PRICES AND PRICE ANALYSIS IN THE FRAMEWORK OF THE NATIONAL ACCOUNTS

BY JACK ALTERMAN AND MARTIN L. MARIMONT*

Bureau of Labor Statistics and Office of Business Economics

The paper discusses the role of prices in the framework of the new System of National Accounts (SNA) in terms of three major uses: (1) deflation, (2) price indicators, and (3) price analysis. Following a brief review of the price and quantity measures required by the new SNA with its emphasis on deflation of commodity flows and input-output accounts, in addition to the more conventional deflation of final demand categories, the paper discusses some of the conceptual, methodological and data problems involved in implementing the various uses of prices in the new SNA.

Implementing the use of prices as deflators depends, in part, on the concept of output selected (national versus domestic; gross versus net), and which of six concepts of valuation, ranging from purchasers' value to true factor cost, is used. Some of the difficulties in deflating nonmarket flows (e.g., interplant transfers) and industry value added, based on the double deflation method, are discussed.

In concept price deflators, which have shifting weights, cannot be used as price indicators, which should have fixed weights. In practice, this is often disregarded and the deflators are used as price indicators. The paper support the SNA recommendation for the development of price indexes with fixed weights to be used as price indicators, in addition to the implicit price deflators. Research in the United States indicates that differences in weights can result in different price measures for various subperiods, components of demand and sector output.

Periodic revisions in weights to provide more current fixed weights for price and quantity indexes in each subperiod may minimize the problem but it introduces a new problem—lack of comparability with the constant price tables in the SNA which have fixed weights for the entire period.

The new SNA provides a comprehensive and integrated framework for price analysis including the analysis of the structure of aggregate price changes, the industrial origin of final demand prices, and the impact of price change in one sector of the economy on the rest of the economy. Some major gaps which need to be overcome in order to implement the use of the new SNA for price analysis include the development of industry capital stock estimates, separate estimates of proprietors' income, reconciliation of value added and distribution share estimates, and the development of a wide variety of information to supplement the conventional input-output tables in the SNA.

Implementing the various objectives of price measures within the framework of the accounts will require a number of improvements in existing price measures and expanding the scope of coverage. "List" prices should be superseded by "transactions" prices and better techniques and data need to be developed to provide for quality adjustment of prices. Coverage will need to be expanded to include services, freight rates, trade margins, government expenditures, and also fill in gaps for many manufactured products. Finally, where possible, use of unit values as price indexes or deflators, e.g., imports and exports, should be replaced by direct price measures.

*Jack Alterman, Director, Economic Growth Studies, Bureau of Labor Statistics, U.S. Department of Labor. Martin L. Marimont, Chief, National Economics Division, Office of Business Economics, U.S. Department of Commerce. The authors take full responsibility for the views expressed in this paper, which are not necessarily those of the Government agencies at which they are employed. This paper was given at the Eleventh General Conference of the International Association for Research in Income and Wealth, August 24–31, 1969, Nathanya, Israel.

Although this is a joint paper, Mr. Marimont had primary responsibility for the first two sections; Mr. Alterman, the last three.

Introduction

A distinguishing feature of the new U.N. System of National Accounts (SNA)[1] published earlier this year is the inclusion, for the first time, of a system of quantity measures and their associated implicit price deflators. The quantity and price measures envisaged in the new SNA, with its major emphasis on commodity flows and input-output accounts, go considerably beyond the information in these areas developed by even the most statistically advanced nations. This session of the 11th Conference of the International Association for Research in Income and Wealth, on "The Role of Prices in the National Accounting Framework" provides an opportunity to evaluate the expanded role of prices in the New SNA and to discuss some of the problem sinvolved in developing the price system.

Implementing the price aspects of the SNA will require major improvements in price statistics. But such improvements, as Mr. Simon Goldberg has pointed out in his statement on the objectives of this session of the conference, must go beyond the "direct requirements of the national account system for deflation purposes. It must also take into account the need for studying movements in prices in juxtaposition with those of incomes, values of output and input, and, to the extent possible, physical quantities. Information that throws light on the sources of price change, and the relationship between changes in prices, costs, incomes, and productivity would greatly help in the study of the inflationary process and economic growth among other things."

In keeping with this broad view of the role of prices in the framework of the national accounts, the present paper discusses three major uses of such a system—deflation, price indicators, and price analysis. The major emphasis of the paper is on some of the conceptual and methodological problems involved in implementing the various uses, and their implications for price and related data requirements. This includes an evaluation of the interrelationships among the objectives, and the extent to which they may imply somewhat different concepts and data requirements. Development of a multi-purpose price system within a consistent and integrated national accounts framework may require more than one set of price measures and involve either modification or further elaboration of some of the elements in the SNA.

In order to provide the basis for such an evaluation, the paper starts with a summary description of the price measures called for in the new SNA. The next three sections discuss some of the problems involved in meeting the various objectives—deflation, indicators, analysis—of a system of prices within the framework of the accounts. The paper concludes with a discussion of some of the implications of the new SNA for price programs, including improvements to meet a variety of needs in addition to deflation of the accounts.

Price Deflators in the New SNA

Price measures have an important role in the SNA in which they are used primarily to transform values in current prices into values in constant prices. The

[1] *A System of National Accounts*, Studies in Methods, Series F, No. 2, Rev. 3, Department of Economic and Social Affairs, Statistical Office of the United Nations, United Nations, New York, 1968.

fact that the purpose of the price measures is to deflate the current price values has a significant effect on the form that these price measures take. Furthermore, the form required to suit these purposes will not be appropriate for other types of price analysis, and to meet such needs, the basic deflators must be modified. The modification would be achieved largely by applying different weighting schemes to arrive at desired aggregations and, in some cases, by developing additional price measures.

Scope of Constant Price Values

Within the new SNA, price deflators are used to derive constant price value of production, expenditures, and gross capital formation. Although perhaps desirable, the SNA does not require deflation of the accounts which are concerned with the various forms of income nor of the capital finance accounts. This limitation of the scope of the deflated values, reflecting the current practice of many nations, is due to the problems in developing an appropriate and operational concept of price or quantity for most of the components of income and capital finance flows.[2]

In addition to limiting the scope of the data to be expressed in constant values, the SNA also adopts a single concept of the deflated series. Constant values in the SNA are based on the decomposition of the current value into its price and quantity elements. An alternative basis would be to measure the power of the current value to purchase a specified collection of goods. This, however, is not recommended for the SNA supporting tables.

Accounting Framework of the Value Flows

Among the most noteworthy innovations introduced in the new SNA is the statistical and conceptual integration of the income and production accounts with the input-output accounts. This integration has been accomplished by disaggregating the production accounts to show both the output (or supply) and the consumption of commodities. The supply information has been expanded in a matrix to show the value of broad classes of commodities produced in each industry. Correspondingly, the consumption matrix provides measures of value of the commodities consumed by each of the producing industries and by the final consumers. Within each matrix the sum of the row generally is not equal to the sum of the corresponding column.

These separate supply and consumption matrices of outputs and inputs are to be distinguished from an input-output table. In the commonly accepted form of an input-output table each row represents the value of the output of a commodity (or industry) distributed to its intermediate and final users. The column for that same commodity or industry shows its consumption of the output of commodities (or industries) and also its value-added. The column sum of inputs, including value-added, is equal to the row sum of output.

This kind of input-output table, where the column and row totals are equal,

[2]As an aside, it should be noted that these difficulties are not uniquely those of the income and finance data. Such difficulties also occur in some parts of the production and expenditure series.

can not be assembled directly from the data derived from industry records. The difficulty arises because, in the real world, an industry produces not only the commodities which are primary to, or characteristic of, this industry; it also produces commodities which are characteristic of other industries (secondary commodities). Industries can report how much of each commodity they produced, and they can report on the commodities they consumed. However, they usually can not report the commodity inputs separately for each commodity output. Consequently, it is not possible to measure directly how much one industry uses of another industry's output nor how much of a given commodity was used to make another commodity. However, the SNA describes various methods for estimating matrices which show the inputs of commodities into commodities and the inputs of industries into industries.

Supporting Tables

In the new SNA there are eight supporting tables which provide for values in constant prices. In addition there is one table which shows employment by industry. The eight supporting tables of values in constant prices cover a wide range of difficulty in preparation. They include series that have been regularly compiled by virtually all nations, as well as statistics which are published by some but would strain the statistical resources of many nations, even those with the advanced programs for the collection of data.

The first table contains the broad summary measures of the total gross domestic product. The total is disaggregated to show the traditional categories of the final markets—government, private consumption, inventories, fixed capital formation, exports, and imports. This table also includes a section for the implicit price deflators, total, and for each final market.

