more expansion in general economic activity in the immediate postwar period than was indicated by the aggregate expenditure data.[1] The strength shown after the war in the private

[1] A possible expansion of 60 per cent in consumer goods output above the 1935–39 average was noted in the leading article on "Wartime Production and

economy more than offset the widely expected deflationary effects of the cutback in federal war expenditures. With the unfolding of events in the postwar period and as more adequate data became available, work on market groupings of the production index continued and regular monthly publication was undertaken in 1959. A related development was the Census Bureau's publication beginning in 1963 of market groupings for the monthly series on value of manufacturers' shipments, inventories, and orders.

Two chapters in *Industrial Production—1959 Revision* provide a description of the composition of the market groupings, their relationships to other series, and possible uses of such groupings in cyclical analysis, with various qualifications. These analyses have been carried forward in special articles and in the U.S. reply to the Economic Commission for Europe inquiry on industrial production measurement.[2] The present paper brings some of the earlier comparisons up to date and discusses various improvements which will be provided by new features of a comprehensive revision of the production indexes. This revision is now underway and should be published in a year or so.

This paper also recommends future development of additional monthly measures of production and distribution in the commodity-producing and construction sectors of the economy. Such measures, with weights to represent gross flows, would provide monthly measures of input and output in constant dollars for these sectors; when combined with value-added weights they comprise a monthly measure of real gross product originating in those sectors.

I. Measurement Considerations

In a number of respects, the production measures differ in concept, in measurement techniques, and in scope and classification from the

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Incomes," *Federal Reserve Bulletin,* September 1944. An exact comparison of this change became available in a recalculation of the Census-Federal Reserve bench-mark production index from 1939 to 1947, which showed an increase of 58 per cent for consumer goods, as described in Board of Governors of the Federal Reserve System, *Industrial Production Measurement in the United States,* February 1964, p. 5. Since 1939 was 6 per cent above the 1935–39 average the actual rise was about 65 per cent. See also Frank R. Garfield, "Measuring and Forecasting Consumption," *Journal of the American Statistical Association,* September 1946, pp. 322–333.

[2] Board of Governors of the Federal Reserve System, *Industrial Production Measurement in the United States,* February 1964.

Department of Commerce constant-dollar final-expenditure series in the national product accounts and the revised specially calculated annual real gross product originating by major industries presented at this conference. In some periods and some areas of measurement these differences lead to differences in indicated changes in apparently similar categories. We are mainly concerned in this paper with describing some of the analytical purposes for which the monthly production measures may be used and the inferences that may be drawn from their relationships to each other and to the final-expenditure series.

CONCEPT

In concept, the Commerce Department's gross product measures are net, whereas the Board's value-added-weighted production measures use gross series. The quarterly final-expenditure series are net since they measure output at only one stage, the last. The same approach is used for certain purposes in production index analysis when gross weighted end products of industry are used to compile an unduplicated output measure. In both cases, inputs from outside the measured sector are netted out—imports in the case of GNP, and imported, farm, and service inputs in the case of the net industry measure.[3]

The annual industry real gross product series are net by virtue of using the double deflation technique wherever input and output data are available. A complete system of measures of constant-dollar input, output, and net output for all sectors of the economy, or even just for the business or commodity sectors, would be of great usefulness. It should be pointed out that relatively small errors in the input or output measures for a given industry or sector may cause larger errors in the value-added residual and impair the usefulness of the industry detail; input measurement is particularly subject to error since reported detail is incomplete even in the industrial censuses. But if input and output measures are so constructed as to provide a consistent accounting for the flow of goods and services from one sector to another, the errors in measurement of intermediate output cancel out and the total will be the same as that derived by the final-expenditure approach. And the study of behavior of the flows and their interrelationships is of interest in itself, and is a main subject of this paper.

[3] See Clayton Gehman, "Alternative Measures of Economic Activity," *Annual Proceedings of the Business and Economics Statistics Section,* 1964 Annual Proceedings of the American Statistical Association.

The annual industry gross product data do not account consistently for these flows of goods and services, partly because the input and output series are not separately published for the sectors where double deflation was used and partly because data—and the fact that the compilations are based on the current-dollar series for employee compensation, interest, capital consumption, indirect taxes, and profits—did not permit consistent application of the double deflation technique. Manufacturing, utilities, and agriculture are double deflated but mining and trade are not. Changes in materials input–output relationships may be insignificant in mining and trade; the point is, however, that it is important for the consistency of a set of net output measures with each other, and with the measure of final unduplicated output, that (for example) iron ore as output of domestic mines be deflated by the same deflator (except for changes in transportation and distribution charges) as domestic ore used in the domestic iron and steel industry.

The production indexes provide accounting for real gross flows, and can be combined into measures of real value added, under the assumption that at the level of weighting there are no (or there are offsetting) changes in output per unit of material input. For short periods this can be accepted with little question. Even for a longer period such as the years since 1947, evidence has not been presented that there has been significant change in material and business service input per unit of output for the U.S. industrial sector as a whole. Of course, there have been changes in individual industries or industry groups (another reason why if double deflation is to be applied it is best to apply it consistently throughout the industrial sector), and some tests suggest the likelihood that the exclusion of these inputs would result in a net output index showing somewhat more growth than the value-added-weighted index since the mid-1950's (Gehman, "Alternative Measures," cited in footnote 3 above). In any event, for current analysis of monthly fluctuations in real terms, such value-added-weighted series are the only information available.

The expenditure and industry-originating series are both on a market-price basis: excise taxes are included in the manufacturing gross product data and retail excise and sales taxes are in the trade margin. The industrial production indexes are on a factor-cost basis, which is considered more appropriate for measurement of industry utilization of capital and labor. (In practice they include some indirect taxes, mainly property taxes.) The exclusion of manufacturing excise taxes

has little effect on over-all manufacturing indexes, but the retail taxes may cause some difficulty in attempts to link consumer demands measured in market prices with trade and industrial activity measurements.

Finally, the production indexes use 1947 weights for the 1947–52 period and, therefore, show somewhat more growth than the 1958-weighted expenditure series.

SCOPE AND CLASSIFICATION

The industrial production system differs in several respects from the expenditure series in scope and classification. Some of the differences could be resolved by adoption of common standards, others are less tractable. Although these differences have been described in detail in the *1959 Revision* publication, it may be useful to summarize some of their main features here.

The expenditure series measure goods output at the point of sale, including all value added by trade and transportation. The production indexes exclude value added by trade and transportation, except in a few cases where the industry boundary includes distribution, as in utilities and dairy products. The production indexes can be supplemented by monthly measures of distribution activity to add up to series for total commodity output and distribution. For some experiments with this concept see Gehman, "Alternative Measures."

In the expenditure series, consumer purchases of electricity and gas are classified as services and oil and gas well drilling is included in structures, while the production groupings include these as consumer goods and business equipment, respectively. The expenditure series for nondurable goods includes consumption of unmanufactured farm products not in the industrial production series. Motor vehicle parts used in repairs are classified in the services sector of the expenditure series, whereas the production index includes all replacement parts.

The expenditure series cover exports net of imports, whereas the production index includes exports of domestic industrial products and when gross-value-weighted includes imported materials (raw or processed) that are consumed in further processing. To complete the measurement of commodity flows, a high priority should be placed on developing monthly measures of quantity and price as well as the value of merchandise exports and imports for (1) manufactured consumer goods, business equipment, defense equipment, and industrial materials;

(2) the latter preferably subdivided between construction materials, materials for processing, and miscellaneous finished materials; and (3) fresh foods and foodstuffs and other raw materials for processing. Such measures should also contribute new insights into changes in the merchandise trade balance and hence analysis of balance of payments problems.

Finally, the production grouping classification is, with the major exception of aircraft, by type of product rather than by type of purchaser. Thus, consumer goods include purchases of autos and other consumer products by business and government, business equipment includes government purchases, etc. This type of classification has advantages for some types of analysis. Electric power generating equipment adds to the nation's capacity to produce whether it is purchased by a utility company or a Federal power project. The purchase of autos by rental fleets reflects consumer as well as business demands. (Indeed, the shifting importance of auto rental raises the question of whether the fixed percentage split of auto sales between consumer and business use in the expenditure series is appropriate.)

MEASUREMENT AND INFERENCE

The final expenditure series is based on the value of final transactions, with output at earlier stages inferred from changes in deflated inventories of final products and materials. Inventory values are collected and published by holder—manufacturers and distributors—and are also combined by major type of products sold—durable and nondurable. From the point of view of the study of relationships of industrial production to final demand they can be more usefully divided into two broad stages of processing. On the one hand, all stocks of materials to be used for further industrial processing can be grouped, whether they are held by their purchasers or by their producers as "finished goods." The second grouping would combine the stocks of all end products of industry, whether held by manufacturers or distributors, including stocks of construction materials held by wholesalers and retailers.

The production index approach measures output directly at several stages of industrial activity. Changes in materials inventories may be inferred from comparison of the materials and end-product indexes; changes in inventories of end products from comparison of end-product output and final sales. Owing to the various considerations noted in the *1959 Revision,* such inferences must be made with considerable qualifi-

cations and a continuing check of other data. Even so, it is believed that these inferences have some advantages for current analysis because the production data are available from two to six weeks earlier than the book value inventory figures and are subject to little current revision, while the inventory change data have been subject to larger revisions and to special difficulties in allowing for changes in valuations.

