NEEDS FOR CONSISTENCY AND FLEXIBILITY IN MEASURES OF REAL PRODUCT BY INDUSTRY[1]

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Study of relationships between outputs, inputs, prices, and final demands in the United States can be strengthened by: (1) eliminating disparities in official measures of output (mainly the Index of Industrial Production and Real Gross National Product), and (2) obtaining agreement on the conceptual framework for studying these relationships.

Real Gross Product has provided a consistent framework for study of productivity and prices for the total economy and for broad industry groups, but has not easily permitted the analysis of commodity detail particularly for intermediate commodities. Industrial Production, on the other hand, has considerably extended the detailed analysis of commodity output but has not provided a basis for systematic analysis of productivity and prices within a consistent framework for the total economy.

This paper illustrates the effect of some of the disparities between Industrial Production and Gross Product in manufacturing on the analysis of relations between prices and output and prices and productivity. This is done for the 1954–1958 period when benchmark data are available for both measures. Inconsistencies for a number of industries cause difficulties in analyzing the interplay of demand and cost influences on price changes; for example, industries which rise above average in output and below in price in one measure are not the same as those in similar price-quantity relationships in the other measure.

The paper concludes by recommending improvements in data and concept in order to eliminate some of the disparities and to enable analysts to reap the benefits of both types of measures of real output.

The growth of an economy in constant prices constitutes both an ideal goal of policy as well as a refinement of economic measurement. Both the ideal goal and the statistical refinement produce numbers which we call "real" but recognize as imaginary. Yet, just as imaginary numbers are necessary to mathematics, their counterparts are necessary to economics. For these numbers to serve the demanding needs of economic analysis, important improvements will be required in the years ahead.

Work on measurement and analysis of real output is in a dynamic state. In recent years this work has tended in three general directions:

1. Interrelated analyses between output and other variables, principally involving inputs, prices, and final demands. These interrelated analyses have been stimulated by increasing concern with balancing the objectives of stable growth, full employment, and modest inflation, and with the study of technological change. While these analytical efforts have been carried on principally for the total economy, they are being intensively done for the goods producing sectors, notably manufacturing.

2. Measurement of real output in service type industries both public and private, profit and nonprofit. This has been mainly stimulated by the

1. This work is part of a project in which the author is engaged, on a part-time basis, as a Federal Executive Fellow at the Brookings Institution. The views expressed in this paper do not purport to represent views of the Bureau of the Budget or the Brookings Institution.

recognition of the relative increase in service activity in advanced industrial countries. It has also been stimulated by debate as to whether productivity, cost and price behavior in such industries differs significantly from that in the goods producing industries and whether the traditional concepts of real output need to be changed.

3. Extending the concept of "real" beyond traditional boundaries of production, investment, and cost. A range of efforts are included here from a widening of the definition of investment to include education, for example, to attempts to measure costs and benefits of economic and social effort, most of which at present is still in a very nebulous state.

This paper deals only with the first aspect—perhaps the least difficult—mainly to illustrate the pressures for consistent detail which analyses between production and other variables for goods producing industries place upon our data and concepts.

Detail on Production, Prices, and Productivity in Major Measures of Real Output

Study of changes in inputs, prices, and final demands in relation to output has greatly increased the need for disaggregation. At one time, detail was important to insure adequate representation of broad aggregates, at least so it seemed to some index makers who tended to view individual series mainly as "indicators." Increasingly, however, because of such interrelated analyses, detailed series have become more important in their own right.

Detailed data on real output have become requisite for guides to wage-price policy involving particular industries; for clues to an understanding of pricing decisions in key markets; for measurement and projection of changes in requirements for materials, capital, and labor by industry; and for monitoring short-run imbalances in flows of commodities involving large changes in work in process.

The pressure for detail has even proceeded to the point of regarding industries as too aggregative and requiring information for individual plants or enterprises to determine many of the interrelated analyses with output, not to mention the accelerated interest in data for small geographic areas.

In the light of these requirements for interrelated detail, it is of some interest to note the possibilities for disaggregated analysis which the major measures in constant prices do or do not provide.

Within the framework of the national accounts three major measures may be highlighted: Gross National Product by type of expenditure, Gross Product Originating by industry, and input-output—all in real terms. In each of these the scope of analyses has been or will be considerably extended, but in each case we tend to face a limit, conceptually, to important further analysis.

GNP by major expenditures provided the basis for an appraisal of the physical volume of final expenditures and also a study of their prices within a framework broader than that provided by the traditional price indexes. It also provided a basis for productivity analysis for the economy as a whole. But two key limitations on further detailed analysis were inherent in this framework.

Price anlaysis was seriously handicapped because final product deflators were too sluggish to indicate the onset of price advances which were better revealed in prices of materials, and materials prices could not be analyzed systematically within the framework of the national accounts. This limitation for current analysis purposes is illustrated in Chart 1.[2]

As the chart shows, materials prices have fluctuated significantly more than prices of finished goods, according to indexes of wholesale prices of industrial commodities. In the inflations of 1950 and 1955 materials prices were the important early warning signals. They also led in the more moderate price advance beginning in 1964 and recently, since mid-1966, have shown some levelling off or decline while prices of finished goods have continued to rise. The deflator for total goods output in GNP (i.e., total GNP excluding services) is also shown on the chart and its movements closely parallel those for finished goods in the line below.

The second limitation for disaggregation in GNP by expenditure categories was the inability to analyze productivity below the level of total GNP.[3]

This latter limitation, however, was overcome by development of measures of real product by industry: first, very broadly, by sector, such as farm and nonfarm; and then more recently, by more detailed industrial categories using double deflation as the general approach. Such disaggregation permitted an analysis of productivity and of the cost of primary inputs per unit of Gross Product Originating in each industry for which a measure of current and constant prices was available.

However, significant limitations for extended analysis still remained. Thus, detailed commodity analysis of each industry's output is not strictly feasible because double deflation is calculated at the level of total output and input for each industry. It is not done product by product. Attempts to put commodities on a value-added basis are rather crude, and in addition interest can center on the gross flows of the commodities and on the pricing decisions made on specific commodities (not on their value-added content).