The second table is also concerned with gross domestic product. In this instance, however, the disaggregation is according to the kind of economic activity. The first grouping includes the industries, the second, government, and the third, nonprofit institutions serving households.

The third and fourth tables of values in constant prices call for measuring in constant prices the supply of detailed commodities and the disposition of these commodities by broad categories of intermediate and final use.[3] In addition, the gross output of each industry is shown, the value of each of the commodities consumed as intermediate inputs by each of these industries, the domestic factor income, the consumption of fixed capital, and the payment of indirect taxes. The deflated income component is presumably derived as a residual since no method is suggested for direct deflation. These tables represent a major extension of data requirements.

The next three tables are once more of the more traditional type in that they show the consumption expenditure by government, nonprofit institutions

[3]The U.S. input-output tables for 1947 and 1961 are available in 1958 prices as well as in the prices of the given year. See "Changes Over Time in Input-Output Coefficients for the United States," a paper presented by Beatrice N. Vaccara at the Fourth International Conference on Input-Output Techniques, Geneva, Switzerland, January 1968; and "Input-Output Transactions: 1961," Staff Working Paper in Economics and Statistics, No. 16. Office of Business Economics, U.S. Department of Commerce July 1968.

serving households, and households. For government and the institutions the expenditures are classified by purpose and whether they are final or intermediate. In the case of households the expenditures are by object and by type of good and service.

The last table covers gross domestic capital formation in constant prices. The fixed capital data are to be classified according to type of goods and also by type of economic activity of the owner. The increase in inventories is to be shown separately for each of the broad industry categories, where it is held, and by stage of fabrication.

There is also a table on employment (number employed and man-hours) classified by type of economic activity. These data may be considered a rough approximation of deflated labor inputs to be used in the measurement of productivity. With respect to capital inputs, however, the SNA does not provide for estimates of capital stock because of the special difficulties in compiling these measures.

The bases for classifying industries, commodities and expenditures for the constant value tables are explained in detail in the SNA. The proposed groupings are intended to meet the needs of widely differing national economies and at the same time maximize the opportunity for international comparisons. As a result, the SNA proposals will usually need to be modified to suit specific national requirements.

With respect to the frequency of compilation of the supporting tables, the SNA proposes that a desirable goal would be to compile each table on an annual basis. However, it recognizes that some of these tables could be very burdensome and therefore may be prepared less frequently. In this latter class are the tables showing the supply and disposition of commodities, the inputs into industries, and the detailed categories of consumption expenditures by government and nonprofit institutions. These tables, it is suggested, may be assembled every 3 to 5 years.

The SNA also notes that it would be useful to have quarterly data on gross domestic product by kind of economic activity, household expenditures by type and by object, and gross fixed capital formation by activity and by type. It is recognized that the quarterly information might be less detailed than in the comparable annual series.

While the SNA almost totally ignores indexes in its supporting tables, considerable attention is given them in the discussion of the system of data and concepts. The SNA provides (chapter 3) for a comprehensive set of index numbers of the flows in constant prices and of the prices themselves. Indexes are discussed for each of the categories of final demand; for production including gross output, intermediate consumption and value-added; and for the primary inputs of labor and capital.

The SNA proposes that the index numbers incorporate weights derived from the values for the most recent base period. New weights are to be calculated every 5 to 10 years. The indexes for the period between two consecutive bases would be Fisher indexes with weights derived from the values at the beginning and end of each period. Successive periods would be linked via the Fisher index.

Some Conceptual and Methodological Problems

The economic accounts underlying the deflated values of production, expenditures and capital formation establish a comprehensive system for price deflators. Developing price measures within such a national accounting framework offers many advantages for the collection, compilation and analysis of the deflators. Deflators of the value flows of detailed commodities and services measured in accordance with the accounts, will be comprehensive since the accounts are intended to cover all economic activity. In addition, with the inclusion of input-output, not only are the final markets covered but also the flows of goods and services among producers.

Furthermore, the deflators of the values will be systematic in that they will be consistently defined from commodity to commodity and as between all the transactors. Consequently, it will be possible to trace the effect of changes in one part of the economy on other parts—including those only remotely and indirectly connected. One can measure the impact of a price change in a specific final market on the total economy, of a change in a commodity price on that final market, and of a change in the price of an industry's input (intermediate or value-added) along the chain of consuming industries through to the final markets.

In addition, the accounting approach is of practical use to the statistician compiling price deflators. The accounting structure assists the statistician in preparing a complete shopping list of the deflators he will need—all transactors and all transactions are displayed in an organized manner. The shopping list promotes completeness, reduces duplication, reveals gaps, and assists in establishing priorities for compiling data.

Despite these advantages, there are important problems to be overcome. These problems arise with respect to the concepts used to define the measures in the national accounts and the methods used to calculate the statistics. The issues to be discussed here are associated with the alternative definitions of the scope of the production and the valuation base as provided in the SNA.

The precise meaning and analytical advantages of many of the alternatives have been explored in a broad and distinguished body of literature. The discussion which follows will touch only briefly on these matters and will be concerned primarily with the relationship between the particular concept and the problems of deflation.

National or Domestic Product

The decision as to whether product should be measured on a national or on a domestic basis is usually made according to the purpose of the analysis. Gross domestic product is appropriate for studying the factors of production within a nation and the volume of goods and services produced. Studies of the income of of the residents of a nation will focus on the "national" concept since it includes income received from abroad and excludes income paid-abroad.

From the viewpoint of price deflators, the national concept presents problems that do not appear in the domestic concept. In the national totals it is necessary to deflate directly the income payments (employee compensation and operating

surplus) which flow across boundaries. The construction of a suitable deflator is difficult because it is not possible to discern the price and quantity units that comprise these flows. Consequently, to deflate this component of the national totals requires resorting to arbitrary assumptions, including the use of an import deflator or other implicit deflators calculated from the accounts.

It should be noted that this issue does not present any additional difficulties in the deflation of an industry's output, input, or value-added. These measures are on a domestic basis since the adjustment to a national basis is made in total via a "rest of the world" category. This is also true for the expenditures of the final markets where the national/domestic adjustment is made separately.

The SNA provides for the separate deflation of imports and exports. It has been suggested elsewhere that it would be more appropriate to deflate directly the difference between imports and exports by a deflator which reflects the terms of trade. However, the SNA method is required in order to maintain the balanced system of deflated flows of output and input that is recommended.

Gross or Net Product

The volume of goods and services produced by a nation may be measured on either a gross or net basis. If measured on a gross basis, the production is before the adjustment for the capital goods which are used up in the course of the production. The net measure excludes the consumption of capital. There has been extensive discussion of the relative merits of the two concepts of output for various purposes. There is, however, general agreement that the gross total can be estimated more accurately, largely because of weaknesses in the available data on depreciation. These weaknesses are quite serious in current prices and are even more troublesome when converting to constant prices.

The figures on depreciation as reflected in the records of firms are questionable because there is no uniformity among firms in the valuation base of the capital stock, the service lives of capital, or the methods for measuring depreciation. In order to deflate even the available depreciation totals, information is also needed on the product composition of the capital stock, and the date of acquisition of the stock, in addition to the valuation base, service life and depreciation method.

Little of this information is usually available. However, it is possible to use the perpetual inventory method to construct a capital stock series. These series can by measured in historical prices, constant prices, and current prices. Then by using standard service lives and a uniform depreciation method, a consistent series of depreciation costs can be developed for each of these price bases.

Such estimates of stock and depreciation have been completed in the United States by the Office of Business Economics for the period since 1929.[4] These estimates have been prepared for special analytical uses and have not been incorporated in the accounts.

This OBE advance is a significant breakthrough which will serve many purposes in addition to help in measuring real net product for the business

[4]L. Grose, I. Rottenberg, R. Wasson. "New Estimates of Fixed Business Capital in the United States, 1929–65," Survey of Current Business, December 1966. Office of Business Economics, U.S. Department of Commerce.

sector as a whole. Nevertheless, even more is required before it is possible to obtain net product at the industry level. In order to apply the same methods on an industry basis, it is necessary to estimate capital stock by industry, which, in turn requires a capital flow table showing each industry's expenditures for each type of capital goods.[5] However, such data are not provided for in the new SNA.

While other papers for this conference dealt with the issue of deflators of plant and equipment, it is appropriate to mention briefly some of the outstanding problems. Capital equipment, more so than other goods, tend to be unique or "one-of-a-kind" product for which it is often very difficult to measure price indexes on a satisfactory basis. Further, there is the question as to whether capital in real terms should be adjusted to include quality increases which comprise its productivity. If the more productive machine costs no more to manufacture than the less productive, according to Denison,[6] the stock should not be increased. Others would include the increase in productivity as a further addition to the growth of the stock.

