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Problems in the Estimation of Industry Output in Current and Constant Dollars in Canada

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I. Introduction

In May 1963, the Dominion Bureau of Statistics (DBS) published a basic reference paper which embodied the results of a number of years of research and development relating to industry of origin real output measurement.[1] This publication made available production indexes for the entire array of Canadian domestic industries on an annual basis going back to 1935, and on a quarterly basis from the beginning of 1946. It encompassed and supplemented the latest Index of Industrial Production Reference Paper, which had been published in 1959 [2] and which contained both monthly and annual production indexes starting in 1935.[3] The Index of Industrial Production components contained in this latter publication and subsequent supplements were used in the comprehensive industry of origin real domestic product system without further adjustment. Thus the real domestic product industry of origin estimates represented both an extension of the official Index of Industrial Pro-

[1] DBS Occasional Paper, 61-505, *Indexes of Real Domestic Product by Industry of Origin, 1935–61*, Ottawa, 1963.

[2] DBS Occasional Paper, 61-502, *Revised Index of Industrial Production, 1935–1957*, Ottawa, 1959.

[3] A monthly Index of Industrial Production, dating back to January 1919, has been published in Canada since January 1926. For pre-1935 data see DBS publication 61-005, *Monthly Index of Industrial Production,* Annual Supplement, May 1963, Ottawa.

NOTE: The opinions expressed in this paper are the responsibility of the authors alone and do not necessarily represent the official position of the Dominion Bureau of Statistics.

duction and, at the same time, a new dimension of the Canadian system of national accounts. The basic need for such a study can best be demonstrated by a brief review of the historical background of industry of origin production measures in Canada.

The Index of Industrial Production has always been considered a timely and comprehensive coincident measure of economic production; but in the early 1950's it became increasingly clear that a broader setting for the Index was needed that could take account of the growing importance of the service-producing industries in Canada as well as short-term fluctuations of output in such volatile goods-producing industries as agriculture and construction. At the same time, the increasing interest in problems of economic growth and the need for a means of checking the validity of the quarterly estimates of deflated GNE being developed at the time lent a strong stimulus to the refinement of concepts and the improvement of national income and product measures. In particular, concern with the industrial distribution of longer-term production gains underlined the need for industry of origin data in both current dollar and real or constant dollar terms. Prior to the development of official measures of industry real product and for longer-term studies predating them, this need had to be met by private estimates, of which Kuznets' work in the United States is the most notable example.

In Canada, official estimates of current dollar national income by industry first became available in 1951 for the years back to 1926.[4] Although providing detail for eleven industry divisions within the business sector, they suffered from three principal defects from the standpoint of analysis. In the first place, being calculated at the net level, they reflected the errors implicit in the estimation of capital consumption by means of current accounting allowances for depreciation, etc. Secondly, it was not possible to adjust these estimates for price change at the industry level, although this could be done at the aggregate level by shifting to the concept of constant dollar expenditure on gross national product at market prices. Finally, the difficulty of allocating the profits of multiestablishment [5] companies or enterprises between industry divisions inevitably resulted in a distortion of the pattern of income distri-

[4] DBS *National Accounts, Income and Expenditure, 1926–50,* Ottawa, 1951.

[5] An establishment is defined as the smallest unit which is a separate operating entity capable of reporting all elements of basic industrial statistics, p. 8, DBS Catalogue No. 12-501, *Standard Industrial Classification,* Ottawa, 1960.

bution, particularly for the resource industries, manufacturing and trade, between which vertical integration is quite widespread.

In 1958, as part of the historical revision of the national accounts,[6] the Dominion Bureau of Statistics replaced the (net) national income concept in the published industrial distribution by that of gross domestic product at factor cost. This change was primarily an acknowledgement of the practical difficulties of deriving an industrial distribution of national income. However, the problem of finding appropriate deflators for the several kinds of domestic income flows remained and, while the inclusion of capital cost allowances resulted in more meaningful aggregates, the problem of the proper identification of particular factor shares and nonfactor costs by industry still remained.

The income side of the national accounts has continued to consist of a mixture of company and establishment data. Establishment data are used for labor income series while company data are used for such other factor shares and nonfactor costs as profits and capital consumption allowances. The need for a closer integration of financial flow data into the national accounts is a predisposing factor towards a completely company-oriented data framework. This point is presently under active consideration and thus the next historical revision to the national accounts, now being planned, could result in tables derived from company records only. This would involve reassembling establishment-based labor data to form company aggregates, and there would subsequently be no industry aggregates of establishment-based current dollar data in the Canadian national accounts.

Such an eventuality would underline even more emphatically the need for a parallel system of economic statistics, in both current and constant dollar terms, relating to the supply side of domestic production and based on establishment data. The use of the establishment as the basic building block would permit the integration of the system at the aggregate level with national accounts concepts and data and, at the same time, provide the maximum of industrial detail permitted by the Standard Industrial Classification system. The primary purposes of this paper are to describe the progress already achieved in the development of industry

[6] DBS Catalogue No. 13-502, *National Accounts, Income and Expenditure, 1926–56*, Ottawa, 1958. It should be noted that unless otherwise stated the term "national accounts" is used throughout this paper to mean the income and expenditure accounts.

of origin domestic product measures within this framework, to indicate the remaining major conceptual and statistical problems which stand in the way of fully consistent and integrated industry of origin data, and to present some statistical results and analytical uses.

Until the release of the industry of origin real output reference paper, the detailed expenditure aggregates were the only tools for a comprehensive real product analysis. The refinement of detail afforded by the new estimates thus permits a major analytical breakthrough. The simultaneous availability of current dollar value added by factor shares and nonfactor costs, although for the time being a less immediately attainable objective because of the conceptual and data difficulties involved, would reinforce the constant dollar data and extend their range of uses considerably. Cyclical behavior and growth studies of output and intermediate input at various levels of aggregation, the analysis of production shifts, productivity change, etc., could be supplemented by price and factor cost analysis. Furthermore, the use of establishment data would open up the possibility of eventually preparing such studies on a regional basis.[7]

While the conceptual and data requirements for current-dollar estimates of gross domestic product by industry of origin are mostly discussed in this paper in terms of gross output and intermediate input flows, the authors are of the opinion that the ability to separate the resultant value added into its factor and nonfactor cost shares is a prerequisite for exploiting the full potential of industry of origin measurements.

II. The Conceptual Framework for Industry of Origin Estimates

THE BASIC CONCEPT USED

From the beginning of work in Canada on the estimation of production by industry of origin, the goal has been to derive measures which sum to a complete and unduplicated aggregate. Working within the framework of an integrated statistical system, with the national accounts at its center, the requirements of industry disaggregation dictated a domestic

[7] A number of regional allocation problems, such as the treatment of the armed forces and shipping, would have to be solved by convention. Once these were solved, cost considerations would probably confine such comprehensive studies to individual provinces or groups of provinces.

product concept of economic production. In an open economy such as Canada's, the use of a national product concept presents very difficult conceptual and data problems at the individual industry level. This is true of both current and constant dollar data and is a well-known area of difficulty which it does not appear useful to explore further here.

The concept of economic production has been discussed by many writers, for example, Richard Stone, who in one of his earlier papers referred to "bringing into being goods and services (or perhaps more strictly the utilities associated with these) on which members of the community or the community as a whole through its agents sets a valuation." [8]

A definition given in the national accounts publication amplifies this statement somewhat and makes explicit a number of corollary points such as the fact that the creation or loss of economic value can occur in relation to products already in existence:

> While to many people the idea of production is restricted to the activities of a manufacturing plant, a mine, or a farm, to the economist any process that creates value or adds value to already existing goods is production. Thus, while the transformation of raw materials into finished goods is obviously production, the transportation of these goods from the factory to the market where they can be sold is also production. The distribution of these goods through wholesale and retail trade channels to the user adds value since goods which were inaccessible to the user now become available. Production may also occur which has little, if any, connection with goods. The services provided by a physician or lawyer and the entertainment of an actor all create value and are therefore production.
>
> The use of value as a criterion permits comparison of the relative amounts produced by different types of production and provides a measuring rod by means of which heterogeneous goods and services can be added together and expressed as a value total. It also follows that each item entering into the value of production total is capable of being expressed in terms of a quantity component and a price component.[9]

Here the idea of creating value or adding value to existing goods is of paramount importance. Purely physical units of output, whether they be tons of steel produced, the number of automobiles assembled, loaves of bread sold or haircuts given, are all imperfect proxies for the quantity

[8] *The Role of Measurement in Economics,* Cambridge, 1951, pp. 38–39.

[9] DBS Catalogue No. 13-502, p. 105, par. 25–26. In the latter paragraph the authors have taken the liberty of replacing the words "physical volume" with the word "quantity" and for this they take full responsibility.

of output being produced—even though, on practical grounds, these units may have to be used for measurement purposes. Product mix, for instance, implies much more than mere differing physical characteristics within a collection of goods. Also included, and often of much more importance, are mixes in sales conditions such as sales in bulk or by individual item, export sales as opposed to domestic sales, delivered products or products sold separately of transportation, products sold with and without warranties and servicing, etc., all of which can, and generally do, result in identical physical units attracting varying market values.

A further point should be made. The "creation of value" concept restricts the boundary of economic production to the production process itself. No further implication or imputation should be read into the creation of value. For example, a consumer's own time is outside the production process so that, when he switches from home-delivery laundry service to the use of a "coinwash," a portion of economic production has moved outside the scope of measurement. It would be a long step into welfare economics to consider consumer time or participation as an input into economic production.

What then is the most appropriate statistical expression of this concept? The costs encountered in creating economic product values provide an obvious starting point. From this point of view, a net domestic product (or domestic income) concept is by far the best of a number of possible choices. This concept of economic production expresses the market value boundary of the factors of production. Factor costs accumulate in the individual production processes and when summed across industry yield an unduplicated measure of aggregate economic production. In Canada, for practical reasons noted in the next section, capital consumption allowances have been included in the industry measures, thus modifying the concept in its pure form to one of gross domestic product at factor cost. Such a measure, although exaggerated due to the duplication inherent in capital consumption allowances, fully reflects technological change. (The constant dollar form, with which this paper is most concerned, measures current year output in terms of a base-period valuation but current year technology.) The desired gross domestic product at factor cost measure can be derived in current dollar terms either by deducting intermediate goods and services inputs from shipments (adjusted for finished goods and goods-in-process inventory changes) or

from accrued operating revenue, or by summing accrued factor incomes earned and nonfactor costs incurred in the production process. The former approach makes operationally possible the calculation of gross domestic product in constant dollars by the double deflation method.

Two other aspects of the basic concept of economic production need to be considered in an industry of origin context. One of these is the question of *when* economic production occurs and the other that of *where* it takes place, i.e., in what industry. The production process is of course a function of the factors of labor, capital, and entrepreneurship working in combination over a period of time which can vary considerably in length, according to the nature of the product. The valuation of the resultant product, however, is determined at a point in time, i.e., when the market transaction takes place.

The cost of intermediate goods and services, and all labor costs (or returns) have to be paid for as they are acquired at prevailing market rates. The returns to entrepreneurship and capital, on the other hand, are determined residually when the product or service is finally sold. An excess of revenue over related costs results in profit but, if the entrepreneur has not gauged the market properly, he may have to pay a penalty in the form of a loss. Such a loss reflects negative factor income (and thus a reduction in net worth), the effect being to offset the production which was contributed by other factors at an earlier stage of the production process.

When measuring production on an annual basis, the actual duration of the production process is of minor importance since the full production cycle is, in most instances, completed within the span of one year. The areas of production which overlap annual periods can be usually ignored, except in cases such as construction where progress payments are made. When the period of measurement is shortened however, as in the case of monthly or quarterly industry measures of economic production, differences of timing between the accrual of factor and intermediate costs and the recognition of the resultant value created attain major significance. Failure to measure sales and inventory change (finished goods and goods-in-process) separately leads to timing errors in an output measure, and the use of indicators based only on quantities produced during a particular period must always be deficient from an economic production point of view.