II. New Market Measures of Production

There is presented below in Charts 1-a and 1-b an over-all monthly picture, going back to 1953, of the market groupings of the industrial production index and these results supply the main framework for the discussion in this paper. The weights used to compile the series from 1953 forward that are shown in these and subsequent charts are all new and relate to the year 1958. The main difference between the new

CHART 1-a

Major Market Divisions of Industrial Production
(seasonally adjusted annual rates, in billions of 1958 dollars)

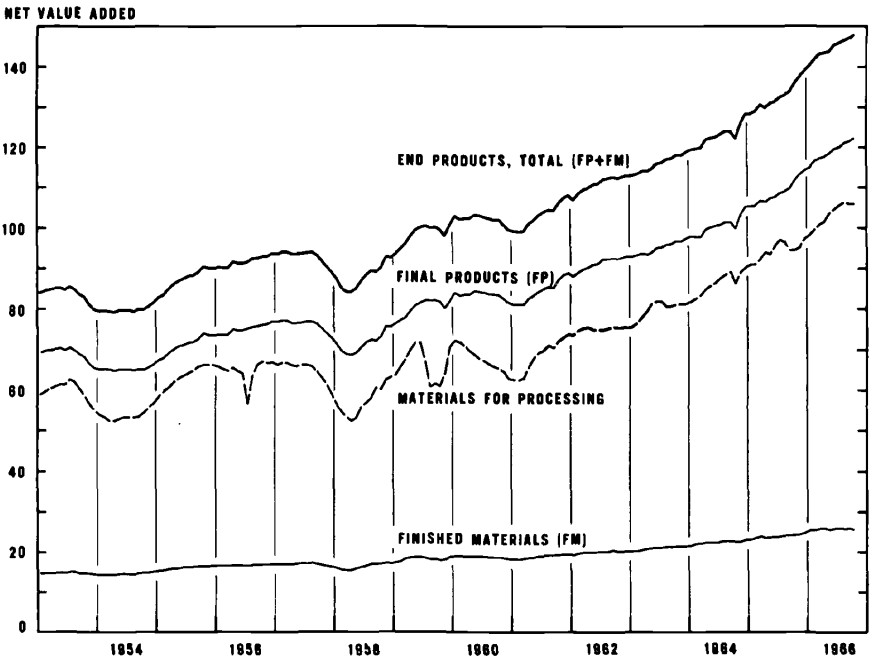
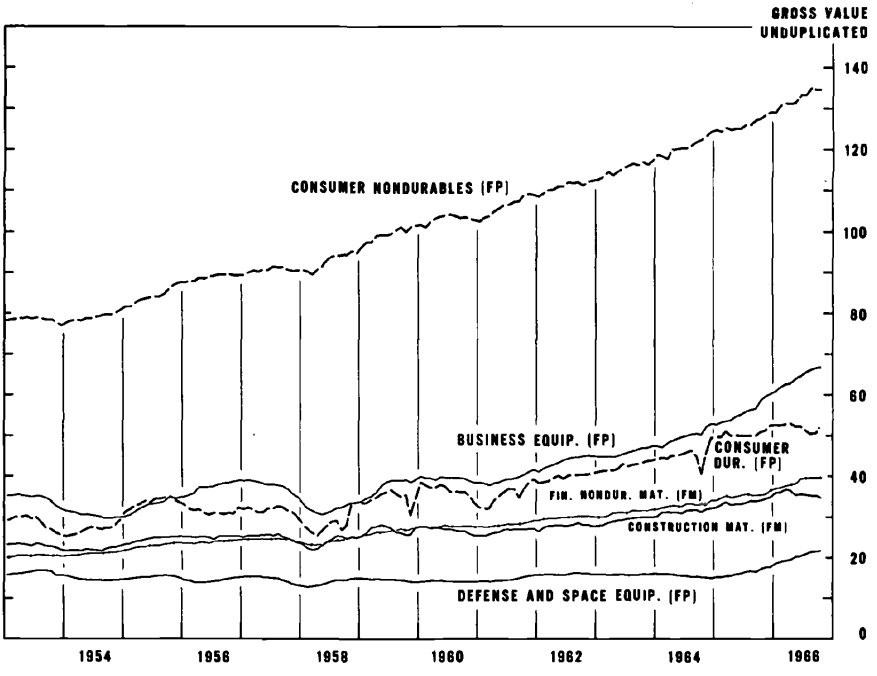


CHART 1-b

Major End-Product Groups of Industrial Production
(seasonally adjusted annual rates, in billions of 1958 dollars)



value-added weights and those used in the presently published index, however, is that the new weights represent "net value added" by excluding the business services. Net value added is reported Census value added adjusted to exclude the cost of purchased business services, estimated by using relationships calculated for sixty-three industry groups from the 1958 interindustry table (*Survey of Current Business,* September 1965). This is a move in the direction of closer national comparability of economic measures since net value added is equal in concept to gross product originating (except for excise taxes). The new data for 1958 are compared in the accompanying table with data for Census value added and gross value for major groupings in the index. The table also shows related summary information for the national expenditure series in 1958.

The composition and levels of the presently published production series will be changed in the revised index but the pattern of movements

shown for the broad groupings will probably not be appreciably different from those indicated in these charts. Preliminary checks indicate that the total index and its major divisions will be revised little in 1958 and 1963 relative to 1954 as a result of the detailed Census-Federal Reserve bench-mark production index calculations now nearing completion, and the over-all results for 1964 and 1965 appear to be close to Census Annual Survey data. These indications do not include the effect of substituting the net value-added weights. The exclusion mainly of advertising outlays from these weights decreases the relative importance of consumer goods in the index, as the data indicate in the table, and increases the influence of equipment and materials output.

The two lower lines in Chart 1-a show new supplementary divisions for materials in the total index. The largest of these represents output of all mined and manufactured materials and components used for further processing or assembly in the industrial sector. It also includes utility output of gas and electricity for industrial-type users. The division for "finished materials" represents output of those materials produced largely for use outside the industrial sector of the economy. It includes all construction materials and various nondurable materials, such as feeds, fertilizer, and gas and electricity for commercial-type users.

This division for finished materials is combined with the present grouping for final products to provide a new total for end products.[4] This combination accounts for three-fifths of total industrial production in the 1958 period. Currently, end-product output is shown in Chart 1-a to be at an annual rate of $148 billion (1958 dollars) in "net value added."

In gross value terms—the terms in which the components of end products are shown in Chart 1-b—end-product output is at an annual rate of 350 billion dollars in 1958 prices. The latter chart presents separately six major groups of end products in the total index: two of these, construction materials and finished nondurable materials, are a subdivision of the finished materials grouping shown in Chart 1-a, while the remaining four groups are subdivisions of the presently published final-product total. The consumer goods groupings used in the chart are based on the durability of products—automotive and home goods are durable, and apparel and staples are nondurable—partly in order to

[4] For an earlier discussion of these subjects and comparisons with alternative weight systems see pages 14–17, Chart 2 following page 38, and page 49 of *Industrial Production Measurement in the United States.*

TABLE 1

Value of Output in 1958
(billion dollars)

	Department of Commerce[a]	Federal Reserve Production Index Data		
		Net Value Added	Census Value Added	Gross Value
GNP total	444.5			
Goods, total	229.4			
Farm	21.3	21.3		37.6[b]
Industrial (private)[c]	142.6			
Industrial production		144.7	164.7	351.7[b]
End products		86.6	99.8	214.8
Final products		65.1	75.3	167.1
Consumer goods		41.4	49.2	121.2
Automotive products		3.3	4.0	13.3
Home goods and apparel		13.7	15.7	29.8
Consumer staples		24.3	29.5	78.1
Equipment		23.7	26.1	45.9
Business equipment		16.0	17.7	32.1
Defense and space equipment		7.7	8.4	13.8
Finished materials		21.6	24.5	47.8
Construction materials		11.1	12.2	23.8
Finished nondurable materials		10.5	12.3	24.0
Materials for processing		58.0	64.9	136.8[b]

[a] *Survey of Current Business*, September 1963.

[b] Includes duplication.

[c] Sum of gross product originating in manufacturing, mining, and public utilities (GNP goods total excludes such utilities' sales to residential users, which are classified as consumer services). Differs from production index values by inclusion of excise taxes and utilities other than electricity and gas, by exclusion of logging, fluid milk, and government-owned manufacturing and utility plants, and because of differences in data sources and methods of estimation.

show how the relative levels and monthly fluctuations of consumer durable goods compare with the business and defense equipment groups and with construction materials.

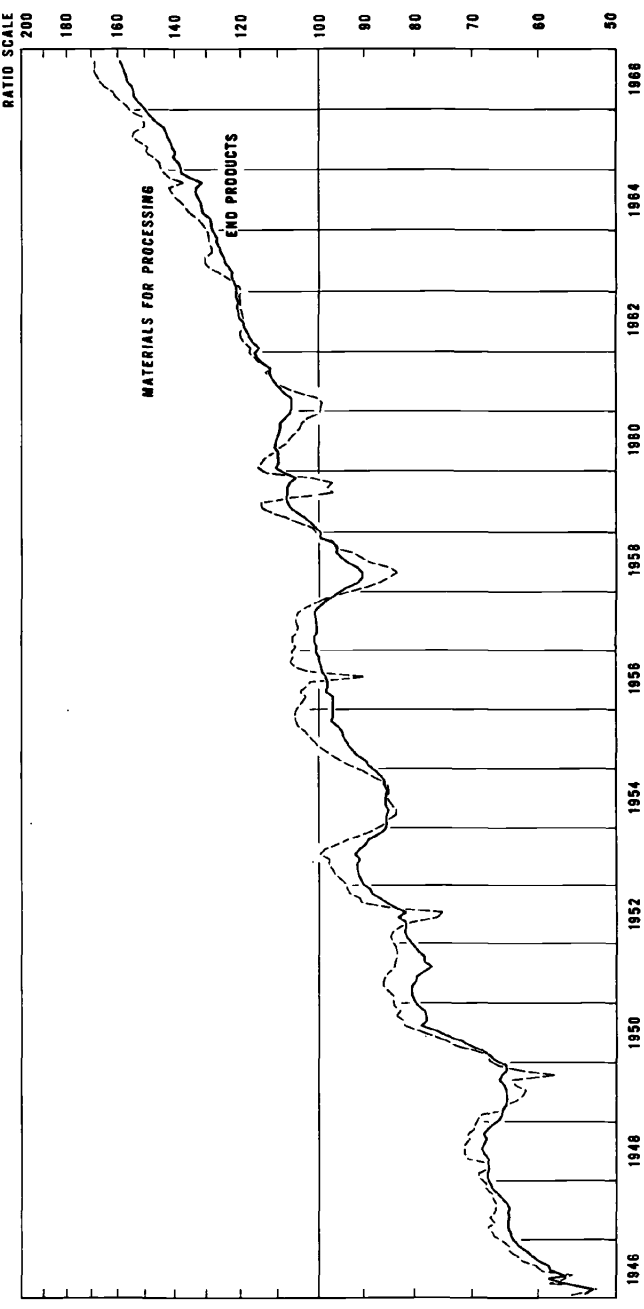
All six major end-product groups are shown in constant-dollar industrial gross value terms (excluding excise and sales taxes and distribution margins) but are without duplication since only one stage of output is included; they do include, of course, the value of farm products, imported materials, business services, etc. incorporated in those products. Gross values of this type have been compiled for each series in the revised index. The use of gross values as weights to combine series into constant-dollar aggregates provides more useful measures of commodity flows and comparisons with other gross-basis series such as merchandise exports and retail sales.