In addition, because output is on a value-added basis in this structure, analysis of costs does not presently permit analysis of material costs per unit of output. It is true, of course, that the inputs and gross outputs can be shown each in considerable detail in real terms, but this can be done only for benchmark periods when such work is feasible and only after considerable lag.

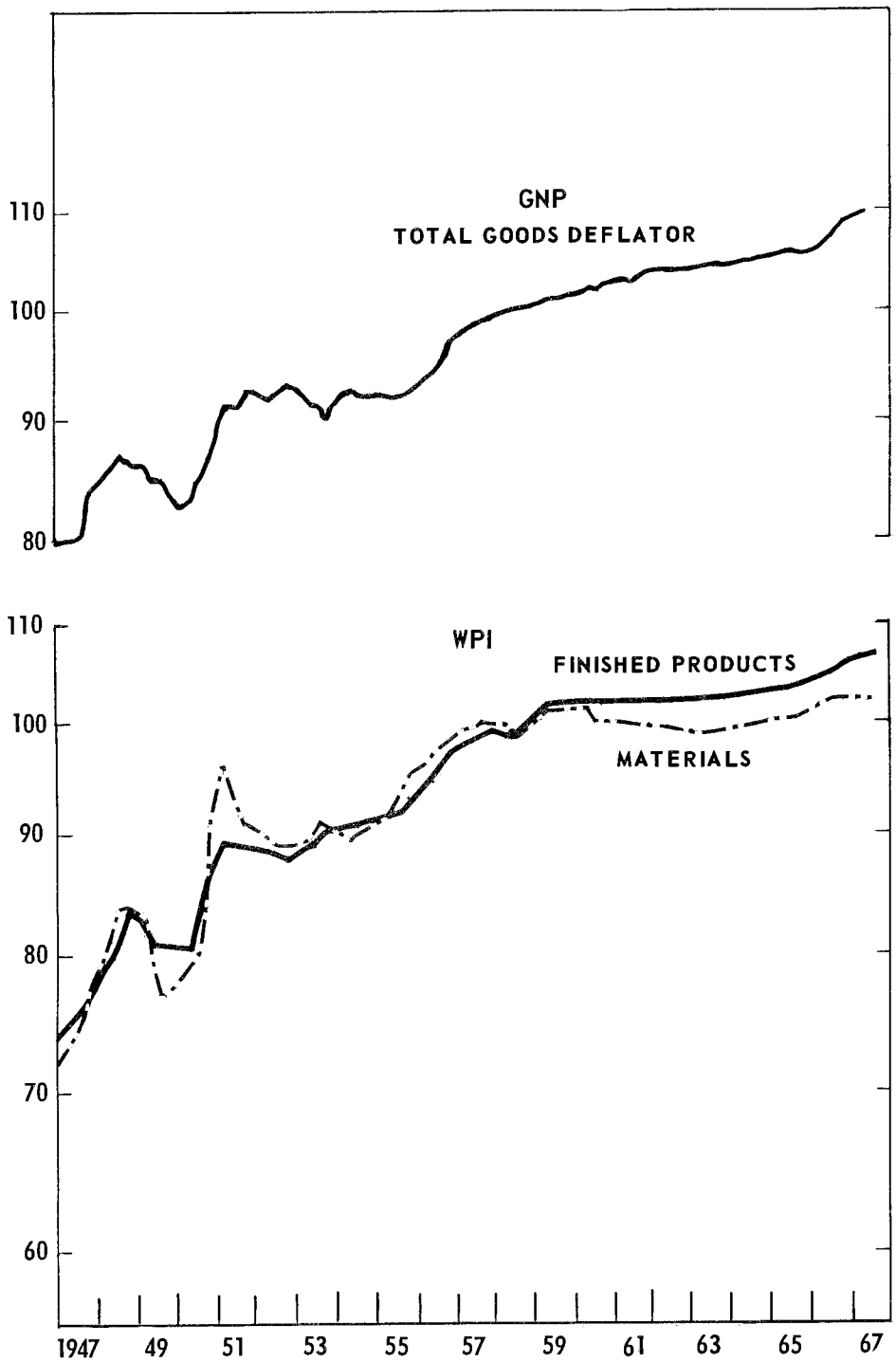
On an annual basis, with less lag than for benchmark periods, broad unpublished totals of inputs and gross outputs based on Census data are made available for special research. This does permit broad comparison of gross input costs per unit of gross output, but does not permit consistent comparison with the labor and capital costs per unit. This is because these latter costs in the

2. For footnotes to this and all subsequent charts, see notes at the end of this paper.

3. See Edward F. Denison, "The Sources of Economic Growth in the United States and the Alternatives Before Us," Committee for Economic Development, 1962, pp. 217 *et seq.*, for an interesting attempt to estimate productivity changes for different end-product expenditure categories such as durable goods, nondurable goods, and services. This was based on the assumption of identity throughout the economy of changes in the price of factor inputs. Fourastié, as Denison points out, employed similar assumptions.

CHART 1

PRICE INDEXES COMPARED, 1957–59 = 100



United States are independently derived from data on *income originating* in current dollars which differ importantly from the residual of Census data or gross inputs minus gross output.

Work has been done and is being further developed on input-output in real terms for selected periods. This work considerably extends the potential scope of analysis of changes in requirements for materials, labor and capital—and for price changes. Both value-added and gross output analysis can be done.[4]

This work permits a tying together of final demand prices with prices at intermediate levels. It also permits analysis of changes in the industrial distribution of output which result from changes in final demand and from changes in requirements for materials. Analyses by industry of changes in requirements for labor and capital are also made feasible.

But data are available only for selected periods, after quite long lags, and the statistical conventions adopted in input-output do not permit easy comparisons with existing measures of real output on an industry-by-industry basis.

In sum, current analysis of commodity detail—say quarterly or monthly—for both prices and production is not yet feasible in this double-deflation framework, and a consistent productivity analysis is still quite difficult—even for annual periods—if the influence of materials (as well as labor and capital) is to be taken into account in each industry.