If the Denison view is accepted, this would have important consequences for price measurement since their price indexes would be adjusted for quality advances only if and to the extent that they involve an increase in the costs of production of the capital goods. No adjustments would be required for cost-free improvements. This principle is incorporated in the price collection programs in the United States. The actual practices may fall short of the principle since it may be difficult to measure accurately the additional costs of the improvement. Nevertheless, the U.S. system attempts to include such adjustments, whereas the cost-free improvements are not taken into account.

Valuation Base

Until the advent of the new SNA, the two major valuation bases for measuring output were market price and factor costs. Under the most widely accepted definitions, market price was equivalent to the price the purchaser paid for the commodity. The factor costs were market prices less the excess of indirect business taxes over subsidies. In general, the market price valuation was considered to be more suitable for studies oriented towards welfare principally because relative market prices were assumed to be useful approximations of relative utilities. Factor costs were considered appropriate in studies of resource allocation. In addition factor costs, by excluding the indirect business taxes and subsidies, made the output measure independent of the tax structure or of decisions affecting subsidies. For example, under the market price valuations, total output would increase more if demand shifted to goods with a heavy proportion of indirect business taxes in the base year, than if the shifts were to goods with relatively fewer such taxes. In a factor cost system the change in total output would not be influenced by such shifts.

With the introduction of the new SNA, the choice among valuation bases

[5]In the United States, the Bureau of Labor Statistics of the Department of Labor has prepared a capital flow matrix for 1958 which is consistent with the OBE input-output study for 1958. OBE has started work on a capital flow matrix for 1963, in cooperation with BLS.

[6]Denison, Edward F. "Theoretical Aspects of Quality Change, Capital Consumption, and Net Capital Formation," *Studies in Income and Wealth*, XIX (Princeton, 1957).

increased by adding graduations in value between the market and factor bases. The choice now includes: purchasers'; producers'; approximate basic; true basic; approximate factor; and true factor. The purchasers' values are identical to market values, that is, they both represent the delivered cost to the purchaser. Producers' values are the value at the boundary of the producing establishment, and therefore are less than purchasers' values by the cost to the buyer, of the trade and transportation margins. The approximate basic value of a commodity is the producers' value less the tax on that commodity. True basic values are producers' values which exclude both the commodity tax on the given commodity and such taxes on the goods consumed directly and indirectly in the production of the commodity. The approximate factor values are producers' values excluding the commodity tax and all other indirect taxes on the commodity. The true factor value is the approximate factor value excluding indirect taxes on the direct and indirect inputs to the commodity.

In the SNA supporting tables the consumption expenditures of each of the final markets are valued in purchasers' values. The gross domestic product originating in each industry are in producers' prices and approximate basic values. The supply and consumption of commodities are in approximate basic values only. Footnotes to the SNA tables for industry gross product suggest using true basic values and factor values (approximate or true) as alternative valuations for compiling these constant price series.

Prices in purchasers', producers' and approximate basic values can be observed in most transactions. Theoretically, purchasers' prices would be measured best by collecting information from that transactor. In the United States, however, little use, up to now, has been made of this source of price data.

The Consumer Price Index (CPI) which measures changes in prices at purchasers' values, is based on information collected from the selling establishment. There is at present no program in the U.S. for collecting prices in producers' values. The data collected for use in the Wholesale Price Index (WPI) compiled by the U.S. Bureau of Labor Statistics are actually data at approximate basic values. It is possible, nevertheless, to modify these indexes to reflect changes in producer prices by incorporating changes in the tax rate on the commodities with the WPI. This has been done in the U.S. to deflate the input-output flows and industry gross product. This adjustment for taxes is more difficult if commodity taxes are imposed by local governments as well as by the central government. The collection of tax rate information from a large number of jurisdictions can be costly.

As has been noted, converting commodity flows from purchasers' value to one based on producers' value, highlights the fact that a single transaction may be disaggregated into three separate elements: the value of the commodity itself; the contribution of the trade industry in the form of trade margins; and the contribution of the transportation industry in the form of transportation costs. Under these circumstances, to deflate these separate flows requires the corresponding three price indexes. The first to deflate the producers' value of the commodity, the second to deflate trade margins, and the third to deflate transportation costs. The first and third prices are observable and subject to measurement, within the context of the usual pricing difficulties. The price for

trade margins, however, is not directly observable and, therefore, is more difficult to measure.

First, let us consider some of the ways in which the deflated trade margin for a commodity and the implicit deflator might be estimated. The conceptually correct method is to use a form of double deflation for retail sales. That is, the cost of the goods sold and the gross receipts from the sale of these goods would both be converted to constant prices. The excess of deflated sales over deflated cost of goods would represent deflated gross margin. An implicit deflator for retail margins could be calculated by taking the ratio of margin in current prices to the margin in constant prices. To yield the correct results, the deflator of the value of sales must take into account not only changes in the quality of the commodity but also changes in the quantity and quality of trade service attached to the commodity.

However, the data required for the conceptually correct method are not usually available. One method for approximating the value of real trade margins in the current period is to assume that the change since the base period is proportional to the change in the deflated value of commodities sold. In other words, to assume that real margins per unit of the commodity remain constant over time. This is the same result that would be achieved if the retail sales deflator used in the conceptually correct method did not reflect changes in the quantity or quality of trade service. Clearly, unit real margins may change because the establishment may increase or decrease the amount or quality of service provided or because of a shift among types of retail establishment (from small grocer to large supermarket). Under this procedure changes in unit real margins would appear as changes in the implicit deflator.

Other questions appear when output and consumption are measured in producers' values and the single transaction is revealed to contain the three components. These questions usually arise with respect to transportation, although they also apply to trade margins. Consider the consumer who buys a pound of apples in each of two years. In the second year, the apples must be transported from a more distant source than in the first year, and the consumer pays more for the pound of apples for that reason. The price of apples can be viewed as having increased, and the transportation is an intermediate cost which is netted out of final sales. Therefore deflated consumer expenditures are the same in the two periods. Another view is that the consumer is buying a composite of apples and transportation. The price of apples has not changed, nor has the price of transportation. Rather, the consumer is buying the same number of apples and more transportation. Therefore, the composite price index would show no change, and deflated consumer expenditures would increase. This is the result that would be considered correct for measuring gross domestic product.

The impact of these two views can also be examined in terms of the industrial origin of gross product. For this examination it is assumed that the full double deflation method can be applied. In the first case, total retail sales (or total output) would be the same in both periods but intermediate purchases of transportation would increase. Therefore, gross domestic output (sales less intermediate purchases) would be less in the second period. Total transportation output and also gross product would be higher in the second period. Consequently, while

the output for the economy remained the same, relatively more originated in the transportation industry in the later period.

In the second case, where output for the economy rises, total retail sales in constant values would have increased, with a corresponding increase in the purchase of transportation. Real gross product in retail trade would therefore be unchanged. However, transportation gross product would have increased, thus accounting for the gain in output for the economy as a whole.

It would appear that if the transactions data are shown in purchasers' values it would be easier to collect price indexes for apples that do not account for the increased volume of transportation. That is, the price index would be based on the concept that the consumer buys apples and the volume of embedded transportation is not relevant to the measurement of real consumer expenditures. On the other hand, if the expenditures are measured in producers' values, this would separate the components to be deflated and establish explicitly the kinds of price indexes that would be needed.

The issue of the transportation and trade components of commodity is typically raised with respect to goods. However, this problem is present even among services where margins do not apply.[7] For example, consider the cost of a doctor's visit. We are all familiar with the pattern of families moving from apartments in the cities to one-family homes in the suburbs. This scattering of the population over wide areas probably increases the doctors' costs as he travels among his patients. It is reasonable to expect that the added costs result in increases in the doctor's fees. In this case (unlike the apples) there is no transportation margin that can be deflated separately. It is probable that the increased transportation costs would appear as a price increase rather than as a quantity increase. But, is this correct? Is the consumer buying a composite of doctors' services and transportation, thus paralleling the apple example?

One might also wish to consider whether the only valid decomposition of the transaction is the one of goods-trade-transportation. What if the price of apples goes up because the retailer buys more advertising? On what principle is advertising excluded from the transaction and transportation included?

Total Output and Value-added

The output of each industry can be measured either as total output which is equal to the sum of value-added and intermediate inputs or it can be measured as the value-added. The latter measure when summed for all industries will be equal to the gross domestic product calculated as the sum of sales to the final markets.