Before considering the relationship of these more detailed market groupings to the most comparable expenditure series, the behavior of the two major divisions for end products and for materials for processing which were shown in net value-added dollar amounts in Chart 1-a will be reviewed. These series have some characteristics of a monthly input–output measure as is illustrated in Chart 2 which shows their relative movements using indexes on a 1957–59 base plotted on ratio scale chart paper.

MATERIALS AND END PRODUCT RELATIONS

It is a well-established fact that output of industrial materials fluctuates more than output of final products because of changes in business inventories and other influences. It is partly because of this greater instability—which is a cause of instability in incomes, as well as in production—that the direct representation of the series for materials contributes to the analytical value of the monthly production index and its market groupings. Also, under modern technology, the output facilities for steel, cement, chemicals, and other major materials have a much greater capital ratio than those for the production of final goods and services. Consequently, an appreciation of the greater volatility of materials output contributes to a better understanding of changes in fixed investment. A related point which helps account for the temporary over-building of plant capacity is the fact that in periods of expansion 8 per cent or so of materials output has gone into inventory accumulation. The extent of apparent over-building has subsequently been exaggerated by sharply reduced rates of materials output associated with inventory liquidation.

CHART 2
Industrial Production by Two Broad Stages
(seasonally adjusted, 1957–59 = 100)



During the post-World War II period there have been three general declines in materials output of about 14 per cent and one shorter but sharper 22 per cent readjustment (apart from the steel strike decreases in 1959, 1956, 1952, and late 1949). These followed varying intervals of major economic expansions which crested in 1948, 1953, 1957, and 1960 with markedly larger rises in output of materials than in final products. The expansions were influenced by inventory, price, and growth expectations which for various reasons were not fully supported by trends in output and sales of final products.

It is beyond the scope of this paper to analyze each of those situations, but a few comments on the earliest and the latest of those periods may indicate some of the advantages of studying changes in the production indexes in relation to other data. Thus, Chart 2 (and a later Chart 10) shows that a major feature of the immediate postwar period was the sharp recovery and expansion in output of materials and final products which contributed to an end of the immediate postwar inflationary trend and the first major postwar economic readjustment beginning in the autumn of 1948.

In the latest period of 1960, too, output of materials, as well as total industrial production, reached relatively advanced levels. The inventory imbalances accompanying the extended steel strike of 1959, in addition to other influences, contributed to the shallow economic downturn in 1960. As may be noted in Charts 1-a and 2, about 9 billion dollars of the drop was in materials output which declined about 14 per cent. There was a sizable decline in output of consumer durable goods, but business equipment fell off only a few per cent (Chart 1-b). In view of these changes in relationship to the relatively sustained levels of final sales of goods and construction (Chart 10), it became apparent by the spring of 1961 that a rapid recovery in production was likely by midyear. Within another year, output of consumer goods and total end products was up to 118 per cent of the 1957–59 average, back on or above the longer-run growth trend of 4 or 5 per cent per year which these production series indicated had been resumed by 1959.

In each of these and other periods of accelerated increases in output of industrial materials it has not been possible to judge in advance the extent of the subsequent production adjustments that might be involved. This is because of various coverage and data problems and structural shifts which occur over time—as, for example, changes in the volume of inventories needed per unit of output or final sale, or in the balance

of foreign trade in industrial materials. Another coverage consideration is that while output of some of the more stable final products such as manufactured foods and tobacco products consumes an important volume of manufactured materials—chemicals and paper, for example—some of their major materials are purchased from agricultural sources. Regularly published monthly series measuring the real flow of domestic agricultural products into manufacturing, as well as the previously recommended foreign trade series, would be useful in this context.

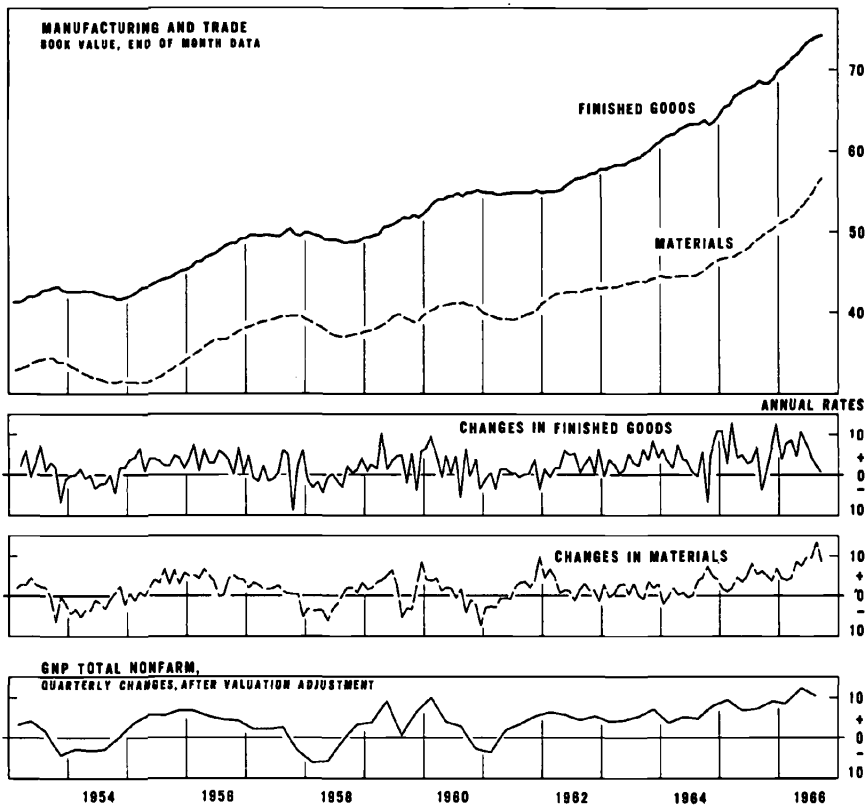
Since the differences between the two monthly series in Chart 2 reflect structural changes as well as coverage and weighting influences, in addition to straight data problems, the differential movements need to be interpreted with some caution. For example, it is apparent from the movement of these series and other data that requirements of domestic industrial materials per unit of domestic output of industrial end products fell off after 1956–57. Only relatively large changes that are sustained for some time are likely to suggest important cyclical imbalances in output relationships and provide an advance indicator of changes in the real volume of inventories of materials.

The differences between the two output series may be compared with changes in total materials inventories, wherever held. For this purpose, Department of Commerce data on the current-dollar book value of business inventories have been regrouped, and the results for two new series are shown as total values and monthly changes in Chart 3. The materials series includes all manufacturers' stocks of "materials and supplies" and "work in process" and also the stocks of "finished goods" held by manufacturers of materials such as primary metals and textiles. The finished goods series includes "finished goods" holdings of manufacturers of final products and total distributors' stocks (as revised in the November *Survey of Current Business*). The finished goods series in combination with the materials data, and after various adjustments for coverage and inventory valuation, provide the main basis for compiling the regularly published expenditure series for quarterly nonfarm inventory change shown in the bottom panel.

Differences between the processing materials and end-product output series were calculated monthly, after first making their difference in the base period equal to the change in the special materials inventory grouping in that period. The difference series (published in a chart in "Industrial Production in 1966," *Federal Reserve Bulletin,* January 1967) shows fluctuations generally similar in direction and amount to the series

CHART 3

Nonfarm Inventory Levels and Changes by Stage
(seasonally adjusted, billions of current dollars)



presented in the third panel on Chart 3, but with much less month-to-month variation than the book value series. Since the difference series is apparently less subject to random influences and free of the valuation problems in the book value series, it can provide a useful addition to current information on inventory change.

Over the past eighteen months and in some other periods, the behavior of these and other production data in relation to other information has provided a useful indicator of impending inventory changes supplementary to the usual projections of the nonfarm inventory expenditure series. The results of business surveys of manufacturers' expectations of inventory change, which have figured heavily in the projections of little

change or less accumulation in the expenditure series, have proved to be quite wide of the mark.

III. Comparison of Major End Product Measures

Analysis of current economic changes and growth developments is facilitated by combining industrial end products by their durability or by particular market groupings. Gross unduplicated value of output of all consumer goods at the industrial level amounted to 121 billion dollars in the 1958 base period and accounted for about 55 per cent of total end products, as shown above in the preceding table.

CONSUMER GOODS

By defining monthly the fluctuations in industrial output of consumer goods with about eighty individual series, the production market grouping provides a picture of leads and lags among these products and between these products and other parts of industrial production and the rest of the economy. The total consumer goods measure and its breakdown for durable and nondurable goods can be compared to the quarterly personal consumption expenditure series for goods and the monthly retail trade data, with due allowances and qualifications for the differences in concept and scope. The individual series available permit more detailed analysis of the composition of demand changes than can be made from the retail sales series which are based on total store reports. They can be weighted with value-added data for analysis in relation to the rest of the production index or with gross values for analysis in relation to demand measures.

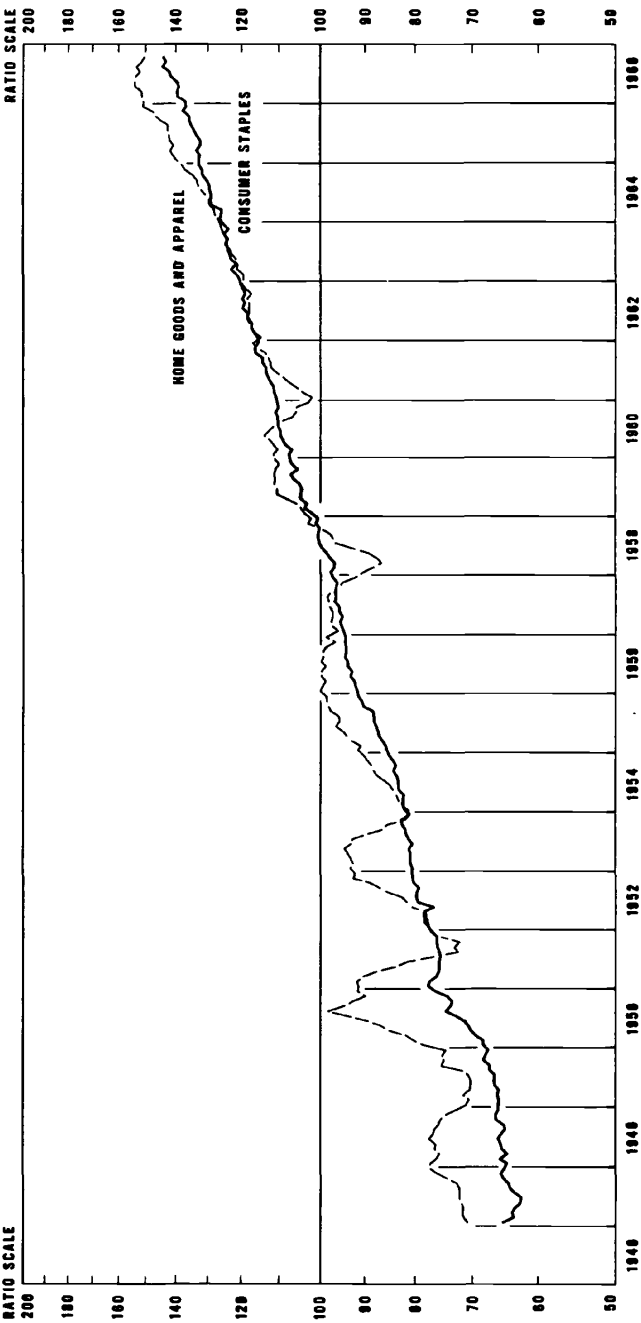
At various times during the postwar period comparisons between output and final sales of consumer goods have provided clues as to changes in relationships at different stages of activity and as to changes in stocks of finished goods held by manufacturers and distributors. On many occasions, however, the differences displayed have been within the limits of the statistical discrepancies involved and subject to relatively large revisions of the final-sales data (and of inventory data for comparison) a year or two or even a decade or two later. The accuracy of inferences regarding final-product inventories might be improved if the margin of error in the advance monthly retail trade series could be reduced.