Outside the national accounts, another major measure of output in constant prices is, of course, the Index of Industrial Production. Indexes of industrial production have been integrated within the structure of Gross Product Originating in a number of countries. In the United States, however, a somewhat separate development has occurred, although in a few respects some uniformity of definitions and classifications have been or are being developed which will be noted at a later point.

There has been a further detailing, extending and regrouping of indexes of industrial production over the years which has greatly improved analysis of commodity flows—particularly for intermediate products, but also for relations between final-product output and demand. But these indexes have not been organized in a framework consistent with totals for the economy as a whole nor have they easily lent themselves directly to a study of prices, costs, and productivity except perhaps for benchmark periods after very long lags. Moreover, for annual periods beyond the latest benchmark dates and monthly throughout, the use of assumed productivity factors for about half the total index has seriously limited its usefulness for measuring short-run changes in productivity.

The foregoing brief review of major measures of real output has noted the limitations of how far down the road of disaggregation and interrelated analyses one can go and still remain within the conceptual bounds of a particular measure.

They can, of course, be used more or less together with appropriate assumptions but practical difficulties stand in the way of their consistent use because

4. See for example, B. Vaccara and N. Simon, "Factors Affecting the Post-War Industrial Composition of Output," Conference on Research in Income and Wealth, National Bureau of Economic Research, December 1966. Also, J. Alterman, "A Framework for Analysis of Changing Industrial Composition of Industry and Product," same conference.

of differences at one or more points—particularly (though not confined to) the differences between the Index of Industrial Production and Gross Product Originating each covering the manufacturing sector.

Production, Price, and Productivity Comparisons for Manufacturing

This paper does not attempt to explore in detail differences between the Index of Industrial Production (IP) and Gross Product Originating (GPO).[5] Very briefly the differences in procedure between the two measures are:

1. IP combines gross output series with value-added weights while GPO generally uses double deflation;

2. IP excludes, GPO includes excise taxes; IP includes and GPO excludes purchased services;

3. For benchmark periods the implicit prices in IP generally are average unit values from the Census of Manufactures (value divided by quantities in the finest Census detail available), while for all periods, implicit prices in GPO are based on the Wholesale Price Index of the Bureau of Labor Statistics. It is this latter aspect which has, in this author's view, given rise to a significant, if not the most significant, source of difference between the two measures, and the effects of which are illustrated in this paper.

The effect of some of the disparities between IP and GPO on analysis of the relations between prices, output, and productivity industry by industry are illustrated in this paper by means of a series of scatter charts showing changes from 1954 to 1958 for 2-digit groups in Manufacturing. The data for IP are based on benchmarks developed in a joint project of the Census and Federal Reserve Board which are soon to be used in revising the Board's index. The data for GPO represent unpublished data for 2-digit groups made available by the Office of Business Economics. For more information on the nature of the "price," "production," and "productivity" data used in the charts, consult the footnotes shown at the end of the paper.

In each of the charts, lines have been drawn to indicate the average change in price, in production, and productivity over that time span. This has the advantage of (1) indicating differences in the average shown by IP and GPO; and (2) providing quadrants which distinguish four combinations of above and below average change in price and production or price and productivity.

As can be seen from the four panels of Chart 2, IP shows a higher average increase in output and productivity and lower increase in price than GPO in the 1954–58 period. A similar pattern of difference has characterized the whole period since 1947 although in recent years differences appear to have narrowed.

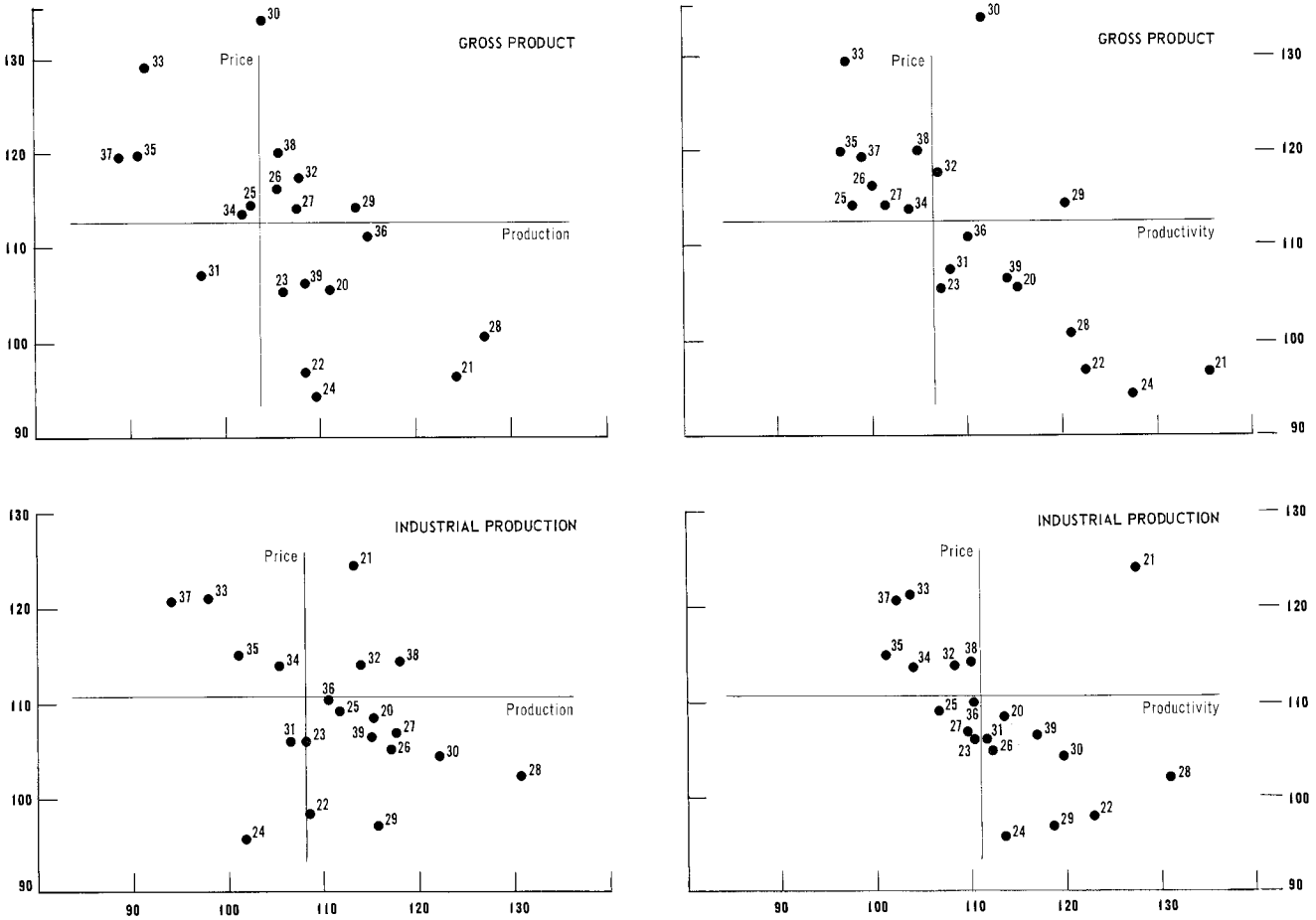
Before examining the detail in Chart 2, the significance of each quadrant in a given panel is noted, going counterclockwise.