The value added measure is well known to have significant advantages over the total output measure. Since the former concept is consistent with the sum of final sales, it is possible to analyze the industrial source of changes in aggregate output and of changes in the aggregate price change. Furthermore, since value-added of an industry does not duplicate the output of other industries it will

[7]In addition, there are the fundamental problems of how to define the unit of service output itself. These problems are the subject of another paper in this conference.

be more suitable for measuring productivity than total output if the use of purchased inputs changes.

However, there are some difficult problems in calculating value-added in constant prices and the value-added implicit deflator. Satisfactory concepts and methods have not yet been developed for separating value-added into its price and quantity components—an essential step for direct deflation. As an alternative to direct deflation, the Fabricant–Geary double deflation method is often used. Under this method, output and intermediate input are each deflated and the excess of real output over real input is value-added in constant prices. The ratio of current price value-added to real value-added yields the implicit deflator.[8]

The constant price value-added data and the related implicit deflator for the economy as a whole should be equal to the corresponding measures derived by deflating final sales. In actual practice they will not be equal. First, there may be a discrepancy between gross product measured as the sum of income payments and as the sum of final sales. Second, there may be inconsistencies between the price indexes and weights used to deflate value-added and those used to deflate final sales. In the United States program, the practice is to show a "residual" item which adjusts the sum of real value-added to the sum of real final sales.

The double deflation procedure has been criticized on the grounds that it combines the current technology of production in terms of relative amounts of materials, services and value-added with the prices of a base period which may reflect a different technology. This mixture of technologies may yield anomalous results which in the extreme form would be negative value-added. That is, deflated intermediate inputs would be greater than deflated output. This could occur if in the current period the industry uses, as an important input, a material that was in the early stage of development in the base period. Under these circumstances, the relative price in the base period is likely to be much higher than in the current period. Therefore, the large quantity consumed in the current period multiplied by the high base period price could "overstate" intermediate consumption and result in an "understated" value-added. As noted, in extreme circumstances, value-added might even be negative.

The opposite result will, of course, appear in the industry producing the new material. Its output would be large, input small and its value-added would be overstated to the same degree that the consuming industry's value-added is reduced. Thus the sum of value added for all industries would not be affected by the problem. However, the industrial distribution of output is affected. (It should be noted that these offsets occur only for the commodities which appear as both outputs and inputs. Consequently, there would be no offset for imported materials or for commodities used by the final markets.)

This phenomenon is another expression of the "index number" problem. That is, that the index of real values is affected by the selection of the year whose prices are used as weights. This influence may bias price and quantity indexes since changes in prices tend to be negatively correlated with changes in the volume of production.

[8]For the United States, annual series on industry gross product in current and constant prices are published regularly by the Office of Business Economics in the *Survey of Current Business*.

Another weighting difficulty arises in connection with the information used in deflating outputs and inputs. In the SNA and in the data prepared by many nations, the total output of each industry is usually measured on a product-by-product basis for each year and the value of output of each product can be deflated by an appropriate price index. This means that a real output index can be calculated which does indeed represent current year's quantities at base year prices.

However, the data for inputs are less satisfactory. For many industries, intermediate purchases are available in total only. The input-output tables which would specify the commodity composition of these purchases are likely to be prepared at 5-year intervals. These detailed input data would be the only source of weights to be used to develop an aggregate price index for intermediate purchases. Total intermediate purchases, therefore, would be deflated by an input price index which would incorporate as fixed weights the pattern of inputs for the period covered by the last available input-output table, whereas the output deflated would be currently weighted.

The use of such inconsistent weights in developing deflators for output and input can bias the measure of real value-added because price indexes incorporating recent period weights tend to show less of a change in prices than do indexes with early period weights. Consequently, in a period of rising prices and output, deflated values based on a current weighted price index would increase more than those based on a price index with early period weights. Total output would be deflated by the first type of index and intermediate inputs by the latter type, with the result that value-added would tend to be overstated compared to what it would have been if both the output and input price indexes were current-weighted. This could be one of weighting inconsistencies contributing to the discrepancy between the industry and expenditure measures of real product referred to earlier.

The U.S. plans for an annual updating of the most recent benchmark input-output table, on a summary basis. These updated data would provide changing and more current weights for deflating intermediate purchases. Nevertheless, considering the time required to assemble an input-output table—even an updated one—it does not seem feasible to construct input deflators with weights as current as those for output.

Because of these and other difficulties in the double-deflation method, there have been various recommendations for deflating value-added directly or for approximating real value-added by indirect procedures. However, it should be observed that the double-deflation approach is the only one which is meaningful in a system of input-output data in constant values.

Nonmarket Commodity Flows

In order to make the national accounts as comprehensive and meaningful as possible, the output and consumption measures include not only the transactions that occur in the markets but are extended to include nonmarket (imputed) activities as well. These imputations are well known, as for example, owner occupied dwellings, services provided by government and nonprofit institutions, banking services, and so on. With the introduction of the input-output system as part of the integrated system, the nonmarketed flows have been

further augmented by the addition of interplant transfers. These transfers refer to the movement of goods between the producing and consuming establishments of a single enterprise. The value of these goods are included in the output of the producing establishment and in the cost of materials consumed of the receiving establishment.

From the viewpoint of deflation, the immediate difficulty associated with the nonmarketed flows is that there is no observable price. The following discussion will be concerned with the problem of developing price deflators for only two categories of nonmarket flows—inventories and interplant transfers. The other nonmarket flows are related largely to the service industries and are to be covered by another paper presented to this conference.

The deflation of inventories is always difficult. In most cases, and certainly this is true for the United States, there are major statistical gaps. First, information is lacking on the commodity composition of inventories and stage of fabrication. Second, business firms use different reference periods for pricing their inventories. Pricing practices may differ not only among enterprises but also among establishments within a single enterprise, and among the types of inventory within a given establishment. Furthermore, these practices may change over time.

In addition there are special problems associated particularly with goods in process inventories since such goods have no market counterparts. Consequently, the book value of these inventories may represent some arbitrary valuation and may include direct costs only, excluding overhead costs or their direct and overhead costs but omitting profits and so on.

Before the SNA integrated input-output flows within the national accounts, the deflation of interplant transfers did not present a significant pricing problem in the accounts, since transfers generally refer to intermediate flows. However, the interindustry requirements of the new SNA give these interplant transactions a new importance. In part the difficulties arise because we are uncertain how these transfers are valued. In the U.S., firms are usually asked to report such production and consumption valued at the usual commercial prices. However, the adherence to such prices may not be very close. Furthermore, a commercial price would be difficult to determine for goods which are produced largely on a "captive" basis and there is little or no regular commercial market.

Lastly, measures of price changes for interplant transfers will not be adequate since such transfers are not included in the regular program of price statistics.

Interplant transfers occur in many industries in the United States. The *U.S. Census of Manufacturers* provides separate information on the output for industries where they represent a substantial portion of total shipments—textile, steel products, motor vehicles, etc. In many cases both value and quantity data are shown so that unit values can be calculated at least for the Census years. Some of the reasons why unit value indexes may not be as useful as price indexes for deflation purposes will be noted later in this paper.

Price Indicators

Up to this point, the discussion of the role of prices in the national accounts has been primarily on the need for price deflators in order to derive measures of

production and commodity flows in constant prices. The national accounts, in turn, can provide a framework for a system of price indexes which can be used as price indicators and as the basis for price analysis. This section examines the use of the accounts as a framework for price indicators and the relationship between price deflators and price indicators.

The price deflators in the national accounts, except at the level of the individual product or service, are derived by dividing the current dollar flows by their constant price counterparts, with prices fixed as of some base period. Since the constant price value measures have fixed weights (Laspeyres indexes), the resulting implicit deflators have changing weights (Paasche indexes).

It is generally agreed that, in concept, price indexes which are to be used as price indicators should exclude the effect of changes in product mix and reflect only the effect of changes in price. From this viewpoint, the price deflators in the national accounts are not suitable as price indicators precisely because they reflect the change in product mix from one period to the next in addition to the change in prices. Strictly speaking, the implicit deflators can only be used to measure the change in price between the base period and a given period, and not between given periods. For this reason the SNA recommends the development of Laspeyres price indexes in addition to the Paasche implicit deflators, as part of a system of price and quantity indexes.

In spite of the recognition that implicit deflators are, in concept, not appropriate for use as price indicators, fixed weight price indexes within the framework of the accounts have generally not been developed and published except on an ad hoc basis for special studies. This may be due, in part, to the belief that the differences between deflators and fixed weight price measures are relatively minor and can be ignored. We shall want to explore the validity of this assumption, at least for the United States.

