Volume Title: The Industrial Composition of Income and Product

Volume Author/Editor: John W. Kendrick, editor

Volume Publisher: NBER

Volume ISBN: 0-870-14487-1

Volume URL: http://www.nber.org/books/kend68-1

Conference Date:

Publication Date: 1968

Chapter Title: Introduction to "The Industrial Composition of Income and Product"

Chapter Author(s): John W. Kendrick

Chapter URL: http://www.nber.org/chapters/c1136

Chapter pages in book: (p. 3 - 16)

The Industrial Composition
of Income and Product

Introduction

JOHN W. KENDRICK
THE GEORGE WASHINGTON UNIVERSITY

The gradual refinement and elaboration of national income and product accounts in the United States and Canada since the 1930's have made possible increasingly sophisticated quantitative analyses of these economies. There have been important advances in econometric models explaining changes in aggregate demand by major categories of final product, and these new techniques are now useful tools for short-term forecasting. The income and product accounts in current and constant prices also serve as the basis for analyses of economic growth and as background for reasonably accurate long-term aggregate projections.

Until recently, however, the basic estimates were not at hand for adequate analysis of changes in the industrial structure of the economy. For many years estimates of national income by industry and type of income have been available, but not until 1962 in the United States and 1963 in Canada did official estimates of national product by industry in current and constant dollars become available. Then, in 1964 and 1965, input–output tables for the United States economy were published on a consistent basis with the income and product accounts, making possible a linkage between final demand and industry product.

It was against this background of statistical developments that a conference on the industrial composition of income and product was planned. The date of this conference was delayed until December 1966, however, to enable the authors of the papers on the U.S. economy to take advantage of revisions of the industry product estimates which were made available on an unpublished basis in May 1966 and subsequently published for broad industry groupings in the April 1967 *Survey of Current Business.*

The structure of the program can be described briefly, although each of the papers is summarized in the next section for those who wish a more detailed guide. Three of the conference papers (in Part III) describe the U.S. and Canadian estimates of industry product, discuss the conceptual and statistical problems encountered in their preparation, and point to directions for further improvement. The other papers make use of the new estimates for analytical purposes. The two papers of Part I discuss the uses of input–output tables in providing a bridge between expenditures for, and prices of, final products and real product and prices by industry. The three papers of Part II are concerned with explaining industry changes in labor and nonlabor costs (total and per unit of real product) and in factor shares by industry. Unit costs are decomposed into the productivity and factor price components. Relative changes in factor prices and inputs are used to explain changes in the functional distribution of gross income by industry.

The conference papers thus make a definite statistical and analytical contribution to understanding economic structure. The thorough description and critical appraisal of the industry estimates of income and product will be of value to both users and producers of the numbers for some time to come.

The papers by Jack Gottsegen and Richard C. Ziemer, Gordon Garston and David Worton, Clayton Gehman and Cornelia Motheral, and their several discussants, will serve as reference documents for continuing efforts to improve the estimates and for further analytical work. In particular, the comparisons of the real industry product estimates for the United States with the other important body of industrial production measures—those of the Federal Reserve Board—provide a systematic appraisal of the conceptual and statistical differences between the series. It is to be hoped that the conference has provided both an impetus to, and an agenda for, further efforts to refine the two sets of estimates and to reconcile them while preserving the distinctive features and advantages of each for their somewhat different analytical uses.

The authors of the analytical papers addressed themselves to key elements in the changing industry structure of income and product. Their substantive findings enhance our understanding of this important area of economics, and their methodological innovations will facilitate future work. The papers do not, nor were they intended to, provide a comprehensive analysis of changing economic structure. Yet the future

authors of the systematic models that may eventually be built will have to link changes in final demand and in the technical coefficients of input–output matrixes to change in industry products, as done by Beatrice Vaccara and Nancy Simon. They will have to translate changes in final-product prices into changes in industry prices, as done by Jack Alterman, before the interaction of factor markets and product markets can be understood. They will have to decompose changes in labor and property costs into price and quantity components, and unit factor costs into price and productivity components, as done by Leon Greenberg, Jerome Mark, and John Kendrick, as a prerequisite for further analysis of the factor markets. They will have to examine relative changes in quantities and prices of labor and property in order to explain factor substitutions, whether by the approach suggested by Alvin Egbert or Ta-Chung Liu, as an element in the production and pricing of products as well as in the functional distribution of income.