5. See J. J. Gottsegen and R. C. Ziemer, "Comparison of Federal Reserve and OBE Measures of Real Manufacturing Output: 1947–64," Conference on Research in Income and Wealth, NBER, December 1966.

CHART 2

PRICES VERSUS PRODUCTION AND PRODUCTIVITY IN MANUFACTURING

Indexes Based on Gross Product and Industrial Production, 1958, 1954 = 100



NOTE: "Price" represented by deflator in case of Gross Product and Unit Values in case of Industrial Production.

Quadrant 1 includes the industries for which the aggregate price index and production index rose above the respective average index for all manufacturing industries. For example, in GPO panel, the price and production indexes for industry 32, Stone, clay, and glass, are shown up in quadrant 1 at about 4 points above the average, suggesting that relative prices rose under pressure of relatively strong demands.

Quadrant 2 includes the situations in which prices rose above and production below the average. For example, industry 33, Primary metals, is well above average in price but below in output. This inverse relationship for this major group, but evident particularly for the steel industry, raised important questions in the 1957–58 period, calling attention to the special market power of this industry which permitted it to pass on price increases in the face of sharply reduced demand.

Quadrant 3. Indexes in this quadrant signify below average increases in price and production, and in the panel for GPO only industry 31, Leather, is found there.

Quadrant 4. Price and production index coordinates in this quadrant are above average in output and below in price. A particularly outstanding instance is industry 28, Chemicals. For this industry, large increases in demand have been accompanied by above average increases in productivity (see right panel of Chart 2) which have apparently permitted only modest increases in prices—well below average.

It will be noted in comparing the GPO and IP price-production relationships that the general pattern of a negative correlation is shown. A negative correlation is generally obtained when observations fall mostly within quadrants 2 and 4. This finding is usually identified with the tendency for a Laspeyres index to show a higher increase relative to a Paasche index. Although both measures portray this familiar finding, there are a number of differences between the two with regard to particular industries. Notable instances of these differences are industry 30, Rubber, which is high up to the left in quadrant 1 for GPO and well down to the right in quadrant 4 in IP. Another very significant exception is in industry 29, Petroleum, which is found in quadrant 1 in the GPO and quadrant 4 in IP. Somewhat similar differences in quadrant position are to be found for industries 21, Tobacco; 24, Lumber; 25, Furniture; 26, Paper; and 27, Printing and Publishing. While one or two of these industries are not of serious consequence, a number of them are quite significant in size and impact on general prices. Also a preliminary check on relationships for another benchmark period (1958–63) indicates that significant differences persist for about the same number of industries but not necessarily the same ones as in 1954–58.

Differences in the several industry groups between the two measures obviously raise questions about the extent to which detailed analyses can be done by industry involving relationships between price, production and productivity. It is of some interest to examine these differences in the light of the right-hand panels in Chart 2 showing the relations between prices and productivity. For example, industry 30, Rubber, which is in quadrant 1 in the GPO measure, would imply that productivity gains might have been expected to be below average to permit

so high a relative price rise with but a modest increase in output compared to the average. Nevertheless, the productivity advance for the rubber industry is shown in the GPO measure to have been significantly above average. In the case of IP, the relatively high output and low price for this industry (quadrant 2 in lower left panel) is in line with the relatively high productivity advance (quadrant 2 lower right panel). While this procedure does not provide a basis for a decisive test of which measure is right, it is a useful one to employ if time and resources permit.

An adequate explanation of this disparity would involve examination of the data and conceptual differences between IP and GPO, including the fact that the GPO price measure (the implicit deflator) is net of material costs while the IP price measure (Census unit values) is gross of these costs.

In the case of Petroleum refining—for GPO—coordinates for price and productivity and price and production are both found in quadrant 1. In the case of IP, both are found in quadrant 4. In one case (IP) the industry is shown to have passed on productivity gains in the form of a relative and absolute price decrease; in the other (GPO) productivity gains have been accompanied by an absolute and relative increase in price. These are quite different appraisals of price behavior for this key industry but the conceptual differences between the two measures are probably crucial in "explaining" this disparity. In GPO, the higher price advance shown reflects almost entirely an increase in excise tax rates, while excises are excluded from IP. This is an interesting instance of choice between a factor cost and market price measure. Did prices rise in this industry, above average, solely because of the rise in excise tax rates? Does the statistical exclusion of excise tax rates reveal the price change that would have occurred without the increase in those rates?

Which price is the proper one for comparison with productivity? The answers are not easy but it is clear that an assessment of an industry's price behavior sometimes cannot ignore the effect of excise taxes and probably both types of measure are needed if the productivity and price comparison is to be made with and without excise taxes. It can be argued that excise taxes should be included in the gross measure—i.e., IP (where it is not) and excluded from the value-added measure—GPO (where it is)!