The basic point is well illustrated in agriculture, where the costs in-

curred by a farmer in ploughing and seeding have little or no marketable value until the crop is harvested and sold. It is true, of course, that the factor and other inputs used such as hired labor, seed, gasoline, etc., all have economic value as reflected in their purchase price, but whether their combination as reflected in the potential crop will have value or not cannot be determined until the crop is sold. The only value added at the time of marketing is the return to the farmer for assuming risk in combining these inputs, since the value of the inputs themselves would have been previously accounted for and determined by other industries or imports. If, just prior to marketing, the crop is destroyed by accident or act of God then, at that time, all accumulated costs must be written off. In this latter case the factor costs accrued earlier in other industries producing the materials and services used as well as accrued labor and other costs incurred by the farmer are nullified by a negative entry in farm net income. In this case, the production of earlier time periods was destroyed in a later time period. Such additions to economic production in one time period and deductions from economic production in a later time period are completely consistent with the concept of economic production described earlier.

The other question of *where* economic production actually originates raises a number of very basic problems requiring more extensive treatment than is possible within the scope of this paper. It may be noted, however, that it makes a substantial difference to industry of origin measures for factor income and capital consumption allowances to be accrued to "using" industries rather than "owning" industries in cases where the use and ownership of assets are not synonymous. It can be argued that it is desirable that the "owning" industry concept be followed for industry of origin economic production measurement purposes, although the "using" industry concept would clearly be very useful for many purposes. The choice of concept here directly affects the industrial origin of such important items as capital consumption allowances, net rents, and interest. In the case of capital consumption allowances, for example, it is not normally possible for a using industry to report these allowances unless it is also the owning industry. What is needed to clarify these issues is a reexamination of basic concepts relating to the industrial origin and definition of factor income. It seems to us that gross interest on loaned capital and rent payments on rented assets should be considered nonfactor incomes if industry of origin output measures are to be as

useful and meaningful throughout the industrial structure as they might be. This point is further elaborated in the section dealing with "Some Major Conceptual Problems."

FACTOR COST VS. MARKET PRICE VALUATION

As noted earlier, the Canadian industry of origin approach to an aggregate measure of economic production utilizes the gross domestic product at factor cost concept. This is in accordance with the United Nations Statistical Office's preliminary recommendations for the revision of the System of National Accounts (SNA), although market price is considered by that office to be the most basic measure.[10] A net domestic product at factor cost [11] approach is also suggested as part of the production system. Wherever industry of origin estimates are required for purposes of industrial structure analysis, or are to be related to other macroeconomic aggregates such as labor and capital inputs, the factor cost approach is favored. As will be elaborated later, we believe that the factor cost approach facilitates the preparation of a broad range of naturally consistent output and input measures classified by industry of origin. Such a range of measures should be capable of reconciliation with the national accounts at the aggregate level, but the component detail should be free of the distorting effects of unevenly applied indirect taxes and excluded subsidies. As noted earlier, the authors believe that the net domestic product at factor cost concept provides the best conceptual approach to industry analyses.

Demand analysis requires that market prices be used because it is these which determine the quantities of consumption and in turn affect the quantities of factors demanded. However, market prices are largely irrelevant to the broad class of problems relating to the contribution of the different factors, changes of efficiency in their use, etc.

Again, the difficulty of deciding whether indirect taxes originate with purchasing industries or selling industries obscures the meaning of the market price concept of gross domestic product by industry of origin, so that there are both practical and conceptual grounds for favoring the use of a factor cost concept when dealing with the supply side of economic production.

[10] See United Nations Statistical Commission Report, E/CN.3/345, p. 77, and Annex II, The Standard Tables, June 1966.

[11] Also recommended by the UN Statistical Office. See United Nations Statistical Commission Report, E/CN.3/345, p. 78.

In reconciling expenditure and production measures at the aggregate level, it is conceptually clearer, and more accurate statistically, to remove indirect taxes in constant dollars from the constant dollar GNE detailed components than to add indirect taxes to, and subtract subsidies from, the various products of each industry. An analysis of expenditure in terms of industrial source is in no way facilitated by industry measures at market prices if these measures have in them an unknown amount of distortion introduced by arbitrary decisions relating to the industrial origin of certain indirect taxes. An analysis of the industrial source of final products based on factor cost is free of this distortion and serves the purpose as well if not better.

The census and annual survey sales or shipments data, on which the DBS industry of origin real output estimates are based, have traditionally excluded indirect taxes levied on the final products of each industry but have included subsidy receipts as, for instance, in agriculture, gold mines, railways, and feed mills. At the same time, where intermediate input data such as materials, fuel, and electricity have been collected, the valuation boundary has always included all indirect taxes levied, and excluded all subsidies paid. Where census value added has been calculated from these data, it has contained some indirect taxes levied on the industry's assets, both tangible and intangible. An estimate of the magnitude of these residual indirect taxes was made for the year 1949 using 1949 input–output table worksheets, and their relationship with total indirect taxes is shown in the following table:

It may be seen from Table 1 that indirect taxes normally included in census value-added data comprised, in 1949, about 32 per cent of total indirect taxes and about 4 per cent of GDP at factor cost. Indirect taxes originating in manufacturing accounted for 53 per cent of the all-industry total, but only 79 million dollars, or 8 per cent of the manufacturing total of 991 million dollars, could be identified with census value added. In terms of GDP at factor cost originating in manufacturing this amounted to only 2 per cent.

Property taxes represent the major indirect tax component of census value added and in Table 2 the industrial distribution of these taxes is shown. It is interesting to note that the bulk (58 per cent) of property taxes originates with the real estate "industry" which includes the rent imputations on housing and government buildings.

These two tables and the following comments help to appraise possible

TABLE 1

Indirect Taxes Included in Census Value-Added Data Compared With Total Indirect Taxes in 1949

Type of Indirect Tax	All Industries		Manufacturing	
	$ Million	%	$ Million	%
Miscellaneous federal tax	16.0	0.8	0.4	–
Corporation tax[a]	21.0	1.1	6.8	0.7
Public domain tax	39.9	2.1	–	–
License fees and permits	37.0	2.0	4.2	0.4
Motor vehicle license fees and permits	36.0	1.9	5.0	0.5
Miscellaneous provincial and municipal taxes	76.0	4.0	10.5	1.1
Subtotal	225.9	12.0	26.9	2.7
Real and personal property tax	374.0	19.8	52.4	5.3
Indirect taxes included in Census value added	599.9	31.8	79.3	8.0
Total indirect taxes, (all types)	1,885.0	100.0	991.0	100.0
Gross domestic product at factor cost, 1949	14,885.0[b]		4,191.5	
Gross domestic product at market prices, 1949	16,693.0[bc]			

[a]Tax on paid up capital and place of business.

[b]Source: *National Accounts, Income and Expenditure, 1926–1956,* Table 4, p. 35.

[c]Consists of gross domestic product at factor cost (14,885.0), plus total indirect taxes (1,885.0), and less subsidies (77.0).

TABLE 2

Incidence of Real and Personal Property Tax, by Industry, 1949

Industry	$ Million	%
Agriculture	29.0	7.7
Mining	1.6	0.4
Manufacturing (including repair establishments)	52.4	14.0
Construction	3.9	1.0
Transportation	9.6	2.6
Storage	0.4	0.1
Communication	3.4	0.9
Electric power and gas utilities	3.5	0.9
Wholesale trade	2.1	0.6
Retail trade	24.0	6.4
Finance, insurance, real estate	239.1	63.8
(Real estate)	(217.8)	(58.1)
Community, recreation, business and personal service	6.0	1.6
Total	374.0	100.0

distortion in the industry of origin annual measures due to residual indirect taxes. In the over-all real gross domestic product framework the census value added concept has been successfully measured in industries accounting for 30 per cent (within manufacturing 12 per cent) of aggregate GDP at factor cost. Labor input measures are used for about 15 per cent and single item industry projectors for another 5 per cent of coverage. Thus about 50 per cent of GDP originating is, for the most part, free of the distorting influence of indirect taxes and can be said to be on a factor cost basis of valuation. With improvements now under way in price index and intermediate input surveys we believe that about 60 per cent of GDP can be covered by measures based on value added within three to four years' time.

The presently remaining 50 per cent of coverage is mainly represented by the gross output concept, measured for the most part by deflated sales or shipments (adjusted for inventory change where necessary). This level

of valuation includes all indirect taxes paid on intermediate input, plus all indirect taxes levied on the industry's assets or privileges, but it excludes sales and excise taxes levied at the sales or shipments boundary as well as subsidies paid on intermediate inputs used. Individual industry projectors of the gross output type are thus free of distortion due to indirect taxes or subsidies only to the extent that all these taxes and subsidies were proportional to gross output unit values in the base year, or that the industry's output consisted of only one product, or the product distribution remains constant.

It is unnecessary to know all the indirect taxes paid by each industry to obtain factor cost values unless one starts with a gross value that includes all indirect taxes levied on that industry. Canada's measures would, of course, be improved if that portion of indirect taxes levied on assets or privileges were collected on a regular survey basis and could be properly deflated and removed from each industry's projector. We believe that this could be done without introducing significant error into the net measures. The base for such taxes is relatively stable and it would be possible to deflate property taxes by moving them on real capital stocks or by the use of specially constructed price indexes relating to property taxes. Of course, if a gross output projector must be used, or even an intermediate input projector, it is clear that such a projector will be questionable on more serious grounds than those of its indirect tax content. But, in the double deflation approach, it is unnecessary to know the indirect tax content of intermediate input.

In Canada, the problems of assigning indirect taxes to (and excluding subsidies from) particular products within an industry are virtually impossible to overcome without knowledge of the use to which a product is to be put. Depending on its end use, a product may be relatively free of indirect taxes (materials or products used in further processing, and essential consumer goods such as bread, for example), or it may attract additional indirect taxes (cigarettes and liquor, and building materials sold as such to persons, for example). Even in normally taxable end uses, sales may be made without a tax being levied, as for example when the federal government purchases the product. Records of the use of the individual products of an industry are not generally available from producers nor easily estimated. Thus, even if it were desirable to build an industry of origin market value system, it would not seem to be feasible in Canada.

DOMESTIC VS. NATIONAL PRODUCT

As noted earlier, the industry of origin studies have been confined to a gross domestic product at factor cost concept. Thus the economic production measured is that produced by industries located within the geographical boundaries of Canada.[12] The term "domestic" differs from the term "national" as used for national accounting purposes by excluding production in foreign countries accruing to Canadian owners residing in Canada, and including all production taking place within the boundaries of Canada, regardless of the ownership of the means of production. The domestic concept flows naturally out of the basic industrial data while the national concept requires that a number of adjustments be made. To adjust the domestic measure of production (GDP) to a national measure (GNP), it is necessary to deduct not only interest and dividends and certain labor income but also depreciation and unremitted profits where applicable, which accrue to nonresident owners of capital located within the geographical boundaries of Canada and to add these same items accruing to Canadian owners of foreign assets. Such additions and deductions can only be estimated satisfactorily on an aggregate basis. Corresponding industry adjustments are frustrated by both practical and conceptual difficulties.

Table 3 shows the adjustments needed to reconcile GNP at market prices with GDP at factor cost in 1949.[13] Table 4 illustrates a reconciliation in constant dollar terms between the industry of origin GDP results and the deflated expenditure on GDP. The basic approach used in this reconciliation is that of deflating the current dollar indirect tax content of final expenditure category market values using input–output relationships.[14] The approach followed in previous studies,[15] in which

[12] There are a number of exceptions to this general rule. In the case of shipping and airlines, the services of Canadian-flag carriers are covered regardless of where the service occurred. On the other hand, the service of foreign-registered ships and aircraft are excluded even though the service performed occurred in Canadian waters or in Canadian skies. Another exception is the case of the armed forces and diplomatic services. Canadian forces and diplomatic personnel stationed abroad are included in domestic product while the personnel of foreign countries stationed in Canada are excluded.

[13] Both tables 3 and 4 are adapted from *Indexes of Real Domestic Product by Industry of Origin, 1935–61,* Appendix D, "Problems in the Reconciliation of Real Gross Domestic Product at Factor Cost with Constant Dollar Expenditure on Gross National Product at Market Prices."