Obviously, much further analytical work will be necessary before we understand the process of change in the mutually determined sets of prices and quantities of factors and products which result in alterations in economic structure, as revealed by the industry income and product estimates. In a concluding section of the introduction, I suggest some possible avenues for further work; this indication of the needs and possibilities for further analysis attests to the importance of the present set of papers as a contribution to understanding changes in the structure of the economy. The following section attempts to summarize in somewhat greater detail the chief points covered by the authors and their discussants.

Summaries of the Papers and Discussions

In his introductory paper, "A Framework for Analysis of the Industrial Origin of Income, Product, Costs and Prices," Jack Alterman discusses various analytical uses of the industry income and product estimates in current and constant prices, both separately and in conjunction with input-output information. Alterman's summary sections provide a useful background for other papers in the volume. In addition, he develops in some depth the use of input–output tables for tracing the industrial origin of changes in prices of final goods and services and for decomposing price changes into specific factor and nonfactor cost

elements. The analysis is performed with respect to changes in costs and prices of final expenditures between 1958 and 1964 for forty-two industry groups.

As background for his analysis, Alterman had to convert the conventional input–output total-requirements table, which shows *total* output generated in each industry per dollar of final expenditures, into one showing the value-added content of final-expenditure categories, which could be further distributed into types of primary inputs. These distributions are of interest in their own right, but particularly as they contribute to his analysis of the industrial origin of changes in prices of consumer goods and services for 1958–64 (see his Table 7). Here, the industry value-added content of 1958 consumption is used to weight the changes in industry unit value added (net price) to derive the 1958–64 change in price of total personal consumption expenditures. The results suggest many things. For example, of the 7.2 per cent over-all increase in prices of consumer products, 2.5 percentage points were contributed by business and personal services. This was 34 per cent of the over-all price rise, while the industry's share of the value-added content of personal consumption outlays was 12 per cent. With respect to the primary-input content of the 7.2 per cent price change, change in unit labor cost, for example, corresponded to 4.1 percentage points, or 57 per cent of the increase, although employee compensation comprised 48.5 per cent of value added in 1958. Unit gross property compensation also is seen to have contributed more than proportionately, with unit proprietor and rental income contributing less than proportionately.

As Alterman and his discussant Richard Ruggles emphasize, the analysis does not explain price behavior, and causality should not be imputed to the "contributing" factors. Ruggles further notes that the use of unit value-added indexes has serious limitations in price analysis, since consolidation of the accounts to exclude intermediate materials and services obscures important behavioral relationships. Nevertheless, Ruggles states that the papers make a real contribution in analyzing price and unit cost changes by industry and type, in contrast to ". . . the simplistic view which suggests that the price change taking place in the economy represents over-all demand and cost situations which permeate all sectors of the economy in much the same degree."

In "Factors Affecting the Postwar Industrial Composition of Real

Product," Beatrice Vaccara and Nancy Simon of the Office of Business Economics start by noting the sizable dispersion among industry groups in rates of growth of real product. They set themselves the task of explaining the industry growth differentials in terms of two factors: changes in the level and composition of final demand and changes in the technical coefficients revealed by input–output studies that relate the outputs of industries to final demand generally. The input-output technique is essential since it enables the analyst to measure the impact on a given industry's gross and net output not only of changes in the final demand for the products of that industry but also the indirect requirements due to changes in the final demand for outputs of all other industries.

Building on previous work, Vaccara and Simon were able to develop a 1947 input–output table reasonably consistent with the published OBE table for 1958 and thus with the national income and product accounts. They were then able to obtain alternative estimates of the relative importance of the two factors in explaining industry output changes between 1947 and 1958, depending on whether they applied the fixed technical coefficients of the initial or terminal year. Since there were marked differences between the alternative measures of the relative importance of the two factors, they averaged the results in order to obtain single measures.

The authors' interesting findings are presented in some detail in the tables and text. They conclude that the changing level and pattern of final demand were somewhat more important in explaining relative changes in industry real product from 1947 to 1958 than were changes in the technical coefficients. They found further that the two elements of change generally reinforced one another, especially in cases of marked relative changes in output. Estimates of relative importance of the two factors using both 1958 and 1963 technical coefficients will have to await completion of the OBE input–output matrix for the latter year.