The left panels in Chart 2 relating price and production changes suggest less scatter in the IP measures than for GPO. But the seemingly better "fit" in IP can be illusory, and in itself implies little as to relative accuracy of the production-price relationships. This is because the unit value data and production data in the IP calculations have a "built-in" negative correlation which may or may not be present to the same degree in the GPO data. The unit value data, current value, and quantity data in the Census of Manufactures on which the IP indexes are largely based are interdependent.[6] In the GPO data the price data are independent of the value data. In the Census calculations, overstatements or understatements in quantities lead inversely to corresponding under and over-statements in prices and vice versa. The extent to which errors exist in the

6. See *U.S. Census of Manufactures*, 1954, Volume IV, *Indexes of Production*, Technical Note by F. DeLeeuw, pp. 24–26.

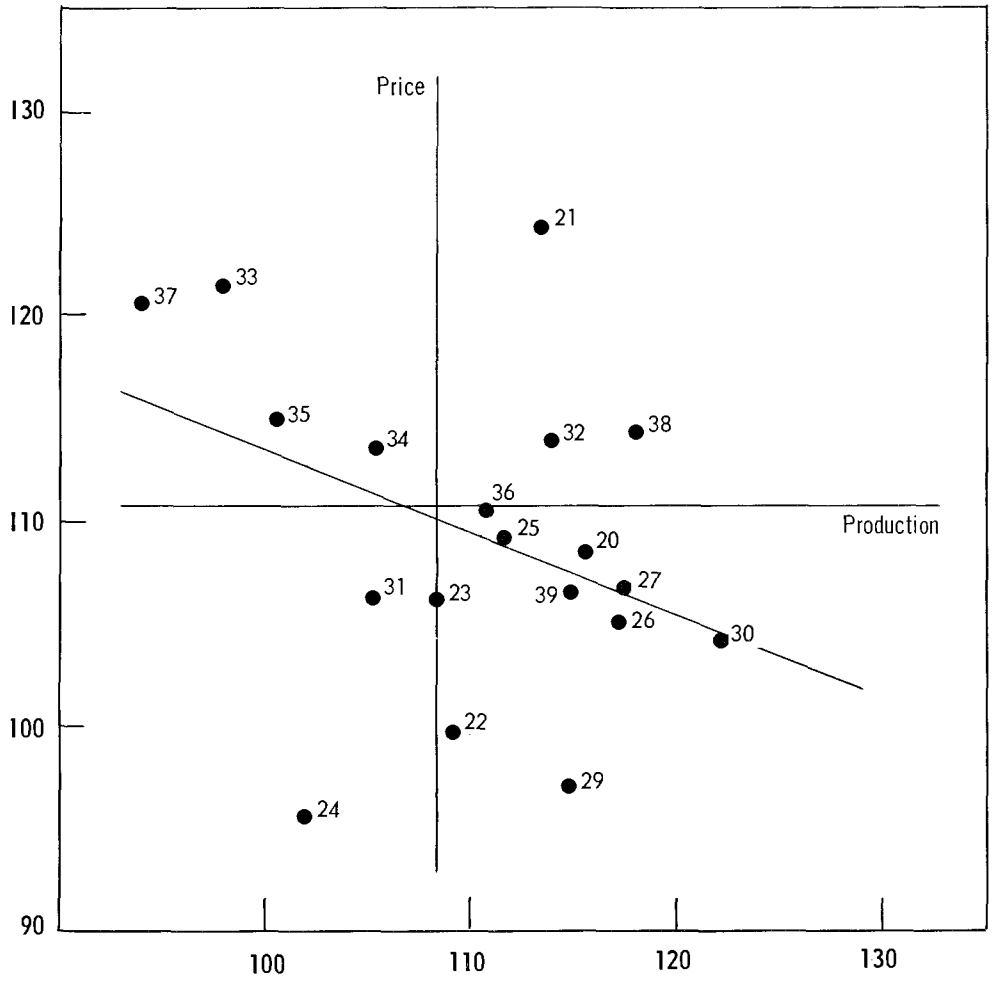
quantity or price data reinforces a negative correlation. To the extent that these errors are frequent, a "better" negative correlation may be indicative of presence of greater error. Of course the "better fit," on the other hand, does not necessarily imply greater error.

This problem is worth pursuing further since it bears on analysis of demand-cost relationships for one of the most controversial periods of price change since World War II in the United States. It will be recalled that there was considerable debate about the nature of the inflation from 1955 to 1957–58 in the United States when prices continued to rise during a period of diminished utilization of capacity.

Charts 3 and 4 compare price and production relationships with prices based mainly on the Wholesale Price Index in Chart 4 and prices based generally on Census unit value in Chart 3—but with IP as the measure of output in both charts. As before, the indexes measure the change from 1954 to 1958. Note the