[14] The technique used is described in Appendix D, *Ibid.,* pp. 135–144. As noted earlier in this paper certain indirect taxes such as property taxes should be de-

TABLE 3

Relation Between Gross National Product at Market Prices and Gross Domestic Product at Factor Cost, Canada, 1949
(million dollars)

	1949
Gross national product at market prices	16,343
Minus:	
Residual error of estimate	-43
Indirect taxes less subsidies	1,808
Income received from nonresidents	83
Plus:	
Income paid to nonresidents	390
Equals:	
Gross domestic product at factor cost	14,885

the industry of origin studies were placed on a GDP at market price basis, has been discarded due to the fact that the allocation of indirect taxes to industries and to industry product detail is both too arbitrary and too difficult.

NET VS. GROSS DOMESTIC PRODUCT

Although it would be desirable for conceptual and other reasons to develop industry measures that are net of capital consumption allowances, it has not yet been possible to do so because of the practical difficulties encountered in isolating these allowances. Current dollar capital cost allowance data are available from taxation records, but these are usually calculated with a view to minimizing taxable income and do not necessarily reflect cost expiration even in the conventional account-

flated by moving them on such series as real capital stocks rather than the gross or net output of industries.

[15] One such study was discussed in an earlier paper to this Conference: V. R. Berlinguette and F. H. Leacy, *The Estimation of Real Domestic Product by Final Expenditure Categories and by Industry of Origin in Canada.* See *Output, Input, and Productivity Measurement,* Studies in Income and Wealth 25, Princeton for NBER, 1961, pp. 214–216.

TABLE 4

Gross Domestic Product at Factor Cost in Constant (1949) Dollars, 1953 and 1954
(million dollars)

Industry approach	1953	1954	Expenditure approach	1953	1954
1. Index of gross domestic product at factor cost, 1949 = 100	(127.4)	(124.7)	1. Expenditure on gross national product at market prices	20,794	20,186
			2. Minus: Residual error of estimate[a]	-117	-11
			3. Interest and dividend receipts from nonresidents	-151	-135
			4. Plus: Interest and dividend payments to nonresidents	360	381
			5. Expenditure on gross domestic product at market prices	21,120	20,421
			6. Minus: Constant-dollar indirect taxes less subsidies	2,130	-2,119
2. Gross domestic product at factor cost (before statistical difference)[b]	18,963	18,562	7. Expenditure on gross domestic product at factor cost (before statistical difference)	18,990	18,302
3. Statistical difference[c]	13	-130	8. Statistical difference[c]	-14	130
4. Gross domestic product at factor cost	18,976	18,432	9. Expenditure on gross domestic product at factor cost	18,976	18,432

[a]As per Table 5, *National Accounts, Income and Expenditure, 1926–1956*. This is the current value national accounts residual error of estimate, expressed in constant (1949) dollars.

[b]These estimates have been obtained by converting the indexes of gross domestic product at factor cost to constant dollars, using $14,885 millions as the estimate of gross domestic product at factor cost for the year 1949.

[c]This is the statistical difference between the two estimates of gross domestic product at factor cost, in constant dollars, and should not be confused with item 2 of the expenditure approach.

ing sense. Further, capital consumption allowances are so far generally available on a company basis only and not on the more desirable establishment basis. These source records are far from adequate in providing data corresponding to the required economic concept of capital consumption allowances for industry of origin studies. It is hoped that the research program underway in DBS on the preparation of estimates of constant dollar capital formation, capital stock, and capital consumption allowances by industry using the "perpetual inventory" method will eventually permit the needed refinement of the real GDP industry measures.[16]

It should be noted that, when this refinement is achieved, real net domestic product at factor cost can be isolated. In our view this is the conceptually desirable level of valuation for supply-side analysis. Of course, factor cost and market price valuation (of the factors of production) are identical at this stage.

COMMERCIAL VS. NONCOMMERCIAL PRODUCTION

In the Canadian industry of origin estimates, a rough split has been made between industries that operate for gain and those that do not. In general, those production units that are classified in the national accounts to the business sector are included in the commercial group of industries, while those classified to the personal and government sectors are included in the noncommerical group. Commercial industries both sell their products and purchase their intermediate inputs in the market; thus the basic data are generally available from which current- and constant-dollar net output can be determined.

Noncommercial industries do not operate primarily for the purpose of making a gain. Examples are charitable organizations, public schools, and hospitals. Some noncommercial establishments do charge the user for their services, but this charge usually falls short of covering expenses and may not be related to the specific service rendered in each case. Establishments classified to the public administration and defense industries do not operate for gain and are included with the noncommercial group of industries.

[16] The results of this program to date are shown in DBS Occasional Papers 13-522, *Fixed Capital Flows and Stock, Manufacturing, Canada, 1926–60 (Methodology)* and 13-523, *Fixed Capital Flows and Stock, Manufacturing, Canada, 1926–60 (Statistical Supplement)*, Ottawa, 1967.

Institutions in the personal sector and in the government sector (such as municipal schools) have no transactions which uniquely define the cost to the user of the individual service being produced. They do, of course, have records of labor costs, some purchased goods and services, and some capital consumption allowances which permit the derivation of current dollar aggregates for national accounting purposes and industry of origin estimation. But any attempt to measure output in constant dollar terms founders on the lack of meaningful product detail. A decision could possibly be made as to what the products are, but the problem of deriving an appropriate weighting pattern would still remain. Attempts to do so in terms of relative base-period costs could not be considered satisfactory because there is no way of knowing how well these would parallel the judgment on the use of primary and other inputs which only the market place can render. Thus, since output is not evaluated, it cannot be properly measured, and a cost convention has to be used which necessarily has a limited meaning.

In Canada, the industry of origin real output measures for noncommercial industries follow the concepts laid down for the current-dollar national accounts series. In the latter, the contribution to gross domestic product of public administration and defense and most other noncommercial industries is measured by salaries, wages, and supplementary labor income. In a few cases such as public hospitals, labor costs are supplemented by depreciation charges. In the deflated final expenditure categories approach, these primary costs are supplemented by the deflated value of all purchased materials and services. In the industry of origin approach, the latter are not included since to do so would cause duplication, such inputs being measured as the products of other industries.

The procedure of measuring the real output of public administration and defense and other noncommercial industries by deflated labor costs leaves much to be desired but seems preferable to presently available alternatives. However, the importance of developing useful output and efficiency measures for these industries is becoming increasingly recognized by governments and others. In turn, this is leading to improved data on program-costing and eventually might well permit some breakthrough in output measurement for these industries.

IMPUTATIONS AND OTHER PROBLEMS RELATING TO PRODUCTION BOUNDARIES

The industry of origin GDP estimates are designed to cover all the industries specified in the Canadian Standard Industrial Classification Manual.[17] In addition, they encompass extensions made for purposes of the Canadian System of National Accounts.[18] These extensions take the form of imputations of a market value to a good or service that does not pass through normal market channels but which does have a reasonable market counterpart, as for example farm income in kind.

A major imputation is made in respect of owner-occupied houses, on the assumption that home owners are in fact business units, renting houses to themselves. This convention serves to make production accruing from the use of residential real estate invariant to ownership, and thus differs from the treatment of other consumer durables such as cars. The present Canadian industry of origin real output measures follow the conventions of the national accounts and include imputed rents in a special real estate (rents) industry, although it might be considered desirable to eliminate this imputation for purposes of industry of origin output and productivity studies because of the difficulty of isolating labor income or input into this "rents industry."

SOME MAJOR CONCEPTUAL PROBLEMS

Public Administration and Defense

There is probably no single industry that has given rise to more theoretical discussion among national accountants than public administration and defense. This results from the fact that its products are not sold on the market. Admittedly less than perfect conventions have been set up to evaluate the goods and services provided by the public administration and defense industries in Western countries. National accounting practice treats production in these industries in the same way as it treats households, the outputs of the various goods and services provided being valued at cost, i.e., in terms of salaries and wages paid and/or the cost of the goods and services purchased, and the economic process covered is deemed to have ended at this point.

[17] *Standard Industrial Classification Manual,* Ottawa, 1948, and as revised in DBS Occasional Paper No. 12-501, 1960.

[18] For the importance of these imputations see *National Accounts Income and Expenditure, 1926–56,* Table 49 and accompanying text.

Thus, this approach to the valuation of the goods and services provided by the public administration and defense industries tacitly assumes that they are provided collectively. No residual rent is created by government activities.

This approach has been challenged in recent years. It is suggested that national income or national product can, on the one hand, be taken to reflect an evaluation of existing output, for the purpose of making comparisons of welfare among communities and through time. On the other hand, it can be taken to measure the value of potential output that might be produced with existing inputs of resources.[19] From both points of view, the present treatment of government is unsatisfactory. Kuznets, for instance, has argued that, in order to measure "welfare," items of expenditure that are not in themselves final consumption or investment should be excluded.[20] Thus, on this line of reasoning, "environmental outputs," which make private production possible, constitute duplication since they are already reflected in the value of final output for the business sector. Only the value of those publicly provided goods which have counterparts in the business sector should be counted as government production.

Apart from the difficulty of drawing the dividing line between such intermediate and final public goods and services, the inconsistency of adding the value of public goods at cost to private goods at market prices remains. Clearly a welfare connotation requires that national product be valued at market price and, as Forte and Buchanan have demonstrated, current procedures of measurement can only result in a mixture of welfare and opportunity cost valuation of the total national income or output.

Those who consider the public administration and defense industry as a producer of goods and services find the present method of measuring government output inadequate. It is argued that national income statistics can be reduced to one basic measurable total of the end product of business and government which would then be invariant to institutional changes. The advocates of this concept propose an imputation for the value of services of government assets. An imputation for gov-

[19] For a summary of this view see F. Forte and J. M. Buchanan, "The Evaluation of Public Services," *Journal of Political Economy,* April 1961, p. 107.

[20] See "On the Valuation of Social Income—Reflections on Professor Hicks' Article," *Economica,* February–May 1948.

ernment-used property, analogous to private property such as rentals (both gross and net) and with due regard for expenses incurred, depreciation, etc., has been made in Canada. However, for such government assets as roads and canals, it is impossible to assess a realistic market value based on returns. Colm proposes, for instance, that the imputation should include the application of some fixed rate of return to estimated capital values.[21] The approach Colm proposed would require a comprehensive survey of public capital assets, their valuation and depreciation. On the question of intermediate or final use of government goods and services, Colm has proposed that they should all be considered as final products.

The serious shortcoming of a cost approach to the measurement of goods and services produced by the public administration and defense industries is that only in a very few instances can asset use be evaluated. As noted earlier, any consistent evaluation would require some fixed rate of return to capital assets. The difficulties of deriving such rates, as well as those involved in the valuation of the capital assets, would be substantial.

The difficulties which present themselves from a national accounts standpoint are even more formidable in the industry of origin context, where the possibility of deriving a useful measure of output for the public administration and defense industries seems more remote. To provide useful comparisons of performance with resource cost, for instance, activity measures are necessary for individual products and services. This in turn depends on the availability of detailed cost accounting data.

Such data would permit valid estimates of primary input costs pertaining to both labor and capital, at least for major activities in the public administration portion, and these could be used to reflect productivity change in the utilization of these factors. Such cost accounting data are not available although progress in government program-costing is encouraging.

The present Canadian industry of origin approach uses a factor (labor input) valuation for services produced by the public administration and defense industries. When the volume of output is measured by means

[21] G. Colm, "A Re-examination of Controversial Issues," in *Problems in the International Comparison of Economic Accounts,* Studies in Income and Wealth 20, Princeton for NBER, 1957.

of a labor-input series, real output in the public administration and defense industries is almost certainly understated, since no allowance is made for the increased productivity of labor input. Advocates of a complete-cost approach are also unable to make allowance in the capital-cost series for productivity change, thus giving rise to a deficient measure. Current dollar measures can be constructed on a reasonably sound basis using the complete-cost approach, but real output and productivity measures require meaningful product detail with price and quantity data. In their absence, any adjustments for productivity must be arbitrary in nature.