Vaccara and Simon recognize various difficulties in their approach. In particular, they point out that changes in the technical coefficients reflect not only technological change, but also changes in product mix both at the final-demand and intermediate-input levels; nonproportion-alities due to scale effects and changes in capacity utilization; and errors of observation, estimation, and computation. Their discussant, Gary Fromm, puts additional heavy stress on the index number

problems. He argues that the averaging of Paasche and Laspeyres indicators gives "a bastard measure." He would also like to see the analysis cast in terms of partial as well as total derivatives. Finally, he would have welcomed clues as to why output and coefficient shifts took place—including analysis of reactions to altered relative prices, capital-labor substitutions, degree of embodiment of technical progress, effects of changing average age of capital, and other aspects of the underlying production functions.

To examine "Sector Changes in Unit Labor Costs," Leon Greenberg and Jerome Mark of the Bureau of Labor Statistics first calculate the quotients of index numbers of employee compensation and of real product, using the OBE nonfarm industry sector estimates. They then "explain" the changes and trends in unit labor cost for the several sectors in terms of the two components, average hourly labor compensation and real product per man-hour. The man-hour estimates used as the denominators for compensation and real product were based primarily on the BLS employment and average hours estimates obtained from establishments in the various industries, supplemented by additional data on average hours of nonproduction workers (and for proprietors and unpaid family workers in the case of farming and the total private economy).

Each industry group had its own pattern of changes in unit labor costs, viewed as a quotient of average hourly earnings and output per man-hour as depicted in the charts accompanying the Greenberg-Mark paper. In general, the authors found a marked deceleration in the rate of increase in unit labor costs during the period 1960–64 compared with the earlier period 1947–60. This was the combined result of some deceleration in the rates of increase in hourly compensation and acceleration of the gains in output per man-hour, with the productivity element generally the more important. Also, year-to-year fluctuations in unit labor costs were greater in the earlier period than in the later one. The chief exceptions to their generalizations are to be found in the construction and service sectors, for which the authors believe the product estimates to be less reliable. Their discussant, Albert Rees, points out that it would not be difficult to improve the construction estimates substantially.

Greenberg and Mark have also developed estimates of total labor cost, including an imputation for proprietors, both for the farm sector

and the total private economy. The trends and relationships for the latter are quite similar to those obtained by using employee costs alone. The authors also calculate the effects of interindustry production shifts on unit labor costs, hourly compensation, and output per man-hour. They find the shift effect to be relatively small—averaging 0.3 of a percentage point a year or less—on the proportionate changes in each of the three variables.

Albert Rees comments that the deceleration of the rise in average earnings and unit labor costs from 1960 to 1964 was associated with a higher average unemployment rate than prevailed in the earlier period. The relevance of his remark is apparent when it is further noted that in the subsequent period, 1965–67, rising labor costs experienced a resumed acceleration as unemployment fell to a low level.

My own paper "Industry Changes in Nonlabor Costs," complements the one by Greenberg and Mark. The analysis was confined to changes between average values for the two three-year periods 1948–50 and 1961–63. First, there is some discussion of industry changes in direct business taxes, total and per unit of output, to clear the way for analysis of the major nonlabor cost, gross property compensation. Not only did indirect business taxes per unit of product in the domestic business economy rise substantially more than unit factor costs and product prices but there was more dispersion in rates of change among industries. Assuming that Commerce Department allocations of the taxes among industries are reasonably accurate, the differential effect of indirect business taxes on prices and resource allocation among industries is obviously a prime subject for further investigation.

Changes in industry shares of gross property compensation (GPC) are broken down into their components: relative changes in real product and in GPC per unit of product. Paralleling the work of Greenberg and Mark, relative industry changes in GPC per unit were analyzed in terms of relative changes in the two components: capital productivity and the price of capital. A significant negative correlation shows up between these variables, as is to be expected for reasons adduced. Relative industry changes in capital (and labor) productivity also appear to be significantly correlated with relative changes in output.