In addition to the analytical use of the separation for durable and nondurable consumer goods, the available alternative production group-

CHART 4

Fluctuations in Consumer Goods Output, Exclusive of Automotive Products

(seasonally adjusted, 1957–59 = 100)



ings for consumer staples and for a combination of series on home goods and apparel provide insight into general economic growth and cyclical changes. A straight line can be drawn through the data for the staples series shown in Chart 4 which would show an average 4 per cent growth rate per annum since 1947, despite all the economic and demographic changes over that two-decade period. In only five of those years were the average annual figures off the trend line, and then by 1 per cent or so, which may be within the expected range of statistical error. These staple products currently have an average annual rate of industrial output of about 110 billion dollars in 1958 prices based on gross unduplicated values; together with sales taxes and distribution markups these values account for about one-fifth of total gross national expenditures.

Industrial output of consumer goods other than staples is subject to marked cyclical fluctuations. These fluctuations are related to changes in consumer expectations, disposable income, and long-run trends in the composition of demand. But they are also—and more closely—related to periodic accumulation and depletion of stocks of goods in the hands of consumers, distributors, and manufacturers; and the fluctuations of output in response to these forces in turn affect the flow of income to consumers.

The volatile nature of the auto market is well known; it is much less generally recognized that fluctuations for the total home goods and apparel category have accounted for as much cyclical fluctuation as auto output. The percentage swings in the home goods and apparel grouping of products have not been as large as in the automotive group, but the former grouping has greater aggregative importance. Currently, the annual average industrial value of output of home goods and apparel is around 50 billion dollars in 1958 prices, while the comparable value of output for automotive products is about half that amount, even though it includes auto replacement parts and tires and auto trailers and boats, as well as new cars produced for sale to business, government, and export buyers.

Home goods and apparel account for nearly all of the sales of department stores and other general merchandise outlets. While their available retail sales data fluctuate widely from month to month, owing to weather or other real or statistical influences, over-all output of these goods follows a fairly clearly defined pattern, as shown in Chart 4. On five occasions after World War II and before the present expansion began in 1961, output of these goods reached advanced levels relative to their

longer-run growth trend for periods varying from a year to two prior to a general downward readjustment in the private economy—although in the Korean War period of 1951 the downturn was offset by a massive expansion in federal military activities and outlays.

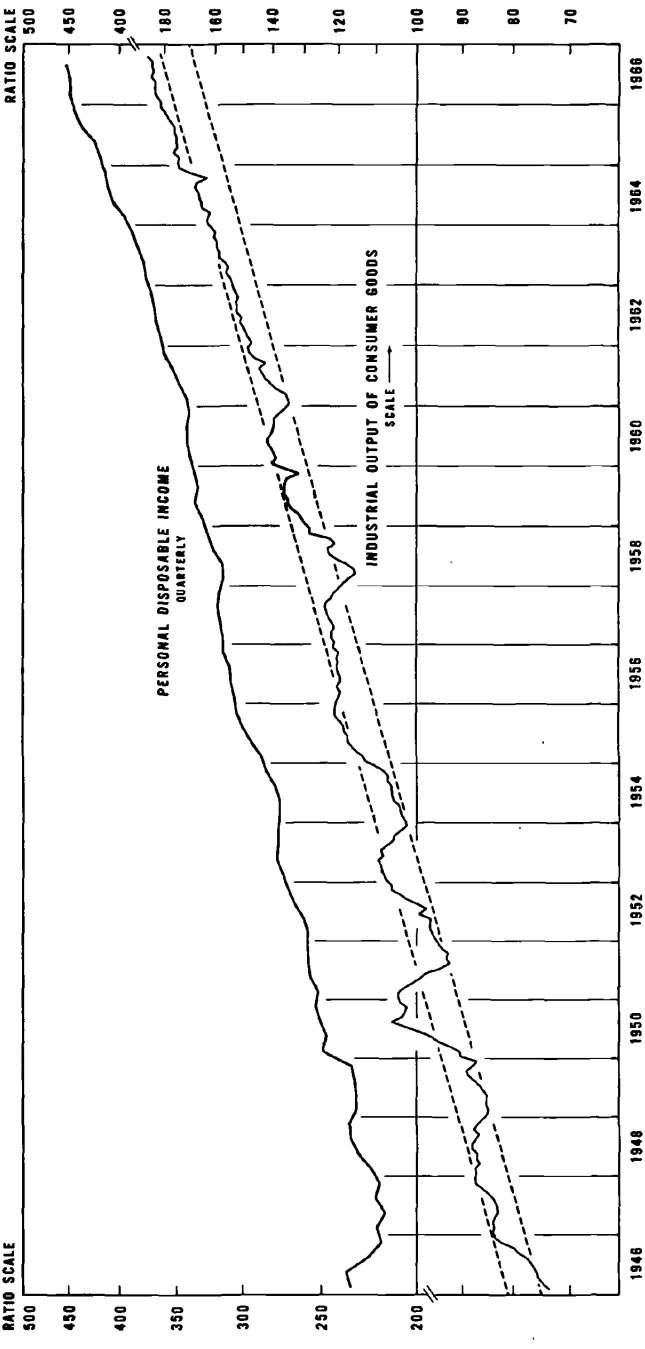
Historically, it has been possible to compile fairly adequate data from department store-type outlets on monthly changes in their stocks of goods. Since sales of these types of outlets, as well as stocks, have been relatively sensitive to general economic changes, they have been of strategic value in analysis—both along with, and in addition to, changes in the auto market where the count of dealers' new-car stocks (in transit and at outlets at ten-day intervals) is of unparalleled accuracy and importance in the field of inventory data. Moreover, there are available relatively adequate physical quantity monthly data on factory and wholesalers' stocks of major home goods. From these data certain broad relationships of monthly changes in output, stocks, and retail deliveries can be fairly firmly established. In summary, too, this information can be related to the over-all changes in the monthly book value inventory figures for finished goods shown in Chart 3, which as specially grouped for this purpose are largely consumer goods. Some of the divergent movements shown between stocks of these goods and of materials are of considerable importance in appraising current trends. Early in the autumn of 1966 the over-all rate of business inventory accumulation slowed down not because of any basic shift in trends but as a temporary result of a sharp readjustment in auto output and stocks. This was reversed shortly and inventory accumulation of other goods and especially materials continued at a rapid pace in the fourth quarter as their output was at or above earlier advanced levels while final sales in constant dollars had slowed.

It is evident from study of Charts 1-b and 5 that over-all cyclical changes in output of consumer goods have contributed about as much or more to economic fluctuations as have business equipment and construction materials. This does not mean, of course, that consumer goods changes have been of equal significance in initiating expansions and contractions in general business activity, since many other economic and political events have also been involved.

Even allowing for a considerable range of uncertainty in the data, the monthly behavior of the total consumer goods production grouping shown in Chart 5 provides little evidence as to the primacy of income changes—although in 1964 the effects of anticipation and enactment of

CHART 5

Changes in Consumer Goods Output and Incomes Compared
(seasonally adjusted annual rates, in billions of 1958 dollars)



income tax reductions were clearly evident. On the contrary, it seems that in many instances output changes are independent of, or precede, changes in personal income. The comparison in Chart 5 is made with the latest revised quarterly series for personal disposable income in constant dollars (admittedly something of an artifact) against the monthly total industrial output measure for consumer goods which combines the two series shown in Chart 4 for staples and home goods and apparel with the production series for automotive products.

The fact that personal consumption expenditures are intermediate to income and output is of importance in influencing business inventory changes in consumer goods but it is doubtful if their fluctuations can account for all the pattern of differences in Chart 5. The periodic post-war fluctuations of consumer goods output are shown to have been within a range of about 8 per cent of their average growth trend of around 4 per cent per annum. During the 1957–58 period there was a limited interruption when consumer goods output fell below the trend through the 1949, 1951, 1954, and 1960 low points.