A possible interim approach might be along the lines indicated by George Jaszi when he stated that, "It may be possible to focus not on the services provided by the government to the public, but on the services government employees render to the government, and perhaps derive a measurement of productivity that is tied to technical efficiency with which various detailed operations are performed and does not concern itself with the more ultimate purposes of these activities." [22]

The Service Industries

Although economics deals with the allocation of scarce resources in the production of both goods and services, the latter sector was neglected until comparatively recent times. This is understandable in view of the tendency for theoretical emphasis at any time or place to reflect the influence of the dominating sector in economic development. For example, the physiocrats tried to establish the criteria of productiveness in terms of agriculture, the mercantilists looked to foreign trade, while Adam Smith and the classical economists who followed him saw the production of material commodities in general as the key to economic prosperity—an outlook that has persisted almost to the present day.

Another more recent fact that has tended to inhibit the development of service industry measures is the difficulty encountered in defining their role and their products. Goods, being tangible, are usually easier to understand and measure than services and, on this account, have

[22] G. Jaszi, "The Measurement of Aggregate Economic Growth, A Review of Key Conceptual and Statistical Issues as Suggested by United States Experience," *Review of Economics and Statistics,* November 1961, p. 328.

tended to overshadow services in both theoretical and statistical development.

What has been accomplished to date in the measurement of service industry output certainly cannot be described as ideal, although it may be sufficient to gauge the requirements of an adequate system. Output measures are available for the majority of the goods-producing industries and, although they may suffer from biases, data gaps, and other deficiencies, they have generally been prepared in an atmosphere of understanding. This is far from being the case with the service industries. Before a really adequate data base can be developed for the service industries, it is necessary to understand clearly what should be measured and how it can be measured.

Considerable attention has been given to the problem of classifying economic activities into goods- or service-producing industries, a common criterion being whether or not the activity in question involves a physical transformation of materials. This has inevitably resulted in a number of borderline cases, among which public utilities come readily to mind. It seems to us that classification as such is a secondary issue which can quite satisfactorily be resolved by arbitrary treatment appropriate to particular situations. Inasmuch as the criteria involved have been carried over to the problem of measurement, however, they have had a misleading effect in creating confusion between superficial and fundamental characteristics of the production process. In the constant dollar approach particularly, the measurement of output has been so closely identified with a transformation process that the failure of the service industries to meet this criterion may have resulted in a somewhat negative attitude towards the problem. For example, a shirt being sewn or packaged is clearly seen as some form of production, but a packaged shirt that has been transported, sold, insured, etc., always looks the same even though it in fact represents a different aggregate of factor incomes.

There can, of course, be no doubt that when the creation of market value is synonymous with an act of physical transformation, supported by value data for both output and input which can be factored into quantity and price components, the measurement of constant dollar value added is greatly simplified. However, the lack of such data in certain durable goods industries is just as serious an obstacle to

measurement as it is in the great majority of service industries, despite the fact that physical transformation is clearly evident in the one case and not in the other. The primary problem is thus one of recognizing the identity of measurement requirements throughout the whole industry of origin approach. Grave difficulties of application may exist in particular cases, but the availability of a common and consistent framework within which to view them should permit a more positive approach to what had hitherto been regarded as an intractable group of industries.

Notwithstanding these difficulties, it has been possible to prepare real output measures on a basis roughly equivalent in quality to those in the goods-producing industries for about one-third of the service-producing industries, concentrated for the most part in trade and transportation. Another third have serious data problems but these could be overcome without great difficulty by initiating statistical surveys designed to fill gaps and clarify ambiguities. The remaining commercial service industries, such as insurance, financial intermediaries, and business services, pose a much greater challenge from a conceptual point of view. If the problems in these areas can be solved, the way would be clear for meaningful statistical measures covering at least the commercial part of the services-producing industry sector.

Financial Intermediaries

The Canadian national accounts' income and expenditure system, in its presentation, has been largely concerned with aggregative relationships such as those between sectors (personal, business, etc.) of the economy and between income and expenditure flows at the total level. The current-dollar distribution of value added by industry of origin has been of subsidiary interest. A more detailed scrutiny by industry of origin brings to light certain problems which, in our opinion, do not show up in the more aggregative setting. One such problem concerns the origination by industry of certain factor incomes, particularly those arising out of gross interest and rents. On an aggregate basis, the allocation of factor incomes to individual industries is not required and it is sufficient merely to ensure that these be picked up somewhere in the aggregation. In an industry approach no such facile handling is possible, for here the critical question is one of exactly where in the industrial structure economic production does in fact originate.

The present practice in the Canadian national accounts, as well as in industry of origin data, is to treat interest paid as representative of factor income originating in the industry paying the interest. Thus interest receipts from other industries, which are included in the reported profits of the owning industry, must be deducted from these profits. In effect, interest received is treated as a transfer payment. In the case of financial intermediaries, which in total contribute about 3.5 per cent of gross domestic product, a banking imputation is made, the assumption being that certain services performed by the banking system are not reflected in the market transactions of the system. For example, commercial banks in Canada traditionally pay a lower rate of interest to their depositors than would prevail if services performed for the depositors were charged for at a rate designed to cover the costs of the services so performed.

We feel that the treatment of interest in the national accounts should be thoroughly reexamined from the point of view of considering interest receipts and payments as receipts from, and payments for, the sale of services, in conformity with normal business accounting practices.[23] The present treatment in the national accounts, discounting the banking imputation, results in negative factor income in certain financial industries and what the authors believe is a general distortion in the distribution of factor incomes as between financial and nonfinancial industries. It is believed too, that the banking imputation is not a proper solution for that industry. The distorted current dollar distributions in turn carry over into the measures of real output and productivity.

As noted earlier, industry output and income measurement must be related to the creation of market value. The suggestions which follow are an attempt to apply this concept to the measurement of current and constant dollar output in the banking industry, which is perhaps the most obvious example of the problems inherent in the present treatment of financial intermediaries. Market value in this industry arises out of its function in providing certain facilitating services incidental to the production and distribution activities of nonbanking industries, persons, etc. As with fixed capital assets, a

[23] While there is fairly general agreement in the DBS regarding the need for a reexamination of the problems posed by financial intermediaries for industry of origin measures, it should be made clear that our particular proposals represent a minority opinion.

business establishment may choose between ownership or rental of liquid capital, and thus the hiring of money may be thought of as analogous to the hiring of machines or the rental of property. Banks themselves treat interest receipts as revenue and interest payments as costs so that, from the production viewpoint, current dollar value added can be identified in a manner quite consistent with the procedures followed in goods-producing industries. A corollary of this treatment, of course, is that interest received and paid be similarly identified as revenue and intermediate input in other nonfinancial industries.[24]

Once the current dollar industry of origin measures are derived in the suggested manner, the preparation of constant dollar measures may be considerably facilitated. However, the task of obtaining a good breakdown of value into price and quantity components for the financial intermediaries will not be a very easy one. In deflating bank revenue, for example, several alternative methods of deriving constant dollar gross interest have been examined by writers such as Speagle and Kohn. One approach is simply to deflate with a price index of interest rates, while another requires additional deflation using a related price index such as the implicit price index of GNE, the Consumer Price Index or a price index representative of goods and services actually purchased with borrowed money. As Speagle and Kohn have pointed out, deflation with a price index of interest rates alone merely results in a series in which interest rates of the base year are held constant. To quote an analogy in the area of retail trade, this approach would be similar to deflating margins with an index of changes in gross margins which would in fact be no deflation at all since all it accomplishes is a revaluation with constant margins. On the other hand, a deflation of gross interest receipts with a price index of goods or services purchased by the borrower paying the interest equates the service provided with the quantity of goods or services purchased, rather than with the quantity of service actually rendered by the banking industry. Clearly, further research resources should be assigned to problems such as this if mean-

[24] For background discussion relating to the various conceptual issues and views, see National Bureau of Economic Research, Studies in Income and Wealth 10, pp. 28–84; and R. E. Speagle and L. Silverman, "The Banking Income Dilemma," *Review of Economics and Statistics,* May 1953.

For a discussion and analysis of various approaches to problems of deflation, see R. E. Speagle and E. Kohn, "Employment and Output in Banking, 1919–55," *Review of Economics and Statistics,* February 1958.

ingful growth, productivity, and price analyses are to be undertaken for these industries and if these, in turn, are to be integrated within the system of economic production statistics.

It is our contention that each individual establishment should be viewed as an integral operating unit with operating revenue and related intermediate operating expenses, permitting the calculation of domestic product or value added along conventional lines. It is, of course, recognized that a departure such as this from the traditional national accounting systems would ease some problems relating to financial intermediaries, the relationship of financial intermediaries to nonfinancial industries and sectors, and national-domestic concept differences, but would also add some problems in respect to deflation of the output and input of all industries, which would now include interest flows. Other added problems would include the necessity to reformulate basic related theory and concepts and to trace effects on the various flows and components within the entire system of national accounts. For instance, there would be a problem in the personal sector, where there will be gross interest receipts, which under the proposed system might be treated as receipts from the sale of services.

In raising these issues, we hope to stimulate discussion and research which may lead to a solution to the problems we believe are created by the existing treatment of interest.

In DBS, it has recently been proposed that rent receipts and payments be treated as operating income and expenses respectively in establishment surveys and the industry of origin measures. In making this proposal it is recognized that rental income arises in two general areas, namely (a) rental of immovables, such as land and buildings, and (b) rental of capital equipment. Under the proposal, whenever an asset, be it real property or equipment, is leased and where this leasing activity is separable from the other activities of an establishment so that a separate leasing establishment can be identified, rental income derived from such leases should be classified under that establishment and the establishment classified either under the real estate industry, where rent is derived from immovables, or under the appropriate industry where rent is derived from leasing capital equipment. When such rental and/or leasing activity is not classifiable as a separate establishment, then such rental income should be included with the operating income of the leasing establishment. This approach to the treatment

of gross rents classifies net rent and associated capital consumption allowances under the owning or supplying industry rather than under the using industry. We recognize that there may be equally valid arguments for allocating rents to the using industry rather than the owning industry as, for example, in the construction of input–output tables.

III. The Data Base and Basic Methodology for Canadian Industry of Origin Output Measurement

THE DATA BASE FOR HISTORICAL MEASURES

On an historical basis, industry production measures have been dependent on a very broad range of decennial, occasional, annual, and subannual surveys of companies, establishments or locations, and activities. Using these and other source data the industrial distribution of gross domestic product in the Canadian national accounts has been, and still is, a mixture of company and establishment (including location) statistics. Another published current value series has presented census value added data (gross output less materials, fuel, and electricity) for the commodity-producing industries by province and territory [25] but does not provide similar data for the service-producing industries nor data for intermediate service inputs in the commodity-producing industries. Measures of real output such as the Index of Industrial Production and the real domestic product by industry of origin estimates were developed in annual and subannual form, using this mixture of survey data in such a way as to best approximate the desired concept.[26] Thus, the basic data inventory used so far for industry of origin studies, while quite extensive, cannot be described as ideal for most industries, and it has, of course, been much worse from the subannual than the annual point of view.

DATA BASE IMPROVEMENTS

In recognition of this general need for more comprehensive and consistent industrial data, the Dominion Bureau of Statistics has

[25] DBS Catalogue No. 61-202, *Survey of Production* (annual), Ottawa.

[26] Detailed descriptions of data used for both the subannual and annual industry measures may be found in Appendices B and C of *Indexes of Real Domestic Product by Industry of Origin, 1935–61* and in Appendix B of *Revised Index of Industrial Production, 1935–57.*

undertaken a number of programs aimed at improving the industrial data base. One of the main developments has been the introduction (in 1960) of a revised industrial classification of establishments, accompanied by a more practicable interpretation of the establishment itself. Work is also in progress on studies of the relationship between company and establishment classifications and reporting units, the accelerated development of industry selling-price indexes and matching value data, a review of commodity classifications, and the further integration of such systems as the national accounts, interindustry and financial flow tables, industry of origin real domestic product measures, industry prices and productivity measures.