I also consider changes in the property share of gross factor income. The share declined somewhat in the domestic business economy and in about two-thirds of the industry groupings. That is, in these industries

and in the sector as a whole, unit GPC rose less than total factor cost per unit of product. To put it differently, the declining capital share was associated with a proportionate increase in the quantity of capital input relative to total factor input. Estimates of these variables are given in the tables; the associated historical elasticities of substitution are less than unity in twenty-five of the thirty-five industry groups and for the domestic business economy as a whole. In the concluding section of the paper, I suggest the reasons for the apparent general tendency towards a declining property share and the basic variables that would have to be explored to account for industry variations in, and exceptions to, the general pattern.

The discussant, Dale Jorgenson, concentrated on developing a concept of capital input alternative to mine, which assumes that capital services parallel the movement of the stock of capital. Under certain conditions, estimates of capital input under the two concepts would show the same movements, but economy-wide estimates prepared by Jorgenson and Griliches show a significantly larger increase than mine for the postwar period, and thus the associated capital- and total-productivity estimates (and presumably capital prices) show a lesser increase. The effects of the higher growth in quantities of capital inputs and the lesser increase in prices would tend to be offsetting as regards the calculated elasticities of substitution, however.

The paper by Alvin Egbert of the U.S. Department of Agriculture, "Changing Factor Shares by Industry: Factor Prices and Factor Substitutions" covers a challenging topic. After pointing out the limitations of an aggregate production function approach, Egbert develops several equations explaining factor shares of a firm, which he then relates to industry income accounts. Basically, he explains the profit share of gross (or net) income in relation to the proportions of gross income absorbed by the other major cost elements, which in turn are viewed generally as the product of quantities and prices of inputs. He discusses qualitatively the elements, such as market structure and the technological changes, that would affect ratios of profits and costs to sales or value added. But due to lack of data on nonlabor inputs and prices, Egbert is unable to statistically implement his complete model. Rather, he turns to an analysis of changes in labor shares of national product by industry.

He points out that employee compensation as a percentage of GNP

has increased moderately since World War II, mainly between 1947 and 1957. There has been considerable dispersion among industries in the trend of the labor share, with some industries showing marked declines, and there has been variation in movement over subperiods. In general, he finds that the industries in which the labor share has declined are either high-growth or declining industries. Egbert then "explains" statistically the changing industry labor shares by subperiod in terms of the relative changes in four variables: man-hours, average hourly compensation, net output, and the implicit price deflator. He speculates as to the more fundamental dynamic causal forces behind the changes in demand for, and supply of, outputs and inputs, whose interplay is reflected in the factor shares. As he points out, the first step in specifying the relevant behavioral relations within and between industries is obtaining adequate data, particularly on nonlabor inputs and their prices.

In his comments, Ta-Chung Liu notes that the usefulness of Egbert's formal approach is similar to that of the quantity theory of money in that it identifies components of change without providing a theoretical explanation. Further, Egbert's four components are not the result of the working of mutually exclusive forces. Liu enumerates five basic parameters, each of which, with one exception—the speed of adjustment towards equilibrium in the labor market—affects at least two of the terms in Egbert's identity. Liu finds the paper a useful contribution, but advocates constructing a dynamic theoretical model that would include all basic parameters. He believes the difficulties raised by Egbert could be largely overcome except for the problem of aggregation.

The final group of three papers is devoted largely to a discussion of the basic estimates. The paper by Gottsegen and Ziemer of the Office of Business Economics describes in detail the underlying concept and methods used to estimate gross product originating in the various industries. The authors' chief purpose is to compare the OBE estimates in constant prices with the other widely used production measures for manufacturing—those of the FRB. Both sets of measures for the broad categories of total manufacturing, durables and nondurables, show much the same patterns of change over the period 1948–64, although the FRB indexes may be interpreted as having a somewhat higher growth rate. But measures for some of the two-digit industry groups exhibit considerable divergence.