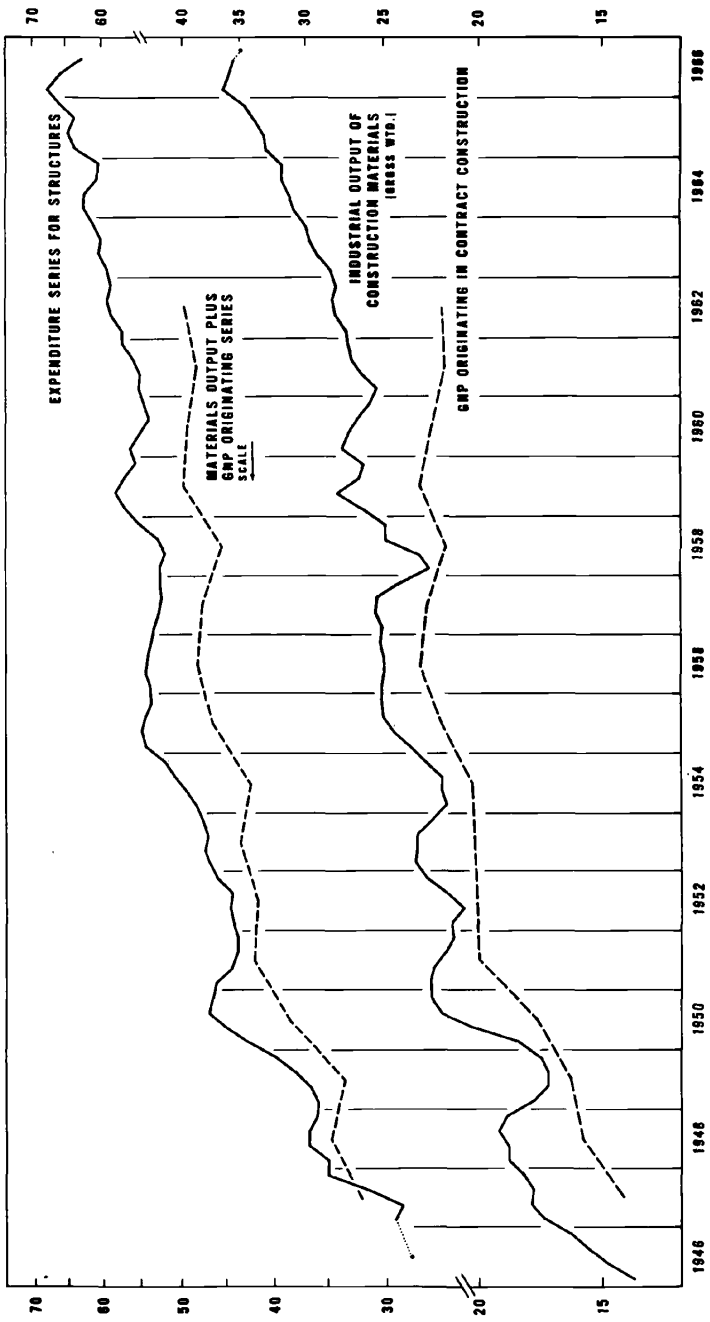
With the outbreak of the Korean War in 1950 there were sharp increases in demand for consumer durables; production indexes revealed an expansion in output of these goods of one-half and a subsequent sharp cutback which reflected mainly an accumulation of excessive inventories. Analysis of these developments by stage of activity indicated less upward pressures on prices after the spring of 1951 than might have been anticipated from observing over-all changes in income and expenditure data.

CONSTRUCTION MEASURES

Construction materials is another major industrial end-product grouping for which direct production measures are useful for analytical purposes. As shown above, this grouping had a net value of 11.1 billion dollars in 1958 while its gross weighted value was more than twice as much. In the current revision of the total index, the construction materials category will be more exactly defined by excluding, for example, the glass and paint used for manufacturing purposes. There will still be some overlap of uses in the materials measured. For the purposes of the present comparison of the grouping shown in Charts 1-b and 6, the presently published monthly production index grouping for construction materials has been rebased and multiplied by revised estimates of

CHART 6

Construction Series by Stages Compared
(seasonally adjusted annual rates, in billions of 1958 dollars)



the unduplicated gross value of construction materials output in 1958. The quarterly average results are shown as the third series from the top of Chart 6.

These construction materials are largely incorporated in new structures, additions, and alterations as represented by the constant-dollar expenditure series which is also shown quarterly as the top line on the chart in 1958 prices. The bottom line is an annual series for gross product originating in the contract construction industry, which accounts for a considerable part of the value added to construction materials in building. This series was compiled by the Office of Business Economics and published in the October 1962 and September 1963 *Surveys of Current Business*. This annual gross-product-originating series is combined with annual averages of construction materials output to provide the results shown by the dash line second from the top.

The quarterly and annual differences in movements and levels among these series present some challenging problems for future study in this area. In addition to statistical discrepancies, the difference between the two top lines (ranging from a minus 2 per cent in 1947 to a plus 20 per cent in 1954 and 1962) is in transportation and distribution of materials to the construction site, in force account construction (not included in the gross product originating), and in oil and gas well drilling which is included in the structures but not in the construction materials component of the production index. On the other hand, both the gross product and the construction materials are affected by maintenance and repair activities which are not represented in the expenditure series for new structures.

It is questionable, however, that these differences in scope alone account for the differences among the series; some stem from inventory building and liquidation at industrial and trade establishments, others from federal government purchases for defense-related use and also from the fact that the monthly representation in the expenditure series is based partly on projections rather than directly observed data. A monthly construction activity index based on construction materials output (with some lag), employment or man-hours worked in the contract construction industry adjusted for productivity changes, and rough allowances for distribution and force account construction might throw some light on views based on the presently available construction series concerning the course of construction activity and its response to financial

and other influences in periods of economic contraction and expansion. Of special interest in recent years has been the showing that industrial output of construction materials has risen at least 15 per cent more than the expenditure series (and a difference also is shown by the composite output index for construction materials compiled by the Department of Commerce).

EQUIPMENT MEASURES

The production index grouping for equipment is based on the same family of industry statistics that are available for use in comparing other information on commodity output and flows in the industrial sector and that can be systematically related to detailed and comprehensive data at Annual Survey and complete Census intervals. Monthly changes in these establishment-type data can be readily compared to changes in labor, power, and other resource use and compared to changes in industrial capacity and labor-cost trends. The monthly compilation of the indexes permits current comparisons and early judgments of rates of change and turning points. The monthly movements, and especially their quarterly averages, are subject to little revision before and after seasonal adjustment, partly because they are based on a number of individual industry series. These individual series also facilitate more detailed analysis of short-run changes.

The business equipment component of the production index is not designed to provide an exact separation from federal defense products or from other government purchases. In the revised production index this grouping will be improved by a clearer separation from defense-type goods, as well as by the calculation of new subtotals for three types of industrial equipment—manufacturing, electric power, and construction and mining. Separate series will be developed for electronic communications equipment, scientific instruments, and military ships built in private yards, which will all be included in the revised defense and space equipment category. Military aircraft and missile production is included in the presently compiled defense grouping of end products shown on a gross weight basis in Chart 1-b.

A detailed 1954–58 Census-Federal Reserve bench-mark production index for business equipment has been calculated which uses these improved groupings, and it suggests relatively little difference in 1958 com-

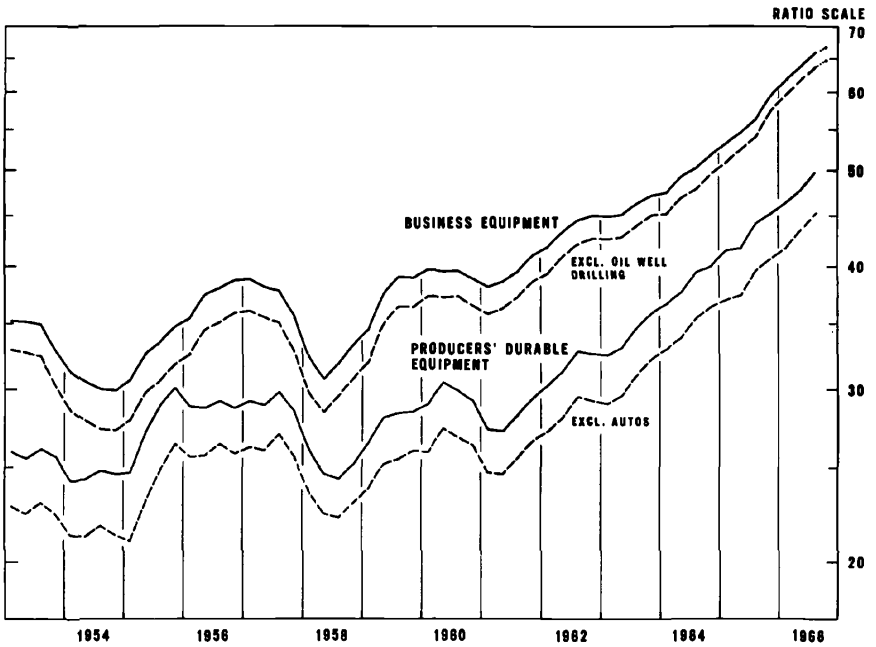
pared to 1954. Very preliminary 1963 calculations suggest no significant revision in that year relative to 1958.

The presently published business equipment grouping expressed in 1958 constant dollars is shown in Chart 7 with quarterly average annual rates based on the revised 1958 unduplicated gross value weights. For purposes of this comparison, the production series is also shown, excluding oil and gas well drilling. The third line shows the published expenditure series for private purchases of producers' durable equipment (PDE), while the fourth line shows the same series exclusive of the fixed proportion of new-auto sales estimated as purchased for business use.

The separation provided by PDE for domestic, private purchases of these goods is an important feature for some but not all purposes of economic analysis. Various financial as well as real volume influences

CHART 7

Output Trends in Equipment
(seasonally adjusted annual rates, in billions of 1958 dollars)



affect capital equipment developments; usually, however, it is difficult to establish systematic relationships based on profits and other financial flows and expectations thereof which apply from one time period to another.

The business equipment measures are roughly comparable in scope with the Census Bureau monthly industry survey data in current dollars for manufacturers' new and unfilled orders, inventories, and shipments of these types of goods. Analysis of changes in these series suggests that new orders tend to precede production changes by four months or so, while changes in inventory holdings of equipment establishments lag about six months after changes in production.

Since business equipment is in the long run an intermediate product, used largely to produce and distribute other industrial commodities, the relationship between measures for business equipment and total industrial production is of interest. Over the entire post-World War II period the index of the ratio of business equipment to total industrial production has fallen to 95 or 90 during cyclical low periods and risen to 105 or 110 during cyclical expansions—until 1966 when it rose above a level of 115 after May.

It has generally been a characteristic of the production index grouping to lead the constant-dollar expenditure series and to define cyclical turning points more clearly, partly because shipments lag behind output and investment outlays lag behind shipments and partly because the production measure is more sensitive to early influences. The business equipment series has levelled off or declined before downturns in the economy as a whole in 1948, 1953, 1957, and 1960. It has generally lagged behind upturns in consumer goods production for considerable periods.

In the 1958 recovery, the lag in business equipment after consumer goods output was only three months and the whole third quarter was clearly up for business equipment, whereas the old expenditure series in 1954 dollars showed no change in the third quarter and the revised series in 1958 dollars shows a further decline. The survey of business investment plans published in the June 1958 *Survey of Current Business* reported a further decline in spending in prospect through the end of the year. As late as the December issue the survey showed that business investment outlays were scheduled in early 1959 to approximate the

1958 average rate. In the period preceding the downturn neither the June nor December 1957 survey provided an advance indication, while activity in the machinery industries began to fall off in the early part of that year. A similar delayed sequence of anticipated and reported events occurred in the 1960–61 readjustment.