The Basic Reporting Unit and Industry Coverage

In order to achieve a complete coverage of economic production using the establishment as the basic reporting unit, the definition of the establishment requires careful interpretation. Prior to 1960, in most industry surveys the "establishment" consisted of a reporting unit corresponding to "process" or "location" (store, plant, warehouse, mine, smelter, etc.) and was generally confined in scope to the main activity only of any multi-activity reporting unit. This resulted in many inconsistencies, and control over reporting procedures in different surveys could not possibly be tight enough to prevent gaps, duplication, and differences in coverage of establishments. With the introduction of the revised SIC the establishment was defined as "the smallest unit which is a separate operating entity capable of reporting all elements of basic industrial statistics." With this new definition, introduced in 1961, data on all operations of the establishment are covered as opposed to the previous emphasis on main activity only.[27] Furthermore, the products of these activities are, with some exceptions noted later, to be valued at whatever boundary—plant, gate, establishment sales outlet, delivery point, etc.—they leave the establishment. Of course this establishment concept results in some increased heterogeneity in the industry data, but it is felt that the advantages of improved accuracy and consistency far outweigh the disadvantages.

In order to illustrate this change in reporting procedures, it may

[27] Intermediate service inputs are not yet covered by annual censuses of industry although these have been collected in the Decennial Census of Merchandising and Services for 1961 and in a special survey of other industries designed to meet the needs of the 1961 input–output table.

be useful to consider the example of a manufacturing establishment which encompasses a factory or fabricating unit, a factory sales office, a warehousing unit removed from the factory, and several retail and wholesale sales branches located away from the factory. According to the new concept and the definitions related to it, this assortment of activities constitutes an establishment within which it is not possible to isolate value added relating to the various activities. The concept recognizes that, for each product item produced or sold, only one firm value—the actual transaction price—exists on the establishment's books and that only intermediate inputs from outside the establishment can be routinely valued at their actual purchase prices. In such a situation, it is thought better to accept the establishment as it actually operates rather than attempt to break it down into artificially separate activities. To attempt such a breakdown would be to force the establishment to file various reports covering the different activities, with arbitrary valuations as the products of the establishment flow from one stage to another. Subsequent to the complete implementation of this establishment-reporting-unit concept it might be possible, with the assistance of supplementary questions on annual survey questionnaires, to sum across establishments for main activities such as shipments of goods of own manufacture and own-account construction on a gross basis, although the problems of isolating value added for such activities within the establishment will remain unsolved because many inputs cannot be identified with specific activities.

This establishment approach to industry of origin measurement thus attempts to rectify the shortcomings of the pure activity system which existed heretofore, while at the same time avoiding the pitfalls inherent in the use of a company system with its broader, more heterogeneous, and changeable industrial structure. Of course, the establishment approach cannot solve all the problems. Establishments that have vertically integrated operations cutting across primary, secondary, and even tertiary industries (as, for example, mining, smelting, and refining; or crude oil production, refining, and distribution) must be split, if this can reasonably be achieved, in order to prevent too much heterogeneity in the industry measures. Errors introduced by such splits can be minimized, however, by means of careful analysis of input–output relations.

Most DBS data collecting divisions have already converted their industry surveys to the new establishment base and others are in process of doing so. Exceptions to this conversion are those surveys expressly intended to cover company data, such as corporation profits, financial assets and liabilities, and location data such as small area sales and employment. Progress in developing establishment surveys based on the new interpretation of the establishment has been good, but somewhat uneven throughout the industrial structure. If this were fully implemented in all industries, the new interpretation would afford a consistent statistical base for industrial analysis.

In the meantime, the process of implementation has itself given rise to some difficult statistical problems and inconsistencies in the industry of origin measures.

The implementation of the new concepts has progressed faster and further in the area of manufacturing than in any other industry division, although, so far at least, intermediate service inputs are not collected in the annual censuses. There are also a number of other problems. For example, some users require manufacturing (activity) census value-added data to be isolated within the total establishment activity framework. This is frequently difficult to accomplish in any consistent and meaningful way since it involves the separation of fabricating costs from selling costs, warehousing costs, etc., as well as the artificial valuation of products at different levels of processing and handling. Some of the outstanding data problems arise because of a lack of provision for the reporting of service outputs such as gross rents received, as well as certain transportation costs included in the transaction price of products sold and also purchased services.

In the manufacturing censuses of Canada and other countries, outward transportation charges paid to common or contract carriers are treated differently from transportation costs provided by the establishment itself. Products delivered by a producing establishment's own transportation facilities are reported inclusive of delivery costs, while payments made to common or contract carriers are excluded from the revenue or gross output data and are not collected as service inputs. This results in a confusion of value and price boundaries and an unknown amount of error is introduced into the net output of the producing establishments. The product of an establishment that is shipped via common or contract carrier, and for which the charges

are met by the producing establishment, would show up on the purchasing establishment's books at the delivered cost. In current-dollar terms, the common or contract carrier transportation charges met by the producing establishment and the related revenue that it receives from the purchasing establishment may or may not cancel, depending on company policy, competition, etc. When these flows are expressed in constant dollar terms there will almost certainly be some non-cancelling effects or error. Such problems and inconsistencies as these are being systematically studied in DBS, and it is hoped that they can be substantially reduced over the next several years.

In the areas of merchandising and some selected personal, business, and recreation service surveys, substantial progress has been made in building an establishment-type set of total-activity data which, although by no means perfect, are reasonably consistent with the gross domestic product concept. For most of these areas, intermediate service input data for establishments have been collected with a fair degree of success in the latest decennial census and will continue to be collected on a triennial rotating basis. Subannual sales data will probably remain on a location basis for the foreseeable future, thus requiring periodic adjustment to the more comprehensive establishment surveys. There still remain, however, numerous data gaps in the service industries.

Some major industry divisions or sectors are still completely or mainly on an activity basis. The most important of these are construction and agriculture. Construction is, of course, a most difficult industry to survey, as evidenced by the fact that most countries do not have proper censuses of their construction industries.[28] In Canada some of these survey problems may result from attempting to measure the construction industry as a whole rather than breaking it down into a substantial number of relatively homogeneous subindustries as in other major industry divisions. The identification of establishments for this industry and a clear distinction between activity or commodity surveys and industry surveys might also help to overcome some of the present problems. Total activity or commodity statistics can be derived by summing the gross output data relating to construction as a primary and secondary activity from the entire spectrum of establishment-based

[28] See the United Nations Statistical Commission report E/CN.3/306, *Summary of the Comments Received from Various Countries Regarding the Study "Construction Statistics,"* January 1965.

industry surveys. We do not see any reason for treating construction differently in this regard than manufacturing and distribution.

What must be accepted here, as indeed for all other industries, if studies of structure, value added, growth, productivity, etc., are to be developed, is the principle of using reporting units of the establishment type. Activity-based statistics that incorporate "own-account" construction by nonconstruction reporting units can never yield these measures because it is generally impossible to match properly related output and input elements. Clearly too, the traditional approach to census value added, which is an unsatisfactory concept in any case in the context of establishment-based total activity measurement, is even less satisfactory in the case of the construction industry because of the wide prevalence of subcontracting.

As noted earlier, collection difficulties are admittedly severe for the construction industry, but it is believed that these could be mitigated by following the approach suggested. It is our belief too that the use of physical measures to project real output in these industries should be avoided because of the difficulty of assessing quality change in construction industry products. A far better approach to quantity measurement is through value deflation using specially constructed price indexes, which can be tailored to major components such as heating and air conditioning, landscaping, electrical, plumbing, steel, or masonry subcontracting.

Agriculture is also an industry which presents difficult statistical problems for industry of origin measures. Again, agricultural statistics need to be developed on an establishment and subindustry basis in order to permit their proper analysis and integration within the domestic industry structure. Historically, the collection of agricultural statistics has been oriented toward individual commodities to meet the specific requirements of governments and market analysts. These commodity data, although valuable from the latter point of view, have been inadequate for purposes of meeting all the technical requirements for the study of agriculture as an industry or group of industries. We recognize the difficulties inherent in obtaining establishment-based data for agriculture in a manner consistent with other industries such as manufacturing or retail trade but we believe such an approach would eliminate most of the present problems and inconsistencies in the industry of origin measures. Commodity statistics are undoubtedly

required in addition to establishment statistics, but both objectives could be achieved simultaneously by giving primary emphasis to the establishment and summing commodity data across these establishments.

Establishment–Company Problems

For purposes of interindustry flow tables, as well as for industry of origin current and constant dollar measures, it is necessary to estimate establishment-type data for some components of gross domestic product from available company records. With the probability that the industrial distribution of income and gross domestic product in the official Canadian national accounts will become entirely company-based, there is, as was noted in the introduction, a pressing need to develop a parallel system of establishment-based current dollar statistics, and to be able to reconcile the two systems.

In the process of preparing both an input–output table and a new set of base-year industry weights for the real domestic product indexes for the year 1961, considerable attention has been given to methods of estimating establishment operating surplus (inclusive of capital consumption allowances) from multiestablishment company returns. With the adoption of a total-activity establishment concept for industry censuses and the gradual extension of these censuses to such industry areas as construction, merchandising, and services, such a task should become easier in the future. Of course insofar as establishment gross output and intermediate-input boundaries are arbitrarily drawn by the company to which they belong, the allocation of company operating surplus to its establishments will run into trouble. However, these difficulties with the establishment as a reporting unit will become better understood through a systematic company–establishment reconciliation and, in time, can be reduced.

One of the major problems encountered in the breakdown of multi-establishment company data has been the lack of complete coverage of the affected component establishments in DBS industry surveys outside those areas covered by full censuses. Other problems encountered, particularly in the early stages of this work, included some confusion in establishment valuation boundaries between industries such as manufacturing and merchandising and, occasionally, actual duplication of establishments. Such problems are gradually being eliminated, however,

through such administrative devices as a central list of establishments and integrated company-establishment files. A considerable amount of attention is now being given to the preparation of matched company-establishment records which in turn should permit the eventual derivation of integrated and matched value-volume-price data for gross domestic product by industry of origin on an annual basis. The attainment of this goal may take a number of years, but there is general agreement that it should be pursued as rapidly as resources permit.

VALUE DEFLATION BY SPECIFIED PRICE INDEXES

Probably the most significant area of recent statistical advance in Canada relevant to industry of origin real output measures is the development of industry selling-price indexes and the matching of value and price boundaries for establishments.[29] Progress in these areas will have significant and direct effects on the quality of the industry real-output measures. Because of its importance, it is worthwhile discussing the background and current development of industry value deflation in Canada.

As may be seen from a study of the appropriate appendixes of the two basic industry real output reference documents previously referred to, annual, quarterly, and monthly real output measures have been developed in large part through the extensive use of value data deflation, either by price indexes based on specific prices or by indexes of average unit value. About 20 per cent of both the annual and subannual aggregates of real domestic product by industry of origin, as published in these basic historical documents and kept up to date in current monthly Index of Industrial Production releases,[30] is dependent on deflation methods using price indexes derived from price surveys of specified commodities. For the historical computation of these annual and subannual measures, price indexes were drawn from a wide variety of sources, including most DBS price index records. It should be noted that these published industry real output measures do not reflect any use of the new industry selling-price indexes. These indexes are being used quite extensively, however, in annual manufacturing industry bench mark updating now underway for the 1959–1961 and

[29] See DBS Occasional Paper No. 62-515, *Industry Selling Price Indexes, 1956–59*, Ottawa, 1961, for the initial stage of this development.

[30] DBS Catalogue No. 61-005, *Index of Industrial Production*, Ottawa, monthly.

post-1961 periods. The initial results of this work will not be available, however, until sometime in 1968.

At the annual level, the physical units, i.e., the average unit value deflation approach, have been principally used in the goods-producing industries other than construction, as well as in many transportation, storage, and communication industries where, depending on the extent and quality of the underlying data, net or gross output indexes have been constructed. Annual indexes for construction have followed the methods used in the calculation of constant dollar GNE, i.e., the value of new investment construction has been deflated by a "cost" price index composed of the prices of main materials used and average wage rates. This approach is, of course, deficient due to its inability to properly reflect productivity changes and gross profit margins. In the general area of retail and wholesale trade and some personal services, real output measures have generally been developed by the value deflation approach using base-weighted price indexes of specified products or services. In the noncommercial industries, as well as in certain components of the finance, insurance, and real estate industry, where labor input is the conventionally accepted measure of output, the deflation of payrolls by average wage and salary indexes has been used. This is tantamount to weighting labor time with base-period compensation rates and is thus analogous to average unit value deflation.