Gottsegen and Ziemer point out that the differences are of three main types. First, the concepts differ in that the OBE estimates are true net output measures, in which the real intermediate product costs are, in effect, deducted from the real gross value of production by the "double deflation" method, while the FRB extrapolates base-period value added by gross production indexes. The second source of divergence is methodological; in particular, the FRB uses Census gross value-added weights, while the OBE weights are net value added, gross of excise taxes and depreciation. Third, there are statistical differences: OBE uses a price-deflation approach, while FRB uses primarily physical volume measures, or proxies for them, particularly productivity-adjusted man-hours following the most recent Census bench mark. At the time of the comparisons, the FRB had not yet adjusted its indexes to the 1958 and 1963 Census production index numbers, so as Gehman and Motheral point out in their comments, the Gottsegen-Ziemer comparisons are more meaningful for the 1947–54 period. The authors provide comparisons annually by two-digit industries for the period 1947–64.

Commenting on the Gottsegen-Ziemer paper, Vivian Spencer is impressed by the striking similarities of the FRB and OBE series, considering the differences of concept and methodology. She points out that the deflated Census value-added series usually fall between the other two, but closer to the OBE series. Marked divergencies in a few groups, however, underscore the need for further study. The availability in 1967 of the Census bench-mark production indexes for 1958 and 1963 will facilitate reconciliation work. Even before completion of this work, Spencer is able to note that the BLS price indexes used by OBE for deflation tend to show more increase than the Census unit value indexes. She suggests this may be a major factor accounting for the slightly lower growth rate indicated by the OBE estimates.

Frank Garfield stresses the sensitivity to errors in either the output- or input-price indexes of the OBE estimates based on the double deflation procedure. He calls for further investigation of these problems and suggests that for some industries alternative approaches are desirable. He also implies that the net output approach is unlikely to be satisfactory for monthly and possibly for quarterly measures.

Milton Moss contributes a comprehensive critique entitled "Eliminating Disparity in the U.S. Measures of Output in Constant Prices." He points to the specific areas in which reconciliation is to be sought;

for example, reconciling Census value added and gross product originating, and the detailed gross output indexes which should be identical in both systems. Moss hopes that the discussion here will provide the necessary push to get the work done. He calls for making bench marks of the FRB indexes more frequently. He also suggests that eventually the OBE should publish its estimates of gross output and intermediate inputs, and the underlying industry detail, at least for special analyses. Moss sees a continuing role for both the OBE- and FRB-type measures.

In the paper "Measures of Industrial Production and Final Demand," Clayton Gehman and Cornelia Motheral describe the FRB index numbers of production by particular market groupings—consumer goods, equipment, and materials—by various categories of each. Their primary interest is in explaining how these series, first published in 1959 and subsequently expanded and refined, are of value in current economic analysis. For example, comparisons of the end-product measures with those for the related materials provide indications of inventory change prior to the availability of the direct inventory measures. Further, the subdivisions of the end-product measures add interesting dimensions to analysis of fluctuations not provided by the final-expenditure estimates.

The authors also compare their end-product measures with roughly comparable segments of the OBE's real final-product estimates. They do not attempt to reconcile the two sets of measures by estimating distributive margins and inventory changes, and adjusting for scope, weights, and other statistical differences. But they do find some puzzling discrepancies, which call for further investigation, between the two sets of measures. In fact, their paper suggests much regarding areas for further substantive and statistical research. They also propose new FRB measures of farm output, commodity transportation and distribution, and foreign merchandise trade in order to provide a complete system of monthly indexes for the goods and construction sectors of the economy.

Michael Godfrey comments on the Gehman-Motheral paper in the context of theoretical and policy considerations. Commenting on both the OBE and FRB papers, Stanley Sigel expresses the belief that a detailed reconciliation between the two data systems should now be possible and regrets that both papers contained only partial elements of a comprehensive comparison. Sigel specifies the framework he would

use for a systematic reconciliation. Certainly, the analytical and policy uses of output measures are of sufficient importance to warrant a major effort to improve and reconcile both major sets of estimates.

Gordon Garston and David Worton, in their paper, "Problems in the Estimation of Industry Output in Current and Constant Dollars in Canada," state their primary purposes as being ". . . to describe the progress already achieved in the development of industry-of-origin domestic product measures . . . , to indicate the remaining major conceptual and statistical problems which stand in the way of fully consistent and integrated industry-of-origin data, and to present some statistical results and analytical uses." The Canadian industry product estimates were first published in 1963, although industry income estimates became available in 1951 on a net basis, and on a gross domestic basis in 1958.