Effect of Weights on Price Measures

Although there has been no truly comprehensive and systematic study in the United States of the effect of alternative systems of weights on price indexes, there have been some studies for specific time periods and at varying levels of aggregation which provide information on the subject. The most recent study by Young and Harkins,[9] compares quarterly price changes (at annual rates) for each quarter, 1965–1968, for total GNP and major components based on alternative fixed weights (1958 weights and 4th quarter, 1965 weights), changing weights (implicit deflator), and a chained price index.

The objective of the study was to determine whether during the inflationary period, 1965–1968, the implicit price index (with changing weights), provided approximately the same indication of price change as price indexes with fixed weights. The major finding of the study was that the implicit deflator for gross national product increased at about the same rate as fixed weighted price indexes over the 3 year period. However, within this aggregate and for some time

[9]Allan H. Young and Claudia Harkins, "Alternative Measures of Price Change for GNP," *Survey of Current Business*, March 1969, pp. 47–52, Office of Business Economics, U.S. Department of Commerce.

periods, the fixed weight measures moved differently from the implicit deflator and the fixed weight indexes moved differently from each other in some of the subperiods.

Some of the differences were rather large. For example, although the various GNP price measures showed about the same annual rate of change, at the total level, between the 4th quarter, 1965 and the comparable quarter, 1968, the price measure for nonresidential fixed investment, with 1958 fixed weights showed an increase of about 3.6 per cent, on an annual rate basis, compared to the 3.0 per cent increase indicated by the implicit deflator. Some of the differences for individual years and quarters were even larger. The change between the 3rd and 4th quarter of 1965, for example, indicated an increase of 1.8 per cent at an annual rate, based on the GNP implicit deflator. The 1958 weighted measure showed an increase 50 per cent higher—2.7 per cent. The difference for the major component of GNP, personal consumption expenditures, was roughly of the same order of magnitude—1.3 per cent based on the implicit deflator and 2.0 per cent, based on the 1958 fixed weight price measure.

In general, earlier period weighted price measures would be expected to show larger increases due to the usual inverse relationship between changes in prices and output. For the most part, the price measure with the earlier (1958) fixed weights shows the largest increase in price, the changing weight implicit deflator the smallest change, with the 4th quarter, 1965 fixed weight price measure in between.

Further evidence on differences between earlier and later period weights is to be found in the comparison of "price" indexes implied by the quite detailed production indexes for manufacturing.[10] An examination of industry price changes implied by the base and current year weighted production indexes for subperiods between 1947 and 1963 show substantial differences.

The price change for total manufacturing, for three subperiods; 1947–1954, 1954–1958, and 1958–1963, based on earlier and later year weights of the subperiods are shown below:

COMPARISON OF DERIVED PRICE CHANGE FOR TOTAL MANUFACTURING
(Average annual rates)

Item	1947–1954	1954–1958	1958–1963
Earlier year weights	2.6	2.6	.5
Later year weights	2.0	1.9	.3

The difference between price measures based on earlier and later period weights are substantial for the first two subperiods. The rate of increase for the third subperiod is quite small in either case and the difference, although large in relative terms, is not important in absolute terms.

[10] U.S. Bureau of the Census and Board of Governors of the Federal Reserve System, *Census of Manufacturers*, 1963, Vol. IV. *Indexes of Production*, 1968. Strictly speaking, the "price" indexes implied by the production indexes, are a mixture of price and unit value changes since both were used in developing the base and current year weighted production indexes.

The results of the various studies indicating that the difference in earlier and later period weights may lead to significantly different measure of price change, at least for some time periods and particular sectors of the economy, lends support to another recommendation in the SNA—the periodic updating of weights for indexes of quantity and price so that the weights underlying an index will be reasonably representative of the period covered.

Some Ambiguity between Levels and Indexes

The recommendation in the SNA regarding periodic revisions of weights for price and quantity measures leads to a dilemma regarding consistency of weights underlying the levels of constant price value flows in the accounts and the weights underlying the quantity and price indexes to be developed within the framework of the accounts. On the one hand the accounts call for constant price values, which, to be comparable from one period to any other period, require that the levels be stated in some common price level, with fixed weights for the entire period. On the other hand, the SNA suggests that the accounts be used as a framework for price and quantity indexes, with periodic revisions in weights. The suggestion regarding the indexes calls for reweighting only the most recent period, with weights for previous subperiods left unchanged. The resulting price and quantity measures would be in the form of link or chain indexes, in which the weights for each subperiod would be based on the first year of the subperiod or an average of the weights for the first and last year of the subperiod. If constant price values were based on the same weights as those underlying the chain indexes, they could not be compared directly from one subperiod to the next because of the lack of a common price level.

There is, of course, no easy solution to this dilemma regarding consistency of weights for both levels and indexes. Since there does not seem to be any one system of weights that will serve both purposes, the approach, which is admittedly, awkward, implicit in the SNA recommendations would be to use the single base year weight system for the deflated values and the link method for the system of quantity and price indexes. The link method in which the indexes, based on new benchmarks, are linked to the earlier measures is, in fact, the approach used in the United States for the Consumer Price Index, the Wholesale Price Index, and the Federal Reserve Board Production Index. The change within and between given periods can be derived from such an index. It is ambiguous, however, in the sense that the price change, for example, does not refer to the same product mix over the entire period, but to the product mix more nearly representative of each subperiod.

The link or chain indexes, of course, require the least amount of revision and reweighting as new benchmark weights are introduced into the system. The revisions would only be required for the period from the new benchmark year to the present. If, on the other hand, the Fisher formula, which is recommended by the SNA, is used, an additional revision would have to be made—that of the subperiod prior to the benchmark.

To minimize revisions and provide consistency with the link method, used in the other major price indexes, it is suggested that the fixed weight price indexes and related quantity indexes to be developed in the framework of the accounts

follow the link method, using the weights of the initial year of the subperiod. However, because there is no unique answer to the basic index number problem of appropriate weighting periods and comparisons over time, alternative indexes should be computed periodically to obtain some indication of the magnitude of differences resulting from different weights and formulae. The various measures, including the implicit deflators, should then be presented in analytical articles which could provide the basis for discussion regarding the need for further modifications of price and quantity indexes. In addition, a table of price deflators, if included as a supplement to the accounts, should note that the implicit deflators may not show the same change as the fixed weight price indexes, which are conceptually the more correct measures of price change, and that an indication of the difference may be found in the analytical articles.

Other Differences between Deflators and Price Indicators

The development of fixed weight price indexes within the framework of the national accounts still leaves open the question of whether, aside from differences in weights, the concepts and scope of the accounts are entirely suitable as a framework for the development of price indicators.

One area of possible difference between price measures consistent with national account concepts and price indicators relates to prices in long term contracts for goods and services to be delivered at a later date. Estimates of expenditures in the accounts for such goods and services refer to the period when delivery is made, and the associated price is that prevailing in the earlier period when the contract was made. In contrast, the price indicator for the current period would reflect the price at which current contracts are being let. This suggests that price programs designed to meet a variety of needs, including that of the national accounts, may have to obtain alternative measures of price change, which can serve as building blocks, to be used in various combinations, depending on the need.

As previously indicated, the requirement for price indicators may also differ from measures consistent with the national accounts because of the inclusion or exclusion of nonmarket commodity flows. The difficulties in pricing these nonmarket flows, i.e., imputations and interplant transfers, have already been mentioned in the previous section of the paper and need not be repeated here. However, the basic concept of the accounts, covering all productive activity, requires their development. On the other hand, for use as a sensitive indicator of inflationary pressure, a system of price indicators might exclude such flows. Here, again, the varying uses of price measures would indicate a flexible approach so that alternative price measures could be developed, including and excluding nonmarket flows. It also implies that price programs need to be expanded to try to obtain information on the acutal practices used by establishments of companies in "pricing" their interplant transfers.

The Use of National Accounts as a Framework for Price Analysis

The national accounts, supplemented by information on factor inputs, provide an integrated and comprehensive framework for the analysis of industry

prices in relation to income, costs, productivity, and output. In addition, information derived from the commodity flow and industry input-output tables in the System of National Accounts provide the basis for tracing the impact of a change in price in one part of the economy on the rest of the economy.

The major types of price analysis within the framework of the accounts, including input-output accounts, are reasonably well known and need not be repeated here in detail. However, it may be useful to outline some of the major elements in order to indicate the interrelationships involved, and to point up some of the gaps and limitations of the accounts as a framework for price analysis.

Price Analysis

Perhaps the simplest and most direct use of the accounts for this purpose is the analysis of the structure of the aggregate price index for the economy as a whole. In the same way that gross domestic product can be derived either as the sum of final demand expenditures or as the sum of gross domestic product (value added) originating in each industry, the overall price index can be analyzed in terms of the change in price for each of the final demand components or as the weighted average of the change in price of the value added originating in each industry in the economy.