Data difficulties generally preclude the use of net output measures in monthly and quarterly indexes. In the industries where these measures were used at the annual level, the logical subannual substitute might appear to be gross output, calculated by the average unit value deflation approach or the value deflation by specified price index approach, as the case may be. Similarly, it might be expected that indexes based on gross output at the annual level would be calculated in the same way for subannual purposes with, as far as possible, the same distribution between the two alternative measurement approaches. This is generally so with the notable exception of manufacturing, where gaps in the framework of subannual commodity data and the scarcity of appropriate deflators for available shipments data necessitate substantial reliance on man-hour indicators adjusted for estimated productivity change. As with the annual indexes, subannual indexes for most service industries other than trade, personal, and recreation services, and transportation, storage, and communication are largely based on un-

adjusted labor input, with most being again derived by wage and salary deflation using some form of average wage deflator.

As can be seen from the foregoing remarks, the specified price index approach has so far played a secondary role in the DBS real output measurement program. The main thrust of effort has been through average unit value deflation, with the alternative approach representing a supporting position. It is being increasingly realized, however, that future refinements of the real output system depend importantly on a much more positive use of value deflation by specified price indexes which, in turn, implies the need for an expanded system of price statistics, classified in the same way as, and conceptually consistent with, the underlying value data.

As Stone has pointed out, the relative change between two periods in the aggregate value of a set of commodity transactions can be factored into a change of relative quantity times a change of relative price, and this identity can be expressed either as the product of a base-weighted quantity index and a current-weighted price index or of a current-weighted quantity index and a base-weighted price index.[31] The recognition of these two areas of index number construction as conceptually complementary and operationally parallel is thus the first step in the development of a truly integrated system of value-price-volume statistics by industry of origin.

However, within such a comprehensive approach there are certain independent and sometimes conflicting requirements of the component index number systems which need to be considered. For instance, because the concept of real domestic product requires that the quantity index number be a measure of net output or value added, primary interest focuses on the final net value result at the industry level. On the other hand, precisely specified commodity detail for both outputs and inputs is an essential feature of price indexes required for double-deflation-derived value added in constant dollars by industry of origin and, furthermore, this detail should be available on a monthly basis. Again, the requirements of comparability through time point to the need for base-weighted formulas in the construction of both price and quantity index numbers. When considered against the background of currently available data as well as the technical difficulties that would

[31] Richard Stone, *Quantity and Price Indexes in National Accounts,* Paris, 1956.

be involved with current weighting, for instance, constraints of this kind indicate quite clearly that the scope for readily deriving all requisite index numbers by the decomposition of a single set of value data falls short of theoretical possibilities. Clearly, very few of the requirements of industry price indexes could be satisfied in this manner.

At the present time, the most fruitful approach to this problem seems to lie in giving high priority within a coordinated conceptual framework to the further extension and strengthening of the existing program of industry price statistics for manufacturing and to the simultaneous refinement of corresponding monthly and annual value data. In manufacturing, available monthly value data relate to shipments reported by establishments on an aggregate basis, so that one requirement of the system of monthly price indexes is that it should permit the regrouping of component commodity relatives on an establishment basis with proper regard for seasonal patterns in shipments. For the deflation of annual census data for shipments and materials used, the main problems are those of developing sufficient commodity detail so as to minimize the difficulty of working with base-weighted aggregates of individual commodity relatives and of ensuring uniform price and valuation boundaries. The latter point is a particularly crucial one in the light of the more realistic reporting procedures now in force in the annual Census of Manufactures. The deflation of finished goods and work in process inventories, generally valued at cost, in order to permit the proper adjustment of shipments data to a production basis, is also an extremely important problem, particularly at the monthly level, and one on which very little progress has yet been made.

In this general connection, a brief review of progress to date at DBS in the development of wholesale price indexes by industry may be appropriate. The indexes so far published cover the selling prices f.o.b. plant of approximately 100 manufacturing industries at the three-digit level or below, as defined in the 1948 Standard Industrial Classification. They are available from 1956 to date on a monthly basis with a 1956 reference base and a 1953-weight base. In terms of coverage, they account for about 70 per cent of gross domestic product originating in manufacturing in 1953, or more than 20 per cent of GDP for the economy as a whole. Notable omissions from this coverage at the present time include the entire printing, publishing, and allied industries major group, a number of transportation equipment industries

such as shipbuilding, railway rolling stock, and aircraft and parts, as well as some elements of clothing and iron and steel products. The problems of heterogeneity and discontinuity of commodity detail, and those associated with the definition of output itself, which have been encountered in the construction of selling-price indexes for these industries are, of course, precisely those which have made it impossible to calculate quantity indexes by the physical units approach.

The commodities and commodity groupings used for weighting purposes within each industry were selected from the respective Census of Manufactures establishment returns in the order of their importance so as to account for 75 per cent of base-year shipments. Underlying these broad classifications is an extensive system of price collection, embracing more than 3,300 individual price quotations from some 1,700 respondents. While the basic weighting diagram for each industry remains fixed for the duration of the indexes, individual indicators are reviewed regularly with respondents and changed if necessary to ensure their continuing representativeness. In contrast with the more demanding requirements of coverage associated with the selection of quantity indicators, economy of effort of this kind is a powerful argument in favor of the value-deflation approach to real output measurement, particularly when most or all of the work has to be done in any case for basic price measurement purposes.[32]

A major obstacle in the past to the realization of the full potential of this approach has been the lack of a corresponding set of intermediate-input price indexes by industry. In recent years, however, substantial progress has been made in the construction of input price indexes in manufacturing, where more than eighty such indexes have already been calculated on an experimental basis, covering industries accounting for about 45 per cent of GDP originating in manufacturing in 1953. One of the principal problems in this area is that of discontinuity in the collection of price quotations, since buyers covered by the sample do not necessarily make purchases in every monthly period for which data are required. This has been partially solved by adapting for use on the input side some of the available output prices, although the supplementary information on transportation charges, taxes, etc., needed to convert these prices to a laid-down basis at the point of delivery are frequently difficult to obtain.

[32] See Richard Stone, *Quantity and Price Indexes*, p. 99.

There are also certain conceptual inconsistencies between the published industry selling-price indexes and the value data of the Census of Manufactures. For instance, in recognition of other important uses, the price quotations on which the indexes are based refer to new orders rather than to shipments. Apart from the particular effects in those industries where there is a characteristic lag between the receipt of an order and its shipment, there may also be a general effect which varies in a cyclical fashion according to the degree of pressure on productive resources. Furthermore, the annual industry selling-price indexes are unweighted arithmetic averages of monthly data, so that their use for the deflation of annual value totals would distort the resultant output measure in a situation where there were seasonal patterns in sales and the related transactions prices. It is also the case that Census of Manufactures returns are frequently based on the fiscal year of the reporting entities, whereas the annual price indexes are on a calendar year basis. Problems of this type are, however, generally amenable to testing for their incidence and importance and can generally be dealt with by adjustments and recompilations of the basic pricing data.

The change in value reporting procedures in the Census of Manufactures which was implemented in 1961, and which was the second stage in the adoption of the 1960 Standard Industrial Classification, has further complicated the measurement of real output by the deflation approach. For instance, respondents were formerly instructed to value their shipments "f.o.b. plant," i.e., at a level corresponding to a boundary of the establishment defined in terms of manufacturing activity only. To the extent that an establishment was engaged in nonmanufacturing operations, it was assumed that these would be measured in other surveys such as those pertaining to wholesale trade, construction, etc. As noted earlier, this attempted fragmentation of the various activities within an establishment frequently found no parallel in the accounting records of respondents who were often forced to value shipments at the point of sale rather than at the desired manufacturing level. This resulted in inconsistencies within the statistics of individual industries, as well as in duplication between industry divisions. The new concept requires that each establishment be coded to only one industry, that its survey return should cover all its activities and that its shipments be valued "f.o.b. establishment."

Thus a problem of consistency arises between the current dollar shipments data of the Census of Manufactures and the corresponding industry selling-price indexes. For a given industry, the former now reflects a particular "marketing mix" which can change from year to year as a result of organizational changes within component establishments, and thus cannot be related to price indexes based on a uniform "f.o.b. plant" valuation covering manufacturing activity only. The forthcoming revisions to the industry selling-price indexes for manufacturing, in which a 1961 weight and reference basis will be adopted, are, however, also designed to reflect the new establishment concept by adjusting pricing boundaries to the corresponding valuation practices and by being extended to cover nonmanufacturing output. The revised indexes may be initially released for a somewhat smaller number of industries than was the case with the previous indexes, but it is intended to extend their coverage as rapidly as resources permit.

Without minimizing the difficulties involved, the calculation of quantity measures in manufacturing by value deflation thus seems to offer encouraging scope. It does in fact constitute the most realistic hope of a solution in such areas as the monthly Index of Industrial Production where excessive reliance on adjusted man-hour indicators has blunted the cyclical sensitivity of the index and where the gaps cannot realistically be filled by the extension or elaboration of commodity surveys. An alternative approach to increase cyclical sensitivity used by the Federal Reserve Board for the U.S. Index of Industrial Production, estimates short-term movements in output per unit of labor input for man-hour represented industries on the basis of implicit output/man-hour relationships in commodity represented industries. This approach has not yet been tried in Canada largely because of the basic differences in the nature of many of the industries represented by commodity surveys and those represented by man-hours. At the annual level, the deflation problems created by nonmanufacturing production and the possibility of changing levels of valuation in the reporting of manufacturing shipments quite obviously militate against the feasibility of the physical units approach.

This discussion of the problems involved in the derivation of quantity index numbers by the specified price index deflation approach has been entirely conducted within the context of manufacturing, where the annual census data provide perhaps the most detailed and historically

complete statistical series within the DBS and were thus an obvious starting point for the development of industrial price indexes. In the immediate future, further development of the system is likely to be largely concentrated in the remaining industrial divisions covered by the annual Census of Industry, namely mining, forestry, and fishing, where the experience derived in manufacturing is expected to be directly relevant. Substantial progress has in fact already been made in mining. In the remaining goods-producing industries, agriculture and construction are likely to prove more difficult since the basic value data are assembled on a commodity rather than an establishment basis. Retail and wholesale trade, and the transportation, storage, and communication divisions offer the brightest prospect in the nongoods sector for the early development of industry price indexes. These areas already have substantial price coverage due to the relevance of their sales boundaries for consumer and general wholesale price indexes. However, there is need for further commodity and service coverage, for input price indexes, for indirect tax and other adjustments to bring the price relatives into line with reported sales value boundaries, and, of course, different weight structures. Refinements and extensions of industry price coverage in these and other service industry areas, while extremely important and urgent within the total industry real output framework, are not as amenable to early solution as those in the manufacturing, mining, forestry, and fishing industry divisions.

QUALITY CHANGES

The assessment of the effects of changes in the quality of the individual goods and services underlying quantity measures of economic production has always constituted an extremely difficult conceptual and practical problem. While it has been treated extensively in the theoretical literature, there has been but little effect on official statistics of prices and real output because of the lack of operational feasibility of most proposed solutions. It is not the intention here to attempt a comprehensive discussion of this complex topic but merely to bring to the fore those aspects of it which the authors feel explicit attention should be given in a real output measurement context and to comment on how they can be handled within the general approaches previously discussed.