CHART 3

PRICES (BASED ON UNIT VALUES) VERSUS INDUSTRIAL PRODUCTION



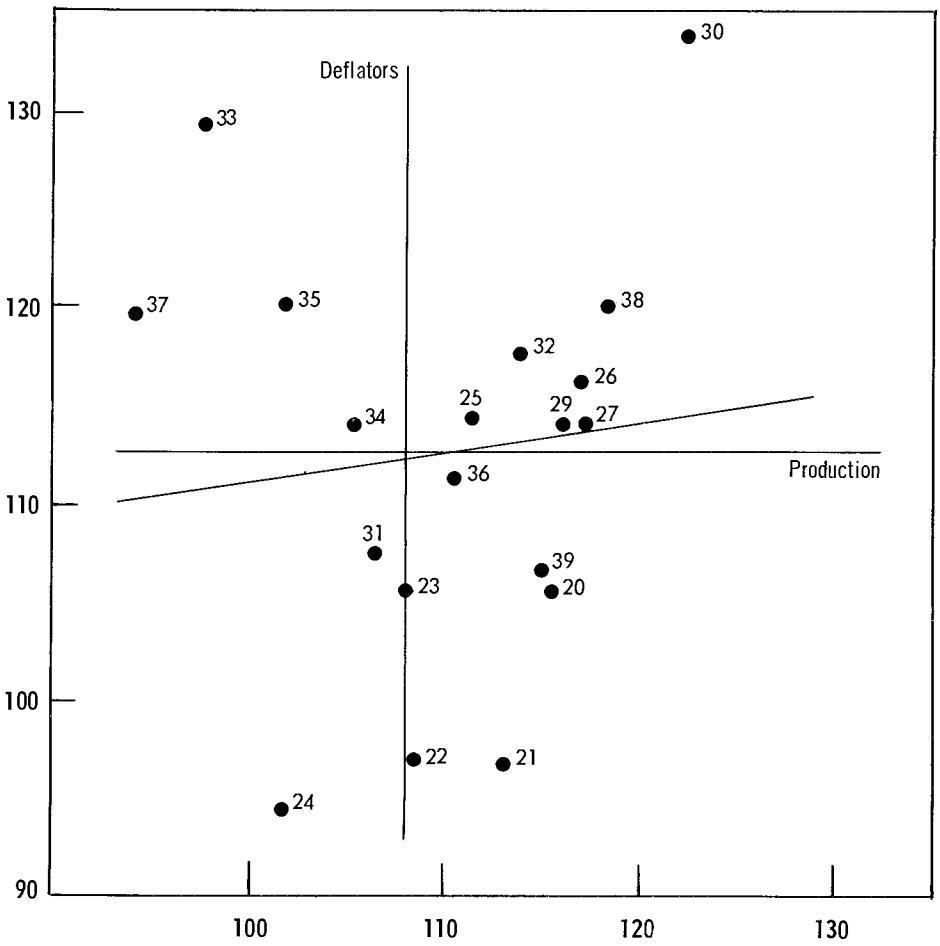
negative slope in the scatter chart based on unit values (Chart 3) and a slightly positive one in the next chart based on wholesale prices. This suggests that differences between the Wholesale Price Index and unit values (at least for the 1954–58 period) are neither random nor uniform industry by industry.

If the Wholesale Price Index differed either randomly from the unit value data or uniformly, industry by industry, then the two scatter charts (3 and 4) would have *both* shown a negative slope. The different slopes seem to suggest that differences between the Wholesale Price Index and unit values in the 1954–58 period are positively related to IP changes. That is, the industries with higher than average increases in IP had larger Wholesale Price Index increases (on which the GPO deflator is based) relative to the unit value increases.

In studies made of *part* of the period under review here, namely the 1955–58 period, a *positive* correlation was found between price and production changes,

CHART 4

DEFLATORS (BASED ON WPI) VERSUS INDUSTRIAL PRODUCTION



based on a matching of indexes of IP with wholesale prices.[7] For that period no other prices could be used in conjunction with IP since unit value data on a comprehensive basis are available only for census years such as 1954 and 1958. It is possible that the relatively short period tended to emphasize demand or cyclical influences and hence produced a positive correlation. It is also possible, however, that for the same period the use of unit values instead of wholesale prices might have produced a negative correlation suggesting quite a different interplay of forces underlying the change in prices and also a different set of policy requirements.

By way of summary of the above considerations about differences in price data, it is of interest to compare directly the implied prices in the IP calculations with those in GPO.

As Chart 5 shows, the GPO deflator tends to have many more industries with price increases greater than shown by the price increases implied in the IP Index. One might have expected the reverse to be true. This is because it is generally believed that, as a result of product-mix changes, unit value data, on which the Industrial Production Index depends, show larger increases than detailed specification prices characteristic of the Wholesale Price Index on which GPO depends. On the other hand changes in mix can reflect relative increases in output of smaller sizes or less expensive grades of commodities, and such shifts are often not distinguishable in Census unit value data.

The choice between the two sources of price change is by no means clear. The unit value data probably reflect transactions prices more than do the wholesale price indexes and therefore are not as rigid as the list prices. The coverage of quantity and unit value data in the Census is substantially larger than the Wholesale Price Index and in many cases the Wholesale Price Index is not applicable to the value data to be deflated. This often requires recourse to the Census quantity and unit value data. In some areas both sources of price data are completely inadequate as in the case of military goods, and are seriously lacking as in the case of heavy equipment. It will be recalled, on the other hand, that because of the interdependence of error which may affect the use of associated unit value and quantity data, there is some preference for using price information independent of the Census value data, such as the wholesale price indexes.