At the aggregate level, the analysis can be carried one step further by decomposing the overall price index into the unit costs for each of the components of gross domestic product on the income side of the accounts, e.g., unit labor costs, unit operating surplus. Depending on the particular concept of output used, the complementary concept of price will or will not include capital consumption allowance and indirect business taxes. Information on labor and capital inputs would permit the further decomposition of unit labor and capital costs into their respective factor productivity and factor returns.

At the industry level, since the new SNA provides detailed information on intermediate inputs as well as components of value added, these can be used as the basis for a systematic analysis of the cost structure underlying the price of total output for each industry. Each category of unit costs can be further decomposed into the change in price for each item and the change in unit requirements. Here again, additional information, at the industry level, on labor and capital input can be used to derive estimates of factor productivity and factor returns.

Given the information on the change in unit costs and price in the initial industry, and information on sales and purchases among all industries in the economy, it is possible to trace the initial change in price to cost and price changes in purchasing industries. Information on sales and purchases among industries would be based on the input-output tables underlying the commodity flow and industry input and output tables shown in the SNA. It should be noted that tracing the impact of price change on other industries would also require some assumption or estimate of the possible substitution effects as prices were reflected in costs of purchasing industries and the relationship between change in costs and profit margins in these industries. Tracing the interrelationships

further and ultimately on final product prices requires the use of the total requirements (direct and indirect) form of the input-output table.

It is the total requirements table which provides the bridge between industry income, costs and prices and final demand expenditures and prices. The total requirements table provides information on how much each industry contributes directly or indirectly to the output of each final goods or service. Estimates of how the total requirements coefficients change over time, and information on the change in price of each industry's output can be used to analyze how much the change in price in any one industry has contributed to the change in price of later users in the production process as well as final goods and services.[11]

Unfortunately, the conventional total requirements form of the input-output table has major limitations as the basis for price analysis involving the effect of price changes in more than one industry on the price of final goods and services. This is due to the fact that the total requirement coefficients include duplications of raw materials and the value of products made from these materials rather than just the value added by each industry. Coal used to make steel which is then used to make automobiles is counted twice—once as coal and again as part of the value of steel. Similarly, price analysis which attempts to estimate the contribution of the change in the price of both coal and steel on the total price of an automobile would overstate the impact of the coal price change, because of the duplicated weights. This limitation can be removed by converting industry output in the total requirements table from a duplicated output to a value added basis by multiplying the total requirements coefficients by the ratio of value added to total output for each industry.

The conversion of the table to a value added basis also means that the price analysis must also be in terms of the price of value added, not total sales price. Value added price, in turn, is derived in the SNA tables as the implicit deflator in converting value added from current to constant prices, through the double deflation method.

Expenditures for specific categories of final goods may exceed the aggregate "domestic value added" contributed by the various industries to the final product if part of final demand for the product is met from imports, e.g., automobiles, or some of the materials used to make the final product is imported, e.g., steel. Information on imports which are comparable to domestic products is provided in the commodity flow table in the SNA and included in the underlying input-output tables. In order to trace the industrial origin of the value and price of final goods and services, the modified form of the total requirements table shows the total value added (direct and indirect) generated in each industry, plus competitive imports, per dollar of final demand expenditures for the products of each industry.

Given the information on the industrial origin (in terms of primary input content, i.e., value added plus imports) of final goods and services and information on the change in price of each industry's value added and of imports, then

[11]In this connection it should be emphasized that statistical analysis, within an accounting framework, of how much each industry and its component cost elements has "contributed" to the change in price at later stages of production and final products should not be interpreted to imply cause and effect relationships. The latter would require the development of behavioral relationships that would take account of the interaction between costs and prices.

the industrial origin of the change in price of final goods and services can be determined. Since the value added price change for each industry can be further distributed into specific cost elements, e.g. unit labor costs, unit depreciation costs, it is also possible to analyze how much of the change in final price is contributed by each component of value added and imports.[12]

Some Gaps

This in brief indicates some of the major elements of price analyses which can be developed within the framework of the new SNA. Its implementation, however, would involve substantial modifications and expansion of price and other economic data systems as well as some expansion of the SNA itself. On this latter point, there are some significant gaps in the new SNA. The first is the lack of measures of fixed capital stock in the accounts. Admittedly, this is a difficult area, with divergent opinions both as to concept and measures, but it might have been useful to have indicated some of the major alternative approaches in this area and suggested the inclusion in the accounts of those measures, including alternatives, which countries could develop. Descriptive statements on concepts and methods could then be used to distinguish among the major types.

A second major gap is the lack of separate information, by industry, of the components of "operating surplus." Operating surplus, as defined in the new SNA represents a heterogeneous category including proprietors' income, interest and corporate profits. Any analysis of the factors underlying the change in the operating surplus, as it affected prices would be quite limited unless additional detail were provided, particularly for proprietors' income. The latter is necessary if there is to be any attempt to analyze factor income and factor productivity with the related need to somehow distribute proprietors' income between labor and property income. The distribution would be used to exclude the effect of the shift from proprietor to employee status on unit labor costs. To be consistent, property income as a return on capital would exclude the labor share of proprietors' income

Consistency of Data

In addition to actual gaps in the information in the accounts needed for a systematic analysis of factors underlying price change, there are a number of transition points in the sequence of price analysis involving problems of consistency of data and classification systems. Some of these have already been alluded to, but their particular role in price analysis should be mentioned here.

The first major problem area is the lack of comparability among data sources used to develop estimates of the cost structure of producing industries in the accounts. In the United States, these estimates are based on essentially three different data systems. Information on total output and intermediate inputs and value added in the input-output table is obtained, for the most part, from the

[12]For an application of this approach to the analysis of final demand prices, 1958–1964, in the United States, see paper by Jack Alterman "A Framework for Analysis of the Industrial Origin of Income, Product, Costs, and Prices," in *The Industrial Composition of Income and Product*, Studies in Income and Wealth, Vol. 32, by the Conference on Research in Income and Wealth, National Bureau of Economic Research, New York, New York. 1968.

periodic Censuses of Manufacturing, Business, Mining, etc. It is difficult, however, to relate value added in the input-output accounts to the components of value added in other parts of the accounts. The data on employee payrolls, in the Census of Manufacturing, etc., are not consistent with payroll data, in the unemployment insurance system of reports. It is the latter system, however, which is the chief source of information used in developing the labor compensation component of the income estimates in the national accounts. Estimates for the other components of value added (depreciation, indirect business taxes and profits) are based largely on tax returns of corporations and proprietorships. The activities of these business enterprises cut across many industries and, therefore, present problems of allocation to specific industries.

The analysis of unit costs in relation to price must, therefore, reflect an uneasy reconciliation of estimates from a variety of sources. Efforts in the United States to match industry value added and value added obtained as the sum of factor payments and indirect business taxes, adjusted from a company to an industry basis, have met with limited success, even at 2-digit levels of industry aggregation.[13] Because of these difficulties in reconciling value added in the input-output tables and components of value added from the income side of the national accounts, value added in the U.S. input-output tables have not been further distributed into factor and nonfactor costs.

Product-industry Problems in Input-Output Tables

Another major problem in using the accounts for price analysis is inherent in the underlying input-output tables. As already noted earlier in this paper, the intermediate inputs refer to specific groups of commodities, classified as characteristic products of particular industries, whereas industry output cover the characteristic (primary) products as well as secondary products produced in the industry. The analysis of costs, therefore based on the input-output table used in the accounts, refers to the costs of producing both the primary and secondary products. Tracing the impact of the change in costs and prices in the initial industry on the cost structure of purchasing industries cannot be done directly because the inputs to industries represent the characteristic (primary) products only, wherever made, and not the sales and purchases among industries. This problem can be handled in a variety of ways, which are described in the chapter on input-output in the SNA report. These involve modifying the basic input-output table by one of two ways. Either by introducing the fiction that each industry "sells" its secondary production to the industry where it is primary (the approach used in the U.S. tables), or by converting both inputs and outputs to a consistent basis in which rows and columns are both on a commodity basis or an industry basis.[14] The latter approach is recommended by SNA. Each

[13]The adjustments of nonlabor factor payments are based largely on establishment reports to the Census Bureau and company reports to the Internal Revenue Service. The cross-classification of establishments and company reports is the "link project" in the United States and these tabulations have been developed for 1954 and 1958. The link tabulation for the 1963 benchmark is currently in progress.