The business investment survey results on spending are of a different order than on expectations; and the regularly published results, together with the business equipment index and other data, led to the view that capital goods output was on a continued downtrend during 1954 and expanded only after a boom in autos and housing late in 1954 and in early 1955. The investment expenditure series, which is not charted here, reached its low point in the first quarter of 1955 and subsequently rose steadily to a peak in the third quarter of 1957, reflecting in part rising prices and costs.

In the revised PDE figures, the low point was moved from the fourth quarter of 1954 to the first quarter of the year, before the low for the economy as a whole was reached. A peak was reached in the fourth quarter of 1955 which was not exceeded until 1960, and then by only a slight amount in a single quarter. (Comparison of the bottom line in Chart 7 shows that the expenditure series before the addition of the auto sales data behaves somewhat more like the production series.)

Differences in cyclical patterns shown by the production and the expenditure series reflect partly changes in work in process at establishments manufacturing equipment. Comparison of the monthly finished goods and work-in-process series for the machinery industry suggests that inventory buildups of this type probably contributed to differences of several per cent in the continued business equipment buildup in 1955–57 while the expenditure figures showed little change.

Quarterly movements of current-dollar PDE are derived largely by subtracting estimates of the value of plant construction from figures on total company dollar outlays for new plant and equipment. The construction estimates are from quite unrelated sources. Residual values for PDE are then deflated by price series whose movements and levels may not be wholly appropriate for the deflation process. Other things being similar, the probabilities are greater that more adequate measurement indications may be obtained if they are made as close as possible to the point where the economic activity occurs.

Apparently, a major reason for the upward revision in 1965 of about

one-fifth in the PDE series is that it was adjusted directly to Census Annual Survey data up through 1962 for equipment shipments by industrial establishments, adjusted to exclude sales to government agencies and sales for export and with price and other allowances.[5] The production equipment series is largely based in the first instance on monthly reports of man-hours at such establishments adjusted for broad productivity trends, and quantity output data for a few major products such as motor trucks. For equipment production, labor input is generally the most important component of its real value, and use of monthly man-hours has the additional advantage of directly representing work done on items with long production times.

It is sometimes suggested that differences in the concept of capital measured are a cause of differences between the production and expenditure series. Such differences would be reflected in the deflators implicit in the two series but for the intervals measured by the Census-Federal Reserve bench-mark indexes, 1947–54 and 1954–58, there are no significant differences in the deflators for the two series; both of them rely extensively on the equipment series in the BLS wholesale price index.

IV. Comparison of Durable and Nondurable Groupings

Some of the major differences arising from the allocation of goods by type of purchaser in the expenditure series are submerged at the level of totals for durable and nondurable goods. However, changes in the expenditure categories so designated cannot be appropriately compared with production series for durable and nondurable manufacturing partly because the latter groups do not include the mining and farm values represented in final sales of durable and nondurable goods, and because the classification of "durable" goods by combining total two-digit SIC groups embodies some "nondurable" materials and vice versa—for example, glass and metal containers for food products. The comparisons that follow will instead use special durable and nondurable groupings composed of final products of each type combined, with net value-added weights, with new materials groupings. These new materials groupings

[5] Revisions in other components of the goods category of the expenditure series were less as the postwar increase in the total was revised upwards by 6 per cent in August 1965.

approximate those which will be used in the revised production index, organized according to the durability of the products in which they are used.

DURABLE GOODS OUTPUT

While some differences in the behavior of the business equipment and PDE series may be expected because of differences in the scope of the measurements, these are largely submerged in a comparison of total durable goods output series. For this purpose of comparison the expenditure series for constant-dollar final sales of durable goods after adjustment for durable goods inventory change is shown in Chart 8. The industrial output series most comparable is a specially compiled total of durable final products, including consumer durables and business and defense equipment, combined with industrial output of durable materials for processing—all with net value-added weights. Construction materials are excluded from the comparison, except to the extent that the materials series includes some metals that may be used in the manufacture of construction materials and to the extent that the inventory change series includes changes in manufacturers' and distributors' inventories of construction materials. The materials-for-processing series is shown separately at the bottom of the chart. It is generally more volatile than the series for final-product output.

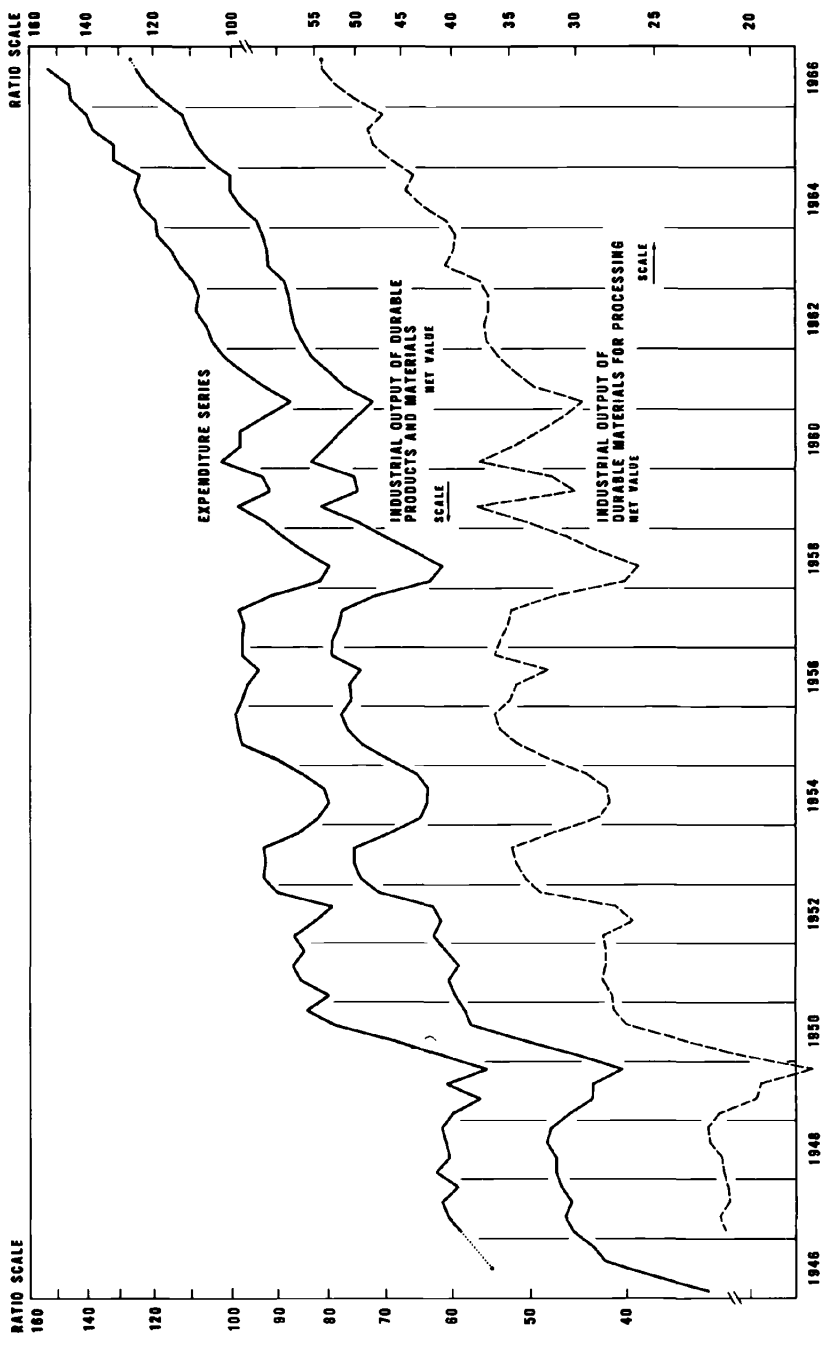
The decline in materials output relative to final products between the mid-1950's and the early 1960's is most noticeable in this durable materials series, which rose only 7 per cent from 1956 to 1962 while final products rose 18 per cent. One of the major elements in this difference was a sharp increase in steel imports while steel exports showed little net change.

The average margin of about one-fourth between the total-production series and the expenditure series reflects mainly the trade and transportation markup for consumer durable goods, but it would also be affected by the level of exports of durable goods relative to imports and, of course, by errors and miscellaneous statistical differences.

In the period since 1953, the production and expenditure series show considerable similarity for most short-run movements but there are differences in some crucial periods. For example, industrial output declines gradually in the first three quarters of 1957 from a fourth quarter 1956 peak, while the expenditure series peaks in the third quarter of 1957.

CHART 8

Durable Goods Output by Broad Stages
(seasonally adjusted annual rates, in billions of 1958 dollars)



The industrial output series declines further in the third quarter of 1960, whereas the expenditure series shows no change. In both of these cases, the movements reflect differences between the amount and direction of inventory change indicated by the constant-dollar business inventory series and the amount and direction of inventory change indicated by comparison of materials output, final-product output, and final sales.

In the period before 1953, the expenditure series show quarterly reversals so large and frequent, and so different from the movements of the output series, as to raise some questions about the usefulness for analysis of this expenditure series. Part of the problem may lie in the allocation of expenditure series data between durable and nondurable goods, since the nondurable expenditure series to be presented in the next chart often shows offsetting movements.

Differences in seasonal allowance are also involved in some cases but here, too, differences at lower levels are submerged as the relatively high third-quarter figures shown in Chart 7 for PDE in the years 1953–57 are less apparent in Chart 8. In this connection it may be noted that the production indexes are built up from a relatively large number of seasonally adjusted groupings of monthly series.

Both the various similarities and differences involved here suggest that a continuing analysis of detailed monthly measures of production and other data on final sales of durable goods would increase our understanding of cyclical processes and the development of cyclical imbalances. One consideration of major interest is the relative current contribution of changes in government expenditures on resource use. This is a major gap of general interest in economic analysis not directly supplied by the production index measurements. As shown in Chart 1-b, only output of the most specialized federal defense and space equipment can be identified monthly. This equipment has a present valuation of about 20 billion dollars in 1958 prices and is subject to relatively larger changes and longer lead times than the remainder of government outlays. A large part of these other government outlays, of course, is reflected in demands for construction and consumer outlays. Even in the national expenditure accounts, however, it is often a long and uncertain path to trace government appropriations and outlays to their current impact on resources.

NONDURABLE GOODS OUTPUT

While the more volatile durable goods sector requires special consideration, the larger category for nondurable goods has shown changes which are also of concern in judging over-all rates of growth in the economy and the possibility of important fluctuations in inventories and other cyclical influences.