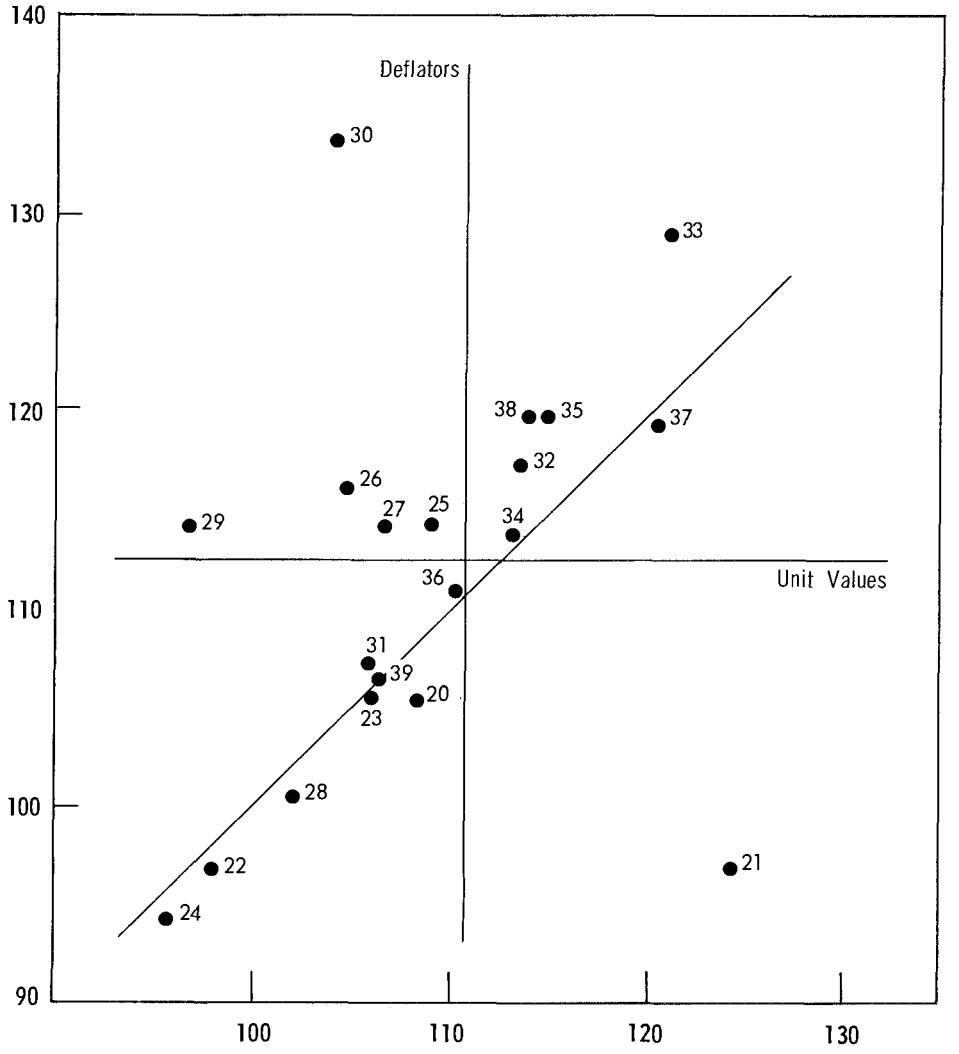
Conclusions

This paper has emphasized two aspects of measurement and analysis of real output. One concerns problems in real output measures *per se*, and the other the related price data. Regarding real output measures, the important point stressed is that the development of the national accounts in constant prices, while considerably extending the scope and detail of analysis of productivity, prices, and costs, has had to neglect intermediate product in the expenditure framework

7. Richard T. Selden, "Cost-Push Versus Demand-Pull Inflation, 1955–57," *Journal of Political Economy*, February 1959, p. 12; Charles L. Schultze, "Recent Inflation in the United States," Joint Economic Committee, Study Paper 1, Washington, 1959, pp. 73–75 and pp. 110–113.

CHART 5

DEFLATORS (BASED ON WPI) VERSUS UNIT VALUE



and has tended to neglect commodity detail—both intermediate and finished—in the industry framework. At the same time the IP, which provides considerable commodity detail—both intermediate and finished—is not easily adaptable to a broadened framework of analysis of prices, productivity, and costs.

In connection with price information, the paper stressed the need to analyze prices and output together as much as feasible. This is important not only because the algebra of deflation requires the joint consideration of prices and quantities, but also because the separation of demand and cost influences should be done within a consistent framework of detailed comparisons between prices and quantities. It makes considerable difference whether increasing or decreasing prices accompany rising or falling outputs in determining the interplay of

demands, costs, and productivity. At the same time this puts considerable premium on the need for accurate, consistent but independently derived price and quantity indexes. Both the present wholesale price indexes and the unit value data do not seem up to the task.

By way of conclusion on the two aspects considered in this paper, recommendations for improvement of price information and for strengthening the relationship between Indexes of Industrial Production and Gross Product are briefly noted.

Prices. Some perspective on needed improvements in the price area may be provided by brief reference to the recommendations of the Government Price Statistics Committee in connection with the Wholesale Price Index which is most relevant here.[8]

It will be recalled that the committee recommended two things with regard to the Wholesale Price Index: (1) the structure of the overall index should be revised to reflect the prices of a condensed input-output table for the commodity producing industries; (2) individual product prices should, where feasible, be collected from buyers (not from sellers as at present) to get more accurate information on actual transactions prices.

Both of these recommendations are in the direction of strengthening consistency between price and quantity information, and some work is proceeding toward their implementation.

Work has been underway in connection with the construction of input-output tables in constant prices, as has been noted above. This provides the basic structure of deflators for gross outputs, inputs, and value added. While useful for the study of technical change and costs on a long-run basis, however, this framework cannot provide the basis for systematic analysis of prices on any current basis in the foreseeable future.

In connection with the work on transactions prices, the National Bureau of Economic Research is presently undertaking such a study and all students await the results with much interest.

It might also be mentioned that there has been underway an effort to develop sector price indexes—or industry indexes classified according to the Standard Industrial Classification. This work has been done in good part in connection with the development of deflators for inputs, gross outputs and value added for Real Product Originating by industry, and is of help in work on the input-output matrices in constant prices mentioned above. It is also being done somewhat independently on the basis of gross output weights. So far indexes are available for relatively few industries.

In addition to these efforts, however, more will need to be done to meet the requirements suggested in this paper. More attention will probably need to be paid to the integration of quantity and price information, and probably at the micro level.

8. See p. 21, "Government Price Statistics, Hearings before the Subcommittee on Economic Statistics of the Joint Economic Committee, 87th Congress, 1st Session, Part I, January 24, 1961."

This means that the data collection process be given more study. It is suggested that consideration be given to the feasibility of collecting price data at benchmark intervals in conjunction with our Censuses. This will permit the introduction for the first time, at least in the United States, of the means for benchmarking time series movements of price data. It is also suggested that the price data be sampled to represent the changes in the value aggregates but ought not to be derived by dividing Census values by Census quantities. In other words, the price data should be consistent with, but independently derived from, the quantity data.

It is hoped that one important consequence of the sessions on deflation in this conference will be to provide pressure to improve the *collection* of price data.

Production. The task of strengthening relationships between IP and GPO should provide the opportunity to enable presentation and analysis of real output to reap the advantages of both the overall conceptual consistency of the national accounts with the rich amount of commodity detail on a current basis available within the IP framework.

Work is going forward to resolve differences between the two measures mainly for benchmark years. The weights, for example, are being made more similar because industrial production indexes will be eliminating from value-added weights business services presently included. More fundamental steps are needed, however, short of a complete absorption of production indexes within the Gross Product framework.

The following steps are recommended:

1. For industrial production

(*a*) To develop gross output indexes, monthly, not as though they were indicators of value added but gross indexes in their own right, combined with gross weights and showing all relevant and useful commodity detail in market and other useful groupings. This would permit analysis on a current basis of the flow of materials and finished products through channels of output and distribution,[9] as well as a matching with price data which are also calculated on a gross basis. Availability of data in current and constant dollars would be helpful. Eventually it would be expected that at benchmark intervals these gross output indexes would be made identical with their counterparts calculated for measures of GPO. At monthly intervals the reliance on man-hour data should be minimized so that changes in productivity could be inferred rather than assumed.