[14]The U.S. 1958 input-output table has been converted to a commodity by commodity table by two independent methods. One was developed at the National Planning Association by Phil Ritz and Lou P. Loenig. The adjusted table is given in "Secondary Product Adjustment with Redistribution (SPAR)," National Resources Analysis Center Technical Report No. 67,

approach has its limitations and introduces additional complications in analyzing the relationship between costs and prices among producing sectors and final product prices. It is clear that more work needs to be done on the commodity-industry problem, both with regard to intermediate inputs as well as factor inputs and costs.

Supplementary Information

Another transition point in price analysis, within the framework of the accounts, is the bridge between personal consumption expenditures classified by commodity group, and expenditures classified by object. This involves two supplementary sources of information. One is a bridge table in which personal consumption expenditures are cross-classified by characteristic products (primary industry) and object. In addition, because the prices of expenditures, classified by characteristic product, are usually in approximate basic value or producers' value, whereas the prices of expenditures, classified by object are usually in purchasers' value, detailed information on trade margins, freight rates, and commodity tax rates, classified by characteristic products are needed to bridge the gap.

Both types of information, which are not part of the regular SNA tables, can be derived from the input-output and final expenditure tables in benchmark years.[15] This, of course, assumes that the input-output table is fully integrated into the national accounts. The problem then is largely one of interpolation for the years between the terminal years.

Given the information on expenditures cross-classified by product class and object, and the items representing the spread between basic or producers' value and purchasers' value, it would then be possible to trace the price change from producer to purchaser. Information on the price change at approximate basic value is available, although with major gaps, from the Wholesale Price Index detail. Prices paid by consumers can be obtained from the Consumer Price Index, supplemented by a variety of other sources. The major missing piece in the sequence is detailed information on trade margins and freight rates, classified by product groups. Trade margins and transportation charges account for about one-third of the total cost of goods purchased by consumers, yet present price programs do not cover either as part of the regular collection of price information. This is one of the major gaps in the price information needed to implement the national accounts, if the accounts are also to be used as a framework for price analysis.

A similar situation exists in the case of government expenditures which are also classified by function as well as by commodity group in the SNA. In some

---

April 1967. The other conversion of the table was developed by Prof. Clopper Almon of Maryland University, "National Input-Output Forecasting," 1967 Proceedings of the Business and Economics Statistics Section, pp. 2–9, American Statistical Association.

The Office of Business Economics, U.S. Department of Commerce, plans to begin developmental work on converting the 1963 input-output table to an activity basis, after publication of the basic table.

[15]In the United States, the bridge table for personal consumption expenditures, cross-classified by product class and object, consistent with the input-output table and national accounts for 1958, is given in an article by Nancy Simon, "Personal Consumption Expenditures in the 1958 Input-Output Study," *Survey of Current Business*, October 1965, Office of Business Economics, U.S. Department of Commerce.

ways, the situation in this area is worse in the United States than in the case of consumer expenditures because in addition to a lack of detailed information on changes in trade margins and freight rate, we have very little information on prices paid by government agencies for goods and services they buy. Here, the problem is not filling in the gap between the change in producers' and purchasers' prices, but not even knowing the size of the gap.

Implications for Price and Related Programs[16]

At various points in the discussion of the role of prices in the national accounts, and its converse, the use of the accounts as a framework for price indicators and price analysis, we have touched upon the implications of these various uses for price and related programs. Here, we should like to explore the subject further. These comments may be grouped into four categories: (a) improvement in methods; (b) expansion of coverage; (c) flexibility to meet a variety of needs; and finally (d) the problem of consistency of price and unit value information.

The comments which follow on needed improvements and expansion in price and related statistical programs, as well as progress in some areas, are based largely on experience in the United States, but are believed to be generally relevant to programs and methods in other countries as well.

Improvements in Methods

Transaction prices.—Many of the price series in the Wholesale Price Index in the United States are based on list prices, less the usual discounts, rather than actual transaction prices. To the extent that these diverge the use of list rather than actual prices as price deflators or as price indicators may result in misleading interpretations of the nature of inflationary pressures and real output changes.

Research carried on by Professor George Stigler, at the National Bureau of Economic Research, indicates, based on preliminary results, that transaction prices are more flexible, both upward and downward, than the price information used in the Bureau of Labor Statistics indexes. However, he finds that in many industries where long term supply contracts are prevalent, the prices paid for purchased materials, supplies, or components are not as sensitive to market conditions as is generally believed.

In order to provide more information on this subject and to make some determination of the areas where the divergence between list and actual prices is important, it would be necessary to obtain data on transaction prices from both sellers and buyers. Obtaining information from both buyers and sellers would provide a check on actual prices, based on common specifications and terms of sales.

Separate information from sellers and buyers is also needed in order to obtain data on differential prices paid by the various categories of purchasers,

[16]This section is based, in part, on information contained in testimony by the Commissioner of Labor Statistics, Geoffrey H. Moore, U.S. Department of Labor, before the Subcommittee on Economic Statistics, Joint Economic Committee, U.S. Congress, May 15, 1969. It also draws upon material prepared by Joel Popkin and Allan Searle, Office of Prices and Living Conditions, Bureau of Labor Statistics.

including intermediate industries, and final demand categories. Without information from buyers, on differential prices, price indexes used in the commodity flow and input-output tables may have to be based on the assumption that all purchasers pay the same price increase (at approximate basic value) when, in fact, price increases may not be uniform for all categories of purchasers. Unfortunately, although the need for expansion of price programs to obtain data on transaction prices, including differential prices by class of purchaser, has been recognized for some time, it has not been possible to obtain sufficient resources to develop such measures.

Product detail and quality adjustment.—We have already mentioned the need for price deflators which are based on sufficient detail so that, if possible, changes in services "embodied" in the final product could be distinguished from changes in prices, e.g., changes in geographic sources and supply and related transportation charges, and changes in services provided by trade. Additional product detail, representing different qualities of a given product are also needed in order to develop improved techniques for quality adjustment.

Work is progressing in the U.S. Bureau of Labor Statistics on the development of empirical multiple regression techniques which could be used to determine what part of the difference in prices among various characteristics of the same product should be attributed to quality factors. These techniques have been used to test the accuracy of quality change adjustments which have been incorporated into the various price series over the past few years. These tests do not reveal any overall bias resulting from inadequacy of quality adjustments, although some segments of the index have an upward bias while others have a downward bias. In general, although some progress has been made, more work is needed to improve the techniques, obtain more prices on a broader cross-section of qualities for carefully specified products, and also to develop concepts and methods that can be used in the much more difficult area of services.

Imports and exports.—One of the major areas needing substantial improvement is the pricing of imports and exports. The use of unit value data, derived from foreign trade statistics, is a poor substitute for specification of pricing because the unit value estimates are subject to changes in product mix even at the finest level of detail used in these statistics. In addition, the unit value ratio may not be the true market value, but a relatively arbitrary estimate.

Correct import and export prices and price indexes are also needed to assess the competitive position of a country's foreign trade vis-a-vis other countries. Some work has been started in the United States to obtain information on international goods price competitiveness which will also be helpful in improving the foreign trade deflators in the national accounts. The plan is to compute indexes showing the trend of export prices of durable manufactured products for the United States and for several other major industrial countries. The data required for the new statistical measures will be secured from: (1) a survey of U.S. companies, (2) a review of commercial invoices accompanying imports at major U.S. ports, and (3) collection of price offers submitted by foreign and domestic suppliers for custom-built equipment procured by government and international agencies. In addition, data will be obtained from other countries through cooperative arrangements under O.E.C.D. auspices.

Construction.—Another major area requiring substantial improvement is the pricing of construction expenditures and output. Most existing indexes in this area are not price indexes but cost indexes without adequate adjustment for productivity change. This may result in an upward bias (assuming technological advance) when the cost index is used as a price index and a bias in the opposite direction in the deflated value estimates. There are several approaches to improving the measures in this area. The preferable approach is the direct pricing of various types of construction, based on some form of specification pricing. This approach has been used in the United States by the Bureau of the Census, within the past few years for single family residential construction, the largest single component of total construction. Indexes of the price of new one-family houses sold have been computed by determining the most important characteristics of these houses, and estimating by regression analysis, the price change in houses with a constant "mix" of these characteristics. The extension of this approach to other areas is being explored.

Another approach, developed by Dacy,[17] is based on the assumption that the changes in real construction output is proportional to the changes in real material inputs. Gordon[18] has used the Dacy method along with additional work of his own involving an assumption regarding the relationship between the price of specific components of construction, i.e., structural steel and concrete, to derive a compromise deflator for structures.