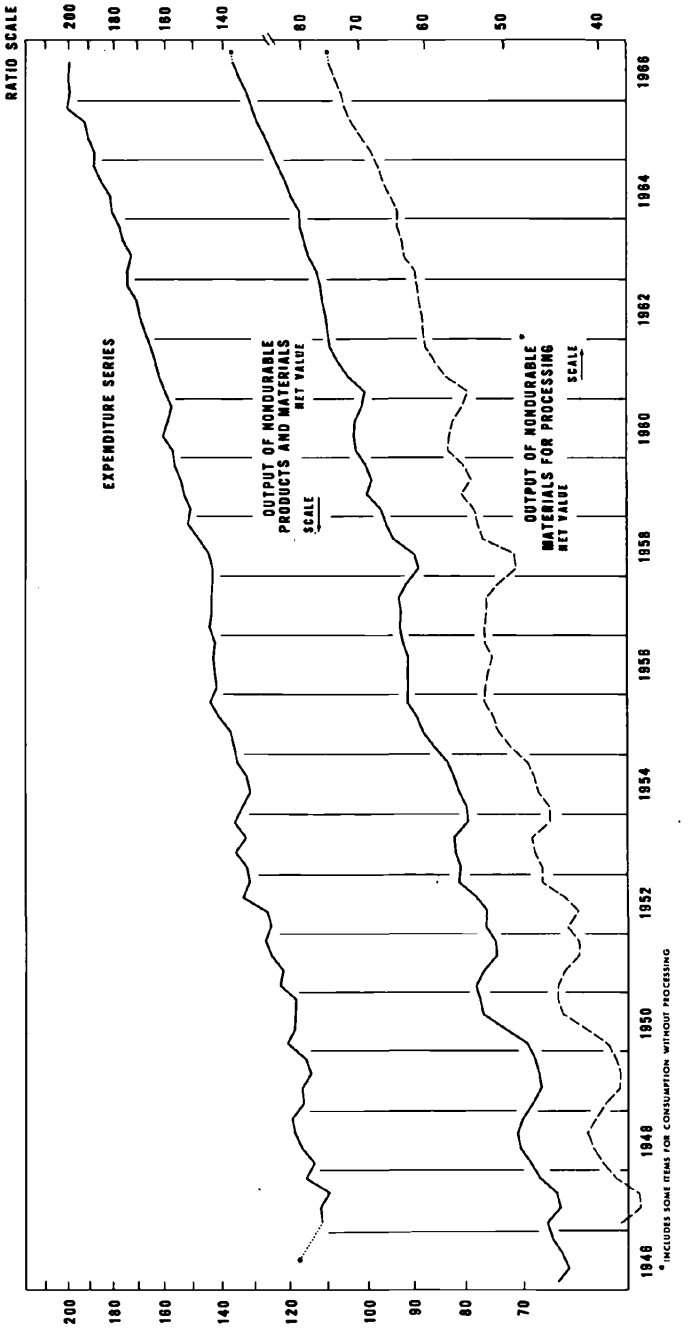
Chart 9 shows the expenditure series for output of nondurable goods in constant 1958 dollars. Below it is shown a broadly comparable production series for nondurable goods at the industrial establishment level exhibiting relatively marked differences from the expenditure series in many quarters. The production measure is the sum, with net value-added weights, of nondurable consumer goods (apparel and staples), nondurable materials, and farm output. The farm output series is based on quarterly averages of a monthly Federal Reserve measure of output of livestock and products and other farm data, adjusted to the annual farm GNP series.

Apart from the differences noted earlier, a substantial portion of the margin between the output and expenditure series represents distribution, including the large volume of services contained in the expenditure series representation for eating and drinking places. As with durable goods, the quarter-to-quarter differences between changes in materials and final products and between changes in final-product production and sales reflect inventory fluctuations, but there are puzzling differences between the reported inventory figures and the inferred movements. From 1947 to 1956, there were a number of quarterly intervals when it would be difficult to relate the inferred output changes for the expenditure series to the production measures—an especially striking difference developed between the two series from the fourth quarter of 1950 to the fourth quarter of 1951. A relatively recent dramatic difference, which figured in the interpretation of the economic situation during last year, occurred in the fourth quarter of 1965, when nondurable goods inventories (revalued and deflated) showed the largest increase since 1952 in spite of an increase in final sales greater than the increase in final-product output.

While the two total series for durable goods show about the same over-all trend from 1953 to date, the expenditure series for nondurables rises about one-tenth less than the production series. Detailed analysis

CHART 9

Nondurable Goods Output by Broad Stages
(seasonally adjusted annual rates, in billions of 1958 dollars)



of the effects of the representation of eating and drinking places in the expenditure series and utilities in the production series, the rate of distribution in this sector, and other conceptual and statistical problems would provide the basis for still another paper for this volume.

These and all the other data shown by the present charts have been subject to successive revisions. In the main, production series for the postwar period have gone through two general revisions in 1953 and 1959 and another one is now underway, while the expenditure series have already been through three such general revisions in addition to the regular annual revisions which carry changes back several years. Another subject of interest for this general discussion would be how the production and expenditure series as initially published portrayed economic developments at the time, and the extent of subsequent revisions. The nature of currently available data and their current impact on analysts and policy makers, both private and public, is beyond the scope of this paper but it represents a central part of economic history which is not sufficiently appreciated.

In such an appraisal it is likely that the production series would fare relatively well. This is partly because there are four major independent sources of monthly figures used to calculate and review the index's overall movements—current BLS data based on state employment reports for production worker man-hours, Census and trade reports on product output and manufacturers' shipments and inventory data, rail and motor truck freight volume, and electric power self-generation and industrial sales by utilities. Since the total index and its major divisions are based on about 200 monthly series, their current movements, after seasonal allowance and especially if averaged for quarterly intervals, are fairly firmly fixed. The slopes, however, of the production indexes and their rates of change over longer-run periods have been subject to some large historical adjustments to bench-mark levels. Since the introduction of adjusted man-hour series for areas not currently covered by product data, such revisions have been considerably smaller. Year-to-year movements between bench-mark dates may be subject to somewhat larger revisions. The relatively infrequent and small revisions in the monthly and quarterly pattern of changes shown provide some assurance in analyzing current economic developments and drawing conclusions regarding current changes in consumption and capital goods trends and

their relationships to each other, and even in indicated changes in inventories, which have been subject to the largest percentage revisions.

V. In Conclusion

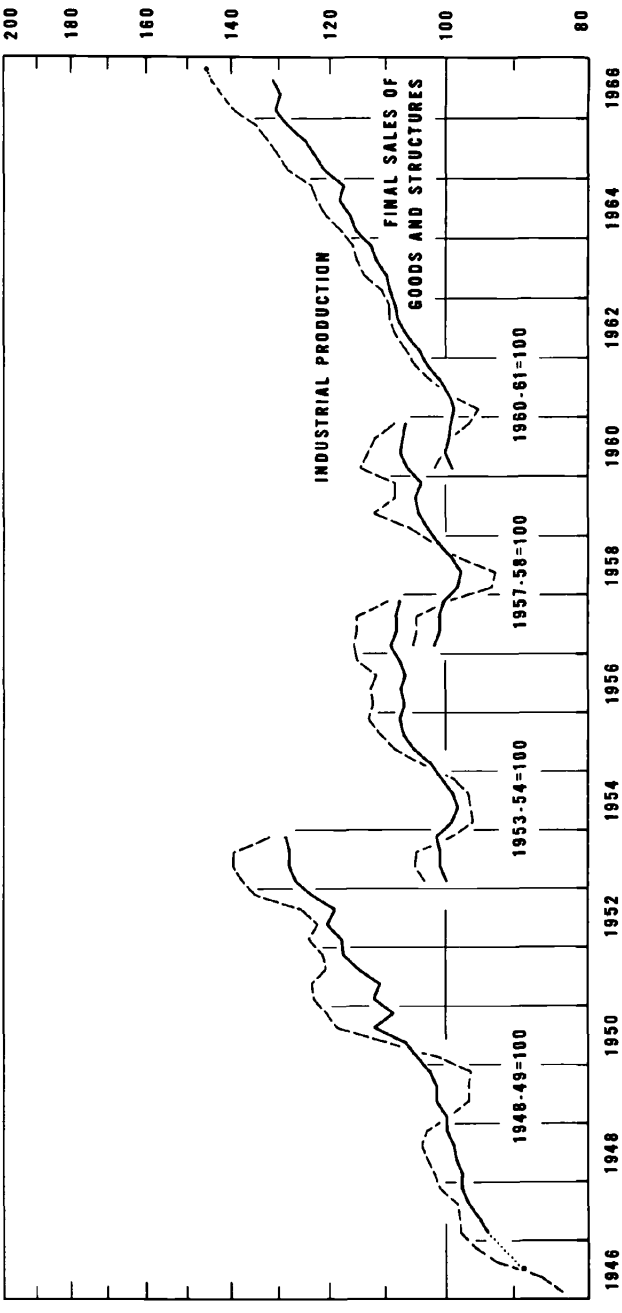
These comparisons of output by stage and by particular markets underscore the value of using commodity flow measures to help illuminate developments in the general economy. One of the most strategic aspects of these studies is the appraisal of the growth of capital goods demands and needs relative to the over-all economy together with the cumulative effects of changes in stocks of goods held by businesses and consumers. The latter are especially difficult to appraise.

A continuing broad summary of major changes in production relations and shifts in business holdings of goods can be provided by examining the kinds of comparison illustrated in the final Chart 10. The main lines of divergence involved here in real terms generally reflect changes in output and business inventories of consumer products and of industrial materials—the latter especially as they may be influenced by fluctuations in equipment production.

Owing to the qualifications already referred to in this paper, not all of the divergences or the similarities in movements shown in Chart 10 should be interpreted as providing measures of output imbalances, or balances, or changes, or lack of changes, in business inventories. It is necessary to allow for inventory shifts in the comparison base period used, which in the most recent period shown for 1960–61 included a rise in business stocks of both materials and final products. Also, part of the larger recent rise in the production series reflects the more rapid growth of the equipment series and its relatively lesser importance in the expenditure measure for final sales of goods; this was also the case in the Korean War period.

Such comparisons do provide, however, a useful framework within which to examine questions of changing output and inventory relations and also to review the matter of statistical consistency which is one of the considerations of this volume. Large sustained changes in industrial production, which now accounts for nearly all of total commodity output and changes in domestic new supplies of goods, relative to the sum of final sales of goods and construction can be expected to be reflected in business inventories. More immediately, large current shifts in the rates

CHART 10
Industrial Production and Final Sales Compared
(seasonally adjusted, four comparison base periods)



of inventory accumulation or liquidation cannot be expected without marked changes in industrial production or in the real volume of retail purchases. These factors must be taken into consideration in analysis of price developments and the formulation of economic policy.