In the first place, it should be stressed that we are concerned with a

producer's view of quality change over time rather than a consumer's view of the same change. For example technologial advance is continually giving rise to changes in design, substitution of more efficient materials and component parts, closer engineering tolerances and better methods of quality control, etc., which can frequently increase the utility of the products to the consumer quite out of proportion to the costs involved. It is on the latter aspect rather than the former that attention should be focussed. The quantity measure of economic production should seek to identify the additional factor costs or returns which have contributed to the quality improvement and to distribute them properly by industry. The consumer does have a role in this process, and it is more than an indirect one, since his acceptance of the product in the market place determines the size of these factor returns. But the consumer's surplus or economic rent which emerges from the interaction of his own utility field with the market price is something which falls outside the scope of the statistical measure of production. It thus seems to us that the identification and quantification of quality change as we have defined it does not require any radically different approach. As demonstrated below, it should emerge naturally from a careful application of some of the techniques discussed previously.

The term "quality change," even in the restricted sense that is being considered here, actually embraces a number of logically separate phenomena, some of which are more amenable to treatment than others. For instance, changes over time in the proportional composition of the set of distinguishable product varieties contained in a prescribed total or aggregate—the product mix, in other words—can be thought of as group or structural quality change. If, for instance, a broadly defined product category such as "tractors" does in fact conceal a gradual shift from large to small units, a quantity index derived by weighting the total number of units by a base-year average unit value would have a progressive upward bias. This kind of quality change is not difficult to deal with in principle by either average unit value or specified price index deflation, since what is needed in each case is more detailed information on value and quantity and price quotations.

New varieties not previously represented in the aggregate can be handled in a manner similar to new products, i.e., by introducing them into the calculations with artificial weights and by providing for regular updating of weighting systems under both the average unit value and specified price index deflation approaches.

A further kind of quality change which cannot be handled nearly as well occurs in connection with model changes in products such as automobiles and farm machinery. From the standpoint of the unit value deflation approach, it would be formally correct to regard each change as a new variety. This, however, would result in considerable discontinuity of product detail, with excessive reliance on artificial weights, and perhaps a less satisfactory result than if no adjustment had been attempted at all.

When such a situation results in an increase in the price quotation for a particular product, conventional methodology in the construction of price indexes permits either of two extreme positions or some intermediate compromise. At one extreme, price quotations of the consecutive varieties may be regarded as directly comparable so that the difference between the two is embodied into the index as pure price change. Alternatively, the contiguous price quotations may be treated as directly proportional to the qualities of the varieties concerned so that the price index registers no change. When a higher current value of output in the later period is deflated by a price index determined according to the second of these alternatives, the resultant volume measure is higher than that which would be derived from the use of a price index based on the first assumption.

The industry selling-price indexes previously referred to take an intermediate position between these two extremes. The convention most extensively used seeks to measure quality change between two varieties by a comparison of the direct current-period quantities of both labor and material inputs of the new model with that of the old under the same price and technological conditions.[33] The implied assumption about the parallel movement of other costs (including profits) in this comparison may introduce some unknown element of bias and should also be taken into account. This, of course, is very difficult to do on an operational basis.

Thus, to the extent that industry selling-price indexes embody this kind of adjustment, their use as deflators of value data at appropriate levels of detail will yield quantity measures which also reflect quality change. In spite of the obvious limitations, this approach is clearly preferable to average unit value deflation which completely evades the

[33] The mechanics of this convention are explained in *Industry Selling Price Indexes, 1956–59,* DBS Catalog No. 62-515, Ottawa, 1961.

problem. From the standpoint of GDP by industry of origin, however, the impact of quality change must be assessed in terms of value added, not gross output. If, for instance, the increase in quality was known to have originated partly in a purchased component, it would be clear that the index of real gross output derived by deflation would overstate the volume increase, thus, in effect, allocating some of the quality change to the wrong industry or duplicating it. Correct allocation would require the use of a corresponding set of quality-adjusted purchase-price indexes, for the purpose of deflating material inputs and constructing a net measure, so that the appropriate part of the quality change could be netted out of the purchasing industry's output.

IV. Uses and Limitations of the Current- and Constant-Dollar Industry Data

GENERAL

The quarterly indexes of real domestic product by industry of origin and their monthly Index of Industrial Production component enjoy an extremely wide circulation among a variety of users including federal and provincial government departments and other official or semiofficial organizations, foreign governments and international organizations, Canadian and foreign business corporations, labor unions, private research and planning groups, universities, the financial press, and others. A common denominator in this broad range of interests is the value of the indexes as major indicators of economic activity. By complementing the changing expenditure patterns revealed by the quarterly national accounts with a detailed picture of the supply side, the indexes make possible improvements in the efficacy of short-term analysis, forecasting, and policy making. At the same time, the availability of a long series of annual data in considerable industry detail has opened up a wide range of medium- and long-term uses at both the macro- and microeconomic levels. No more than a few representative examples of such uses can be elaborated in any detail. Some uses of the measures by DBS itself are described immediately below. This is followed by a brief account of the way in which some other federal government departments have used them, and finally by a discussion of some potential uses which so far have not been extensively explored in Canada.

TABLE 5

Annual Rates of Industry Growth,[a] *1946–65*

Industry	Percentage
Electric power and gas utilities	9.6
Mining	9.1
Construction	5.1
Finance, insurance, and real estate	5.0
Manufacturing	4.8
Transportation, storage, and communication	4.6
Real domestic product	4.4
Trade	4.1
Public administration and defense	4.0
Community, recreation, business and personal service	3.6
Fishing and trapping	1.8
Forestry	1.7
Agriculture	1.5

[a]Calculated by fitting a least squares of logarithms trend line to the annual data for each industry.

Internal Consistency Checks

As previously mentioned, the development of real domestic product estimates by industry of origin was initiated as a check on the validity of the quarterly estimates of deflated GNE. The background of this testing is well documented,[34] but it may be briefly noted here that, even without adjustment for the statistical and conceptual differences involved, the two estimates generally move in the same direction and at approximately the same rate of change. In addition to this check at the aggregate level, individual production indexes are also used in statistical consistency checks for particular components of the GNE estimates.

Analyses of Growth, Change, and Cyclical Behavior

A major analytical use of the industry of origin real output measures in the related DBS publications has been the study of the growth of

[34] *Indexes of Real Domestic Product by Industry of Origin, 1935–61,* Part I (Introduction) and Appendix D.

the Canadian economy, in terms of both long-term trends and cyclical production movements. The most commonly used technique in this context has simply been to examine the relative expansion patterns of the various industries in order to ascertain the sources of past and future growth. Table 5 shows the average annual rates of growth ranked in order of size for the major industry groupings and for total real domestic product for the 1946–65 period.

The examination of a finer industrial breakdown, as in Table 6, which shows the growth rates in major manufacturing industries, indicates that industries producing radically new products and using new processes,

TABLE 6

Annual Rates of Growth[a] in Manufacturing Industries, 1946–65

Industry	Percentage
Miscellaneous manufacturing	9.1
Products of petroleum and coal	8.6
Chemicals and allied products	7.6
Electrical apparatus and supplies	7.0
Nonmetallic mineral products	6.9
Tobacco and tobacco products	6.1
Printing and publishing	5.3
Manufacturing	4.8
Iron and steel products	4.8
Rubber products	4.2
Textile products	4.2
Paper products	4.1
Transportation equipment	4.1
Foods and beverages	3.9
Nonferrous metal products	3.8
Wood products	3.4
Clothing	3.0
Leather products	1.6

[a]Calculated by fitting a least squares of logarithms trend line to the annual data for each industry.

TABLE 7

Percentage Distribution of Real Domestic Product by Industry of Origin for Major Industry Groupings, Selected Years

Industry Grouping	1949	1956	1965
Real domestic product	100.0	100.0	100.0
Agriculture	10.7	10.2	7.6
Forestry	2.1	2.0	1.6
Fishing and trapping	0.5	0.4	0.3
Mining	3.2	4.7	5.6
Manufacturing	27.3	27.6	29.7
Construction	6.4	7.1	6.4
Electric power and gas utilities	1.6	2.2	3.5
Other goods-producing industries, n.e.c.	1.1	1.1	0.8
Transportation, storage, and communication	8.4	8.3	8.9
Trade	14.6	14.0	13.6
Finance, insurance, and real estate	9.1	8.6	9.1
Public administration and defense	4.7	5.0	4.2
Community, recreation, business and personal service	10.2	8.7	8.6

such as petroleum products, chemicals, and electrical apparatus, expanded far more rapidly than traditional industries such as leather products and clothing, the latter of which grew at roughly the same rate as the Canadian population.

Such differences in the relative rates of expansion of individual industries result in certain structural changes in the economy which are reflected in the constant dollar industry of origin measures. The direct effect of the differential growth rates is shown by changes in the relative contribution of each industry to total real domestic product. Table 7 shows the distribution of real domestic product by major industry groupings for the years 1949, 1956, and 1965. A decline in the relative importance of agriculture and an increase in the contribution of manufacturing, mining, and electric power and gas utilities are immediately apparent. Analysis of structural changes is most appropriately performed with the aid of current dollar industry of origin data, as these reflect changes in relative prices—an important determinant of any in-

dustrial structure. Such data, however, are at present available on the preferred establishment basis only for weight-base years.

In addition to their uses in analyzing the long-term growth of the economy, the industry of origin measures are also used for studying short-term production movements and cyclical changes in production. For this purpose, the seasonally adjusted quarterly and monthly data are particularly suitable. However, even annual data can be used for analyzing certain shorter-term trends in the past record or to identify emerging trends in the current period. For example, in Table 8 the post-

TABLE 8

Percentage Rates of Growth[a] by Industry, Selected Time Periods

Industry Grouping	1946–50	1950–56	1956–60	1960–65
Real domestic product	4.4	5.8	2.1	5.4
Agriculture	-0.7	4.9	-2.5	3.2
Forestry	3.6	3.2	-0.3	2.5
Fishing and trapping	5.7	0.4	-1.7	3.0
Mining	10.1	12.2	6.0	5.8
Manufacturing	5.8	6.0	1.6	7.4
Nondurables	4.4	5.3	3.4	6.2
Durables	7.5	6.8	-0.3	8.8
Construction	11.8	7.6	-0.4	5.3
Electric power and gas utilities	9.3	10.4	9.9	8.5
Transportation, storage, and communication	3.4	6.3	2.4	6.5
Trade	4.6	5.1	2.1	4.8
Retail	5.1	4.8	1.7	4.0
Wholesale	3.5	5.8	2.8	6.1
Finance, insurance, and real estate	6.7	5.0	4.6	4.6
Public administration and defense	-3.8	6.9	2.9	1.4
Community, recreation, business and personal service	3.7	3.5	3.8	3.9

[a]Terminal years, using the compound interest formula.

war period has been divided into four shorter periods of four to six years each, the last three of which roughly measure expansion from peak to peak in total real output. In 1946, production was at a relatively low level. It is interesting to note that, except for the steady-growth industries, expansion during the late 1950's was generally much slower than during any of the other periods, with the output of some industries actually showing a decline over that period. During the 1960's, there has been a marked acceleration in growth for most industry groups, with the notable exceptions of mining and electric power and gas utilities whose rates of increase have been gradually decelerating since the early 1950's, and are now closer to those for the rest of the economy.

Detailed industry of origin data are also useful for analyzing period-to-period changes in total real domestic product, as can be seen from Table 9 below, which shows year-to-year percentage changes for the years 1959–65 and the percentage contributions of the various industry groups to the total change in each case. A similar analysis of quarter-to-quarter changes in seasonally adjusted data for a more detailed industry breakdown has been found very useful in interpreting particular movements in total output or the output of a particular industry group, assessing the effect of irregular factors affecting one industry, on higher aggregates, and in reconciling production with related data. Even in the annual data listed below for illustrative purposes, some of these points emerge clearly, particularly the marked differences in the contributions of the various industries to the small increase in 1960, the year most affected by the 1960–61 cyclical downturn. The strong irregular effect of agriculture on total production also emerges quite clearly.