A third approach is the development of labor productivity estimates for specific types of construction which can then be used to adjust the existing construction cost indexes. Such productivity measures are gradually being developed through labor and material requirement studies by the Bureau of Labor Statistics for various types of construction. These studies are repeated on a periodic basis in order to obtain information on the change in unit labor and material requirements. Information on the change in unit requirements for two types of construction—schools and hospital construction—have been obtained in this manner and the derived productivity change, at least for these two types, are considerably higher than implied in the present aggregate construction productivity measure, based on deflation by the cost indexes. This program is being continued and over time should provide information for other types of construction.

Government.—The price and output of government is another area where the conventional measures are seriously deficient. In the absence of market valuation of the services of general government agencies, it is the practice in national income accounting to value government output in terms of the purchase of the direct services of government employees. The constant dollar measure used is based on the change in government employment, with base year compensation weights—a measure which embodies a constant productivity assumption. The change in the price of government output, consistent with this convention, is the increase in compensation per man-hour of government employees, with no adjustment for any productivity change except for shifts in the composition

[17]Douglas C. Dacy, "Productivity and Price Trends in Construction Since 1947," *The Review of Economics and Statistics*, November 1965, pp. 406–411.

[18]Robert J. Gordon, "A New View of Real Investment in Structures, 1919–1966," *The Review of Economics and Statistics*, November 1968, pp. 417–428.

of government employment. This assumption of no productivity change is not consistent with the reported increases in output per man-hour in certain government operations which are subject to measurement.[19] Unfortunately, the government activities covered in these studies are too limited to provide a basis for an aggregate adjustment to the measures for total government. Such studies need to be continued and expanded to cover a broader spectrum of government activities in order to provide a firmer basis for modifying the output and price measures for government.

Expansion of Coverage

An evaluation of the needs of the new SNA for price information serves to point up some of the major gaps in coverage of areas which have traditionally been included in price statistics programs as well as indicating those sectors which have not been covered at all. A convenient starting point for such an evaluation is to examine the price data available for the detailed deflation of commodity and industry output, essential elements in the commodity flow and input-output tables. Such an evaluation of price information based on the input-output table, has recently been completed for the United States.

The most striking fact which emerges from the evaluation is the paucity of coverage by available price statistics. Agriculture and mining are reasonably well covered, but the coverage of manufacturing is surprisingly low. So far, the Bureau of Labor Statistics has found price series sufficiently complete and reliable to warrant publication of separate indexes for only 99 of about 500 detailed 4-digit industries in the mining and manufacturing sectors. Coverage in the agriculture sector, based on data compiled by the U.S. Department of Agriculture, is reasonably good, but there are questions of the level of pricing (whether close enough to the farm), and changes in product mix that are permitted to affect average prices, which must be resolved before separate agricultural industry indexes can be published.

The situation is even worse in the transportation, trade, and service sectors of the economy. Detailed information on freight rates and trade margins are not collected currently as part of a regular system of data collection, although some information on retail sales is obtained. This, of course, is not the same as trade margins, which are needed to determine how much of the change in price between producer and purchaser is attributable to the change in "price" of trade. Business services are not covered at all, but personal services are covered by some components of the Consumer Price Index.

The evaluation makes clear that a great deal of Work remains to be done to develop a complete system of price indexes for important industries and sectors of the economy. Of the total duplicated value of domestic output of $822 billion

[19]Nestor E. Terleckyz, "Recent Trends in Output and Input of the Federal Government," Proceedings of the Business and Economics Section, American Statistical Association, 1964, pp. 76–94.

[20]Even in manufacturing, the area which traditionally has received most of the attention in development of wholesale price programs, the published industry price indexes cover only about 28 per cent of output. The coverage of manufacturing output, in terms of product class data, is much higher, however—about 45 per cent. The difference is due to the fact that some of the product classes for which price information is published do not cover a high enough proportion of industry output to permit separate publication of industry price indexes.

in 1958, published price indexes cover only about 13 per cent.[20] Since there is good, but unpublished price coverage of another 16 per cent, the presently available published indexes could be more than doubled. But going beyond that, the problems become more difficult and expensive. As previously noted, the information on prices paid by purchasers, needed to fill in the input side of the production accounts and also final demand expenditures, is almost nonexistent except for prices of consumer goods and services.

It is clear that, at least for the United States, the bulk of the price information needed to implement the constant price tables in the national accounts, that would also meet reasonable technical standards for separate publication, has yet to be developed. It may be a fair inference that most countries are probably not in a better position to implement the price requirements of the production accounts in the SNA.

Meeting a Variety of Needs

We have earlier noted that a price statistics program must be designed to meet a variety of needs in addition to providing deflators for the national accounts. Several examples may be cited. One is the need for current prices to be used as sensitive indicators of inflationary pressures versus the need for prices in long-term contracts which are to be kept in the price measures as long as the contract lasts. The other is the inclusion of imputed prices for "sales" among plants of the same company, including captive operations in diversified activities.[21] Again, prices to be used as indicators of inflationary pressure may include only prices reflecting actual transaction in the market place whereas deflators for the accounts should cover total production.

There is an additional need for price information which may differ from the requirements of the national accounts. This would include the need for separate price indexes for different groups in the economy to determine the change in the purchasing power of the dollar for that particular group.

This is, of course, the basis for the Consumer Price Index which measures the change in the purchasing power of the dollar, in terms of some fixed basket of goods and services purchased by the urban worker. In this instance, meeting the needs of the national accounts in addition to the needs for price measures for particular groups would involve a more comprehensive set of weights covering all personal consumption expenditures and an expansion of the distribution outlets in the sample used for obtaining the price data. Aside from the differences in the basket of goods and services being priced, there may be differences in concept of what should be included in the two measures, e.g., treatment of medical care expenditures which in the Consumer Price Index cover cash outlays for such care, whereas the national accounts would include, for example, that part of medical care paid for by the government or nonprofit institutions either through direct service or transfer payments.

Consistency of Price Indexes with Measures of Unit Value Change

The final problem involves the consistency of price information with unit

[21]Interplant transfers represents about 15 per cent of total manufacturing output, based on 1963 data.

value changes derived from measures of value and quantity. The problem has already been referred to in the earlier discussion of the limitations to the deflation of imports and exports because of the reliance on unit value rather than price changes. The major area, however, where the problem arises is in manufacturing and is usually presented in terms of different movement in manufacturing output, depending on whether the measure of output is based on deflated output or a production index based on quantities. Given the same measure of manufacturing output in current dollars, the difference in output measures is, of course, the obverse of the difference between the change in price and implicit unit value changes for manufacturing output. To the extent that the differences are substantial, it presents major problems in interpreting what has happened to prices, unit costs and productivity in a key sector in the economy.

The problem of the lack of comparability between deflated output and production, and their related price and unit value changes was the subject of a paper by Milton Moss[22] in the *Review*. The problem is, of course, not unique to the United States, and is probably quite general.

The importance to be attached to the differences between the two sets of measures will vary from country to country, but some satisfactory resolution of the problem is needed if the analysis of price change and the factors underlying price movements is to be put in some meaningful perspective. Although there are a variety of factors which may explain some of the differences between deflated output and quantity measures,[23] the basic difficulty lies in the divergence between the measures of price change and the unit value changes. As between the two, price data would be preferred, in theory, because of the use of detailed product specification and fixed product weights, whereas the unit value changes, because of lack of sufficient detail, may reflect changes in product mix, including shifts in varieties of product lines. In support of the quantity measures and their implied unit values, it has been argued that the product coverage in the price measures has been too limited to cover the full range of products within product classes and the limitations of the unit value changes are more than offset by the broader coverage.

The answers to these questions require, as a starting point, detailed comparisons of unit value and price changes to arrive at possible explanations for some of the largest differences. Work along these lines has been started in the United States, but the results so far are too limited to be conclusive. Some of the preliminary comparisons indicate that any gains in precision which may arise because unit values represent a comprehensive universe of actual transaction prices were offset by problems of product mix during the 1958–1963 period. A more detailed study also showed a persistent tendency of unit values to reflect product mix.

It is clear that progress in this crucial area will require, among other things, a substantial expansion of the coverage of individual products in the wholesale

[22]"Needs for Consistency and Flexibility in Measures of Real Product by Industry," *Review of Income and Wealth*, Series 14, No. 1, March 1968.

[23]Jack J. Gottensegen and Richard C. Ziemer, "Comparison of Federal Reserve and OBE Measures of Real Manufacturing Output, 1947–64," *The Industrial Composition of Income and Product*, Studies in Income and Wealth, Vol. 32, by the Conference on Research in Income and Wealth, National Bureau of Economic Research, Inc., New York, New York, 1968.

price system, both in terms of number of products and number of price reports for each item, if the comparisons are to be pursued much further. Until this is accomplished, the analysis of the industrial source of inflationary pressures and related measures of productivity, unit labor and nonlabor costs will be seriously handicapped.