The production accounts provide only a part of the framework of economic analysis and a whole variety of other economic influences, including institutional and political forces, must be continuously studied to accomplish even the modest objective of describing adequately economic developments, let alone attempting to explain them. It would be a step ahead in both description and explanation, however, if monthly constant-dollar measures were developed for regular publication of farm output, commodity transportation, wholesale and retail distribution, and foreign merchandise trade to complete the system of measures here proposed for the goods and construction sectors of the economy.

COMMENT

MICHAEL D. GODFREY, Princeton University

I frequently find myself critical of economic research on the ground that too little attention is paid to the nature and sources of the data involved in the research. The value of the research ultimately depends on these data. Clearly, however, the Gehman-Motheral paper cannot be criticized on that ground. Instead, I would venture to raise a few questions concerning the economic theory which forms the framework for the results reported here and comment on the potential value of the indicated measures of production in the context of aspects of this theory.

It would seem desirable to justify data operations on the basis of the consistency of these operations with a particular theoretical framework. The choice of theoretical framework is itself partially determined by policy objectives or other considerations. We might consider briefly two extreme objectives in order to indicate the impact that these choices have on the forms of data which we require. First, I will consider the kinds of data required in policy planning for long-term economic growth. Second, I will consider data needs for short-term stabilization policy. Though it is clear that these two categories are interdependent, I will, in general, ignore that interesting fact for purposes of simplicity and brevity of exposition.

If our objective is to determine the long-run growth behavior of the economy we could consider the following simple procedure. We have available a number of time series which we wish to aggregate into one series representing the long-run variation indicated by the original series. Though the actual procedure for doing this will be complicated by considerations of price and structural variations in the economy, we will generally want to perform an aggregation which will smooth out erratic or high frequency variations in the resultant series. We would be willing to pay for this smoothness by accepting relatively slow response to rapid (and usually transient) changes in the original series.

On the other hand, the objective of producing a series which would best represent the variation in the economy for the purposes of stabilization policy will lead to quite a different aggregation procedure. In this case we would require that the aggregate series respond as quickly as possible to any significant variation in the underlying series. Whether the series accurately reflects the trend or long-term variation in the original series would be of relatively minor importance.

Procedures for achieving each of these two objectives are statistically straightforward for linear combinations of the data. The consideration of objectives such as these would both be feasible technically and would bring the development of indexes, such as the measure of industrial production proposed here, into closer contact with the economic uses to which these indexes are put.

Finally, I would like to emphasize that this comment is intended as an encouragement to extend and develop the thorough and obviously valuable work which this paper clearly describes. If more economists demonstrated the concern for, and understanding of, data sources represented here we would all be better off.

COMMENT ON THE GOTTSEGEN-ZIEMER AND GEHMAN-MOTHERAL PAPERS

STANLEY J. SIGEL

The two papers in the present session make substantial contributions to an understanding of the statistical, conceptual, and analytic relationships between the income and product accounts and the index of

industrial production. The detailed and searching work and the knowledge revealed in these papers and in the subsequent discussion, as well as in other papers delivered in earlier sessions of this meeting, indicate that the creation of an explicit, detailed, and systematic reconciliation and comparison between these two systems of data (covering both their major aggregates and their various components and alternative concepts and regroupings) should now be possible. Such a task would not necessarily be a simple or an easy one nor one to be undertaken without expert knowledge. But, given the amount of information now available as a basis for such a comparison in the OBE's work on input–output and real product and in the recent work on the index at the Federal Reserve, it is somewhat disappointing that one or more papers presenting such a systematic comparison were not given at this meeting of the Conference.

Although both of the papers in this session contained elements relevant to such a comprehensive comparison, neither of them was specifically directed toward this task; my disappointment is caused thus not by the papers that were presented but by the absence of those which were not and by the circumstance that all of the relevant information for a comprehensive comparison was probably not available soon enough or distributed widely enough to have permitted the preparation of such a comparison.

I gather that I am not the only one who feels the need for these missing background papers. Thus the discussion following the presentation of the two papers indicates that both papers might, in some respects, have been strengthened or made clearer if a satisfactory reconciliation had been available to the authors and to the profession generally. For example, in the discussion it was pointed out that some of the statistical differences between real-product and index measures noted in the Gottsegen-Ziemer paper may have been attributable to industry boundary and classification differences; discussion of the Gehman-Motheral paper revealed that there is some uncertainty and misunderstanding even among the knowledgeable economists at this Conference as to the exact scope of series in the production index system, particularly in relation to series in the income and product system.

The need for an effective comparison between the two sets of data

is an obvious one and this is certainly not the first time that someone has mentioned it. And there have, of course, been more than one attempt at statistical comparison of various aspects of the series. But until a satisfactory comparison—that is, one that is sufficiently systematic and comprehensive—is provided, it is worthwhile repeating the suggestion. But anyone who does repeat the suggestion ought also to give at least some rough indications of the form and contents of a comparison that he would consider to be satisfactory.

A comprehensive comparison of the kind I am urging here would contain several elements. It should include comparisons of the aggregate measures and of the individual components and special regroupings of the two systems in terms of detailed examinations of boundaries, weighting, and use and interpretation of data. While there will be many instances where these three major elements of difference will overlap or be inextricably linked, it would be extremely helpful, to me at least, if the comparison could distinguish as sharply as possible among these sources of difference.

With respect to comparison of boundaries, what is probably needed is the construction of a schematic master framework that would be in sufficient detail to encompass the differences between the two systems—in total and in parts—with respect to industry classification and coverage, commodity classification and coverage, final product classification and coverage, identification of value added, the stages of the production and distribution process to which the various measures refer, gross and net characteristics, and, perhaps, choice of unit (i.e., establishment, enterprise, etc.). For purposes of the delineation of boundary differences, the framework on which the respective boundary lines would be drawn could be schematic, that is, it would not be necessary at this stage of the comparison to indicate magnitudes for every cell and for every difference. Indeed, as has been pointed out in the discussion this afternoon, there are no estimates available at the present time for some of the differences; this need not, and should not, be taken as a barrier to making a comprehensive and systematic comparison of boundaries and coverage.

Such a schematic framework for the comparison of boundaries and coverage would probably have a general format not unlike an input–output transactions table. In details, however, it would differ from

the present input–output table by whatever additions, deletions, regroupings, and other adjustments might be called for in order to focus on the specific comparisons needed. In particular, the framework might have to have special features to accommodate both industry and commodity boundary comparisons.

The drawing of boundary lines on such a framework would by no means provide all of the important comparisons that have to be made between the two data systems. A separate area of comparison would focus on differences in weighting, on the implications of weighting for the interpretation of what it is the measures are a measure of, and thus for comparisons between particular measures. This analysis of weighting would be done at whatever level of detail is necessary to get to actual operational comparisons. It should cover, of course, not only explicit weighting of production measures but also the implicit weighting produced by the use of particular price indices as deflators.

A third area of comparison would deal with data questions—choice of data, interpretation and evaluation of data, revision and bench-mark practices, the use of direct or indirect measures and other statistical procedures. The data and statistical comparisons should, like the boundary and weighting comparisons, be made at whatever level of detail is operational, that is, at the level where the specific decisions on data and statistical procedures are made.

The distinction between data differences and boundary and weighting differences will in many cases be a fuzzy one. For example, the difference between a gross output series and a net output series may be considered a matter of boundaries and definition, or it may be considered to be a statistical difference with the two series having the same definition but using different data series as proxies for what is being measured. Similarly, the industry classification of particular establishments may differ between two series, even though they use identical industry definitions and intend identical industry boundaries, because of different interpretations of the exact contents of available data or because the raw data available to the two sets of measures contain inconsistent treatments. This would result in differing industry coverage in the two measures, but it obviously can be considered to be either a boundary problem or a data problem. There is, however, no need to agonize over such marginal problems in the classification of differences as long as the paper makes quite explicit what is being compared.

After the boundary, weighting, and statistical comparisons and differences have been systematically sorted out and identified at both a detailed level and at appropriate summary levels, the results can be used—either in the same project or in subsequent analyses—to make the kinds of comparisons and judgments that can be made at present only in less satisfactory and more impressionistic ways. These comparisons might include such things as the comparison of the movements of different series over time, the explanation of any differences between specific series, and the exploration of the implications of these differences for our understanding of what is happening in the economy; the allocation of differences in level and movement as between conceptual and statistical reasons; the better understanding of the conceptual characteristics and differences of various series and thus of their appropriate analytic applications; the confrontation of "accidental" statistical differences (that is, those not basically related to differences in analytic purpose, concept, or fundamental statistical procedure) with a view, hopefully, of reaching agreement on the adoption of the better statistical choices and procedures; the construction of a special purpose index or set of indices to serve as a monthly estimator of real GNP and its major components, etc. Without the firm basis of a comprehensive and systematic comparison, these things can be done only crudely, if at all; the detailed comparison and reconciliation of boundary and definition and concept is thus not an alternative but a prerequisite to working statistical comparisons that themselves must form the background of substantive analysis.

It should be clear that the kind of comparison I am urging would not be an easy task, despite all the information that exists. There are many reasons to believe that it probably can be accomplished most effectively, or maybe only, by those who have the most intimate working knowledge of the details and operations of the two measures. Since it is a tedious task and since those in the best position to do it usually have many other pressing tasks to perform, the risk is great that this particular task may be neglected or given very low priority and that we will have to make-do with cruder comparisons. Undoubtedly work on many of the elements needed for the comparison is already underway. Such work should be continued and strengthened, but it is hoped that serious attention and adequate resources can also be devoted to the kind of systematic and comprehensive approach suggested here.

REPLY

CORNELIA MOTHERAL

In response to the question as to whether we had tried to relate production indexes to production functions: Part of our new annual index program is an attempt to relate production to man-hours and to electric power use, using the latter as a proxy for capital input. In response to Godfrey's question whether electric power was not a better proxy for labor input: That is true in industries where electricity is used only to turn on the lights; but many industries such as primary metals, chemicals, and paper use electric power in conjunction with heavy capital equipment.

In response to questions on problems in market classification: We did have a little more detail than your input–output industries. There are still difficulties, of course, and there were some cats and dogs that were so difficult to classify that we just called them general business supplies. It seemed to us that one of the principal problems was that exports of materials are part of final demand, and it is for this reason that we recommend compilation of special measures for this export category. The other big problem is government purchases, which are not distinguished from consumer and business equipment except in the case of defense and space equipment.