The Canadian paper is a useful supplement to the one by the OBE representatives in that Garston and Worton discuss in some detail various conceptual problems that pertain to the U.S. as well as the Canadian estimates. For example, the authors opt for the real-net-national-product-at-factor-cost concept vs. gross product at market price. Although the Canadian measures are now gross and only partially exclude indirect business taxes by industry, the authors discuss the problems involved in estimating the remaining business taxes and in obtaining current-value depreciation estimates by industry through further development of perpetual-inventory series. They also would treat interest and rent payments as nonfactor costs, rather than as part of income originating in given industries.

Garston and Worton consider the convention of measuring the product of noncommercial sectors at cost (generally labor cost, without allowance for rental values of capital assets), and the inadequacy of the corresponding real-product measures which do not reflect productivity change. They likewise note the inadequacy of some of the service industry measures, and they suggest a new approach to the financial sector.

The authors report progress in development of industry price indexes for production and intermediate purchases. They hope for increasing reliance on the double deflation approach to real-product estimates, rather than extrapolation of base-period product by physical-quantity indexes. On the thorny issue of quality change, the authors propose a

partial adjustment for it to the extent that it is reflected in changes in real costs per unit.

The paper's discussant, Michael Gort, argues that if carried to its logical extreme, the proposed approach to quality change would result in the measurement of real output in terms of real input. Gort also argues in favor of the concept of industry product at market values, which he believes will give better deflated estimates for comparisons over time. Gort disagrees with Garston and Worton's proposed treatment of income and product originating in the finance and real estate sectors; and he believes the problem of discrepancy between company- and establishment-based data is smaller for most industries than they imply.

Estimation problems aside, Garston and Worton provide illustrations of an impressive array of uses for industry product estimates—as a check on the final-expenditure estimates, for business cycle or current business analysis, for analysis of aggregate growth and structural changes, and as a framework for projections which could serve as background for policy decisions. They look forward to the development of Canadian income estimates on a consistent industry basis to make possible the analysis of cost-price interrelations of the sort done for the U.S. in some of the other papers here.

All in all, the conference papers represent important progress reports on the continuing efforts of economists to better understand the process of changing economic structure. It will be evident to the reader that, as noted earlier, various forces affecting economic structure were not covered, nor could they have been in the space of a two-day conference. In concluding this introduction, I shall point out some of the areas which must be covered in other investigations before we can hope to construct a comprehensive model of the changing industry composition of national income and product.

The papers of Part I took as given the changes in the composition of consumption expenditures. Yet relative changes in quantities purchased can be explained with reference to changes in relative prices, differential income elasticities, and shifts in preferences. Even the shifts in preferences might be explained in terms of other variables, such as outlays for new product development and advertising.

The papers of Part II took as given the relative industry changes

in factor productivities. Yet these, as well as the changes in technical coefficients, might be explained in terms of the forces behind cost-reducing innovations, such as research and development, scale, cyclical variation of output, and other industry variables. The factor substitutions by industry, which also affect partial productivity ratios, could be explained in terms of changes in relative factor prices and the nature of industry innovations.

To explain relative changes in the prices of the factors, it will be necessary to investigate the forces behind changing factor supplies which interact with the changing factor demands as influenced by product demands and factor productivities. The influence on prices of differing market structures is also relevant, as is the problem of time lags in the adjustment of factor supplies and prices to changes in demand.

Not only is additional analytical work called for, given the existing body of estimates, but additional data will be needed if a comprehensive structural model is to be developed. In particular, better and more detailed estimates of industry stocks and inputs of capital, and prices of capital services will be needed. In addition to the real industry product estimates and implicit price deflators, it will be helpful if the OBE also publishes the companion estimates of gross outputs and their prices and the intermediate inputs and their prices. Estimates of research, development, training, advertising, and other explanatory variables on an industry basis will also be of use in the correlations suggested above. Finally, there is the perennial question of the advisability of further industry disaggregation of income and product and of the interindustry sales and purchases matrix. Additional detail will add to the usefulness of analyses, but the benefits must be weighed against the costs of greater complexity.

Regardless of the direction of future work, we are fortunate that industry income and product and input–output estimates are firmly embedded in the national economic accounting framework. This ensures that structural analyses will be consistent with aggregate models and that future improvements in the accounts will benefit both.