(*b*) The indexes with value-added weights customarily shown for IP would also be calculated but at more aggregate levels, say total manufacturing and its major groups. Detailed product data while useful as "indicators" for the industry aggregates are not too meaningful for current analysis of value-added aggregates. Eventually the value-added aggregates would be expected to agree at benchmark and annual levels with their counterparts

9. For description of work in this connection, see Gehman and Motheral, "Measures of Industrial Production and Final Demand," Conference on Research in Income and Wealth, NBER, December 1966.

in GPO and constitute the series for quarterly or monthly movements between and beyond benchmark and annual levels.

2. For GPO measures, two steps also are recommended:

(*a*) To work toward a reconciliation, with the cooperation of the Census Bureau, of Census data on value added with GPO figures based mainly on tax return data on profits, and on other sources for employee compensation.

(*b*) To work toward use of more accurate price data with the cooperation of all pertinent parties using improved wholesale price indexes and selected use of unit value data for deflation of inputs and outputs. This will also probably involve even more selective use of double deflation than now employed where errors are likely to be sizeable, particularly where reliable input data are so difficult to obtain.

(*c*) In looking toward the further extension of these measures, to publish as much annual or benchmark detail as possible on inputs and outputs in current and constant dollars so that the full implications of double deflation calculations may be made available for analysis (e.g., influence of materials costs on productivity and prices) and tests of reasonableness.

The foregoing recommendations on prices and production are not intended to eliminate all flaws but they do constitute major steps.

L'étude des relations entre production, facteurs, prix, et demande finale aux Etats-Unis peut être ameliorée: (1) par l'élimination des disparités dans les mesures officielles de la production (surtout, pour ce qui est de l'indice de la production industrielle et le produit réel national brut), et (2) par un accord sur le cadre conceptuel pour l'étude de ces relations.

Le produit réel brut s'est avéré être un point de départ solide pour l'étude de la productivité et des prix de l'économie dans son ensemble et de larges groupes industriels. Cependant, son usage est malaisé dès que l'on veut analyser en détail chaque bien et surtout, les biens intermédiaires. D'autre part, la production industrielle a considérablement élargi l'analyse détaillée de la production des biens, mais n'a pas été en mesure de fournir une base pour une analyse systématique de la productivité et des prix dans le sein d'un cadre cohérent pour toute l'économie.

Cet article donne quelques exemples de l'effet de certaines disparités entre la production industrielle et le produit brut dans l'industrie sur l'analyse des relations entre prix et productions, et entre prix et productivités. Cela, pour les années 1954–58, période pour laquelle on dispose de repères pour les deux mesures. Des incohérences pour beaucoup d'industries sont à la source de difficultés pour analyser l'influence sur les changements de prix de l'interaction entre demande et coûts. Par exemple, les industries qui, dans une des mesures, ont leur production au-dessus et leurs prix en-dessous de la moyenne, occupent une situation differente du point de vue de l'autre mesure.

En conclusion, l'auteur recommande que l'on améliore les données et les concepts afin d'éliminer certaines disparités et de permettre a l'analyste d'utiliser les deux types de mesures de la production réelle.

CHART 1

Total Goods Deflator—based on final sales of goods plus inventory change. Services and structures are not included.

Indexes for finished products and materials are special groupings of industrial commodities prepared by the Federal Reserve Board from the official Wholesale Price Indexes.

CHART 2

Gross Product Panels

(1) Upper left—Price axis refers to Gross Product Originating deflators for each major industry group in manufacturing (see below for identification of industries). Deflators based on deflation with wholesale price indexes of gross output minus gross input (value added in constant prices obtained by double deflation) and then divided into value added in current prices. Production axis refers to Real Gross Product by manufacturing industry. Source of data—Office of Business Economics, U.S. Department of Commerce. *All figures in this and following charts are indexes for 1958, 1954 = 100.*

(2) Upper right—Price axis same as above. Productivity axis represents change in Gross Product Originating in each manufacturing industry group divided by change in man-hours for total employees in those groups.

Industrial Production Panels

(1) Lower left—Price axis represents Census unit value added data for each major industry group (1954 weights). Production axis represents benchmark indexes of industrial production based on detailed Census quantity data weighted with 1958 value added weights calculated at the 5-digit commodity level.

(2) Lower right—Price axis as above. Productivity axis represents changes in industrial production in each manufacturing industry group divided by changes in man-hours for total employees in those groups.

IDENTIFICATION OF INDUSTRY GROUPS FOR CHARTS 2, 3, 4 AND 5

USIC	Industry	USIC	Industry
20	Food	30	Rubber and plastics
21	Tobacco	31	Leather
22	Textiles	32	Stone, clay and glass
23	Apparel	33	Primary metals
24	Lumber	34	Fabricated metals
25	Furniture	35	Nonelectrical machinery
26	Paper	36	Electrical machinery
27	Printing and publishing	37	Transportation equipment
28	Chemicals	38	Instruments
29	Petroleum	39	Miscellaneous

CHART 3

Price and production same as in lower panels of Chart 2. Regression equation for price (P) on production (Q) is $P = 146.4 - .337Q$.

CHART 4

Deflators are same as those in Chart 2 for Gross Product. Industrial Production same as "Production" in Chart 2. Regression equation for deflator (P′) on production (Q) is $P' = 102.9 + .087Q$.

Note: Group 28, Chemicals, has been excluded from Charts 3 and 4 to simplify the showing of the difference in slope. If 28 had been included the essential difference would have remained, i.e., in Chart 3 the slope would have been even more negative than shown while in Chart 4 instead of a positive slope, the slope would have been approximately horizontal.

CHART 5

Deflators as in previous charts for Gross Product. Unit values as in previous charts for Industrial Production. Line sloping from lower left to upper right is drawn as 45° angle representing the locus of points at which deflators would be identical with unit values. This line does not of course pass through the intersection of axes shown since the average deflator index is not equal to the average unit value index.