As mentioned above, the monthly and quarterly seasonally adjusted real domestic product indexes are used for all types of short-term analysis and forecasting and business cycle analysis. The availability of current seasonally adjusted data for industries outside the area of the Index of Industrial Production greatly enhances the usefulness of the estimates. The indexes have been used for all the standard types of business cycle analysis, including the calculation of diffusion indexes, specific cycle turning points, contributions of individual industries to the change in aggregate production over various phases of the cycle, comparisons in the movements of various industries and aggregates over

TABLE 9

An Analysis of Year-To-Year Changes in Total Real Domestic Product and Industry Contribution to that Change
(percentages)

Industry or Group	1959	1960	1961	1962	1963	1964	1965
Year-to-Year Change in Real Domestic Product	5.5	1.7	2.0	6.5	5.6	6.2	6.9
Percentage Contributions to the Above Change (total real domestic product = 100)							
Agriculture	0.1	11.4	-39.8	8.2	13.8	7.6	7.6
Forestry	3.8	9.0	-7.2	1.7	1.9	1.7	0.2
Fishing and trapping	-0.8	-0.4	2.0	0.4	-0.3	0.3	-0.1
Mining	12.4	0.3	7.4	5.6	4.4	5.7	4.5
Manufacturing	35.7	23.7	47.8	28.1	35.0	29.3	36.5
Construction	-5.9	-18.7	10.7	6.2	1.7	6.1	9.7
Electric power and gas utilities	6.4	15.3	9.1	3.2	4.9	3.4	5.1
Other goods, n.e.c.	1.1	-1.5	0.5	0.9	0.9	0.9	0.2
Transportation, storage, communication	13.9	10.6	21.2	8.5	10.8	8.8	9.5
Trade	15.6	1.4	7.2	13.8	9.3	13.5	14.8
Finance, insurance, and real estate	8.0	20.8	16.9	9.5	10.6	9.4	6.0
Public administration and defense	2.1	4.9	8.9	5.0	0.1	4.5	0.3
Community, recreation, business and personal service	7.6	23.3	15.2	9.1	6.9	8.8	5.8

the same phases of the various cycles, and so forth. Tables 10 and 11 show some of these comparisons for the last three cycles in aggregate production in Canada using quarterly data.

Productivity Uses

Another important use of the real domestic product by industry of origin measures is in the official productivity measures published by DBS. In the initial stages of this program, priority was given to the development of aggregate measures, and this resulted in the publication, early in 1965,[35] of annual indexes of output per person employed [36] and per man-hour in the commerical nonagricultural economy and its manufacturing and nonmanufacturing sectors for the period 1947–63.

The noncommercial sector was excluded from the coverage of these measures for the same reason that the corresponding U.S. measures are restricted to the private economy. Canadian practice goes further, however, in excluding not only public administration and defense but also other noncommercial services, such as education, nonprofit institutions, and hospitals, where real output is conventionally measured by deflated primary inputs. In view of the conceptual difficulties involved in the development of true GDP measures for this sector, the present situation seems likely to persist for a long time.

However, the exclusion of agriculture from the first published measures was not meant to be more than temporary. In this case, the available output measures were not essentially at fault. Although they are based primarily on commodity rather than establishment statistics, their conceptual basis is considered to be generally adequate for broad trend or growth analysis. The problem was rather that the well-known difficulties of measuring labor inputs in agriculture, particularly those of man-hours, caused some doubts as to the validity of separate productivity series for this industry as well as the effect which their inclusion would have on the broader aggregate. Since that time, it has become much more apparent that, in spite of the somewhat tentative nature of the productivity measures for agriculture itself, the usefulness of the aggregate measures would be considerably enhanced by their inclusion,

[35] DBS Catalogue No. 14-501, *Indexes of Output per Person Employed and per Man-Hour in Canada, Commercial Nonagricultural Industries, 1947–63*, Ottawa, 1965.

[36] The term "persons employed" covers all persons engaged in the creation of output.

TABLE 10

Trough to Peak Changes in Major Industry Groupings Over Recent Cycles in Production and Their Contributions to Aggregate Change.

	IIQ'54–IVQ'56		IVQ'57–IQ'60		IQ'61–IVQ'65[a]	
	Effect on Real Domestic Product[b]	Percentage Change	Effect on Real Domestic Product[b]	Percentage Change	Effect on Real Domestic Product[b]	Percentage Change
Real domestic product	24.9	24.9	10.6	10.6	35.2	35.2
Agriculture	3.8	44.0	1.0	11.4	2.6	35.3
Forestry	0.4	17.9	0.5	33.7	0.4	22.0
Fishing and trapping	--	3.9	--	-7.4	-0.1	-12.9
Mining	2.0	48.6	0.9	16.2	2.1	39.2
Manufacturing	6.8	24.4	3.5	12.8	13.4	49.3
Nondurable	2.9	19.4	2.1	14.6	5.8	37.9
Durable	3.9	30.1	1.3	10.9	7.6	64.2
Construction	2.2	34.0	-0.3	-3.9	2.4	38.5
Electric power and gas utilities	0.7	33.9	0.7	28.9	1.7	55.5
Other goods industries, n.e.c.	0.2	21.2	--	1.5	0.1	15.2

(continued)

TABLE 10 (concluded)

	IIQ'54–IVQ'56		IVQ'57–IQ'60		IQ'61–IVQ'65[a]	
	Effect on Real Domestic Product[b]	Percentage Change	Effect on Real Domestic Product[b]	Percentage Change	Effect on Real Domestic Product[b]	Percentage Change
Transportation, storage, and communication	2.7	34.6	0.8	9.7	3.3	37.9
Transportation	2.2	40.1	0.6	9.0	2.6	40.4
Trade	3.4	24.5	1.4	9.7	4.4	31.4
Wholesale	1.5	31.9	0.8	16.8	2.2	45.2
Retail	2.0	20.8	0.6	6.1	2.2	24.3
Finance, insurance, and real estate	1.1	12.0	0.9	9.6	2.3	23.8
Public administration and defense	0.4	7.0	0.3	5.1	0.3	5.1
Community, recreation, business and personal service	1.0	10.6	1.0	11.1	2.1	22.2

[a]Production was still expanding at the end of 1965.

[b]The percentage contributions of the individual industry groups to the aggregate change may not add to the percentage change in total real domestic product due to rounding.

TABLE 11

Peak to Peak Percentage Changes in Major Industry Groupings Over Recent Cycles in Production

Industry or Grouping	IIIQ'53–IVQ'56	IVQ'56–IQ'60	IQ'60–IVQ'65[a]
Real domestic product	18.7	7.3	32.7
Agriculture	-1.0	-8.1	14.4
Forestry	19.0	1.3	8.9
Fishing and trapping	1.8	-18.4	42.7
Mining	55.5	24.7	31.9
Manufacturing	20.1	6.1	45.3
Nondurable	19.3	12.9	38.7
Durable	21.1	-1.2	53.3
Construction	27.8	-0.9	30.7
Electric power and gas utilities	44.4	38.1	61.1
Transportation, storage, and communication	26.4	7.9	41.1
Transportation	25.7	4.7	42.9
Trade	20.7	6.9	29.5
Wholesale	20.8	11.0	35.1
Retail	20.6	4.7	26.3
Finance, insurance, and real estate	16.9	15.5	28.2
Public administration and defense	10.4	9.1	10.0
Community, recreation, business and personal service	12.0	12.2	25.0

[a]Production was still expanding at the end of 1965.

so as to provide coverage of the entire commerical economy. The difficulties of measuring labor inputs in agriculture are not likely to be quickly resolved, but they are hardly any more serious than those originating in other primary industries already covered. Accordingly, in the subsequent updating of the measures, indexes of output per person employed and per man-hour have been released for the commercial economy as a whole, with separate detail for agriculture, manufacturing, and the residual nonmanufacturing sector. This enlarged coverage now accounts for almost 90 per cent of total base-year real domestic product.

The analytical potential of the aggregate productivity measures cannot, of course, be fully realized until complete detail by industry division is available. Among other advantages this would permit the distinction within the over-all measures between changes in levels of productivity in the component industries and shifts in the relative importance of industries having different levels of productivity. Such detail cannot at present be provided because of the lack of consistency and comparability between the methods and data sources used in the estimation of real output and employment for particular industries, where the criteria are more exacting than at higher levels of aggregation.

In construction, for example, published real output measures reflect value added in construction *activity* which cannot be meaningfully related to the reported employment figures of the construction *industry*. The ability to collect the two kinds of data within the common framework of a census of the construction industry at appropriate levels of industry detail would go a very long way towards solving this problem. Again, separate measures for industries such as finance, insurance and real estate, and business services, in which output is most commonly measured by labor inputs, would be misleading since they would almost certainly underestimate productivity gains.

Shift analysis has thus been confined so far to various combinations of shifts between agriculture, manufacturing, and the residual nonmanufacturing sector of the commercial economy. However, there are still levels of aggregation where problems arising from the quality, consistency, and comparability of the output and input measures for component industries are not too serious. Work is presently in progress to show, for the 1966 updating, separate figures for the goods- and service-producing sectors of the commercial economy and to measure the effect on over-all productivity change of shifts in their relative importance. In this connection, it may be noted that postwar Canadian experience in the growth of output, input, and productivity in the service industries will be the subject of a paper by one of the present authors at the 1967 Conference on Research in Income and Wealth.

Since a unique feature of the Canadian measures of real domestic product by industry of origin is their quarterly periodicity, there can be little doubt that their analytical usefulness would be considerably enhanced by relating them to the corresponding labor input measures in order to bring to light the variations in the rate of productivity change

which occur over the course of the business cycle as the level of utilization of available capital resources changes. Many users do in fact make such calculations unofficially, generally by means of Labour Force Survey employment data, the annual changes in which, at the aggregate level, are very close to those of the composite series developed for the official productivity measures. In recognition of the growing demand for an official series of quarterly productivity measures, exploratory work is proceeding at DBS towards the development of quarterly labor input series consistent with those used for the annual measures.

Progress has also been made in the measurement and analysis of productivity change at the individual industry level. The present program covers some twenty manufacturing industries which were chosen as a cross-section of representative import-competing, export, and purely domestic industries. So far, studies covering the period 1947–61 have been completed for synthetic textile mills, breweries, and pulp and paper mills,[37] and others for iron and steel mills, sugar refineries, and hosiery mills are well advanced.

The conceptual basis of the industry productivity measures is essentially the same as that of the aggregate measures, with the principal measure of output being constant dollar census value added, as calculated by the double deflation approach from detailed annual data on shipments, inventories, and materials and supplies used. However, we see no reason at this time for forcing productivity measures at this level of detail into a rigid conceptual framework and we feel that all useful and practicable relationships between various output and input measures of a given industry should be explored. A familiar example is the BLS practice of weighting quantities of products with their unit man-hour requirements and relating these to current man-hours to derive a measure of changes in the total man-hours required to produce the base-year composite of goods.

A pressing concern at the moment is the need to fill out the framework of detail within manufacturing somewhat faster than this program of individual industry studies seems likely to permit. Present plans call for the publication of crude productivity measures at the major group level, using the appropriate monthly Index of Industrial Production components and the corresponding employment and man-hours

[37] DBS Catalogue No. 14-502, *Productivity Trends in Industry, Report No. 1: Synthetic Textile Mills, Breweries, Pulp and Paper Mills, 1947–61*, Ottawa, 1966.

data (which relate to wage earners only) of the monthly Employment Survey. While such measures would lack the precision of the more detailed studies, their greater timeliness and breadth of coverage would more than compensate for this defect, and the implementation of the project can proceed as soon as the Index of Industrial Production is converted to the new Standard Industrial Classification and a 1961 weight base.

Finally, it may be mentioned that the DBS recognizes the desirability of extending its program of individual industry productivity studies beyond manufacturing. Because of the heavy demands on resources which such studies impose, however, it is unlikely that more than a token commitment can be made in the immediate future. The choice of a particular industry or industries has yet to be made, but it is likely to be influenced by the availability of similar official U.S. studies.

OTHER USES OF THE CONSTANT-DOLLAR MEASURES

Perhaps one of the most important applications of the real domestic product by industry of origin estimates is their use in the economic review for the previous calendar year which usually accompanies the Minister of Finance's budget speech.[38] This review, which provides the background for determining broad budgetary objectives, has traditionally been based on current statistics of the components of national income and expenditure, employment and earnings, price and cost trends, as well as the balance of payments and the capital markets. Since the industry of origin estimates became available, however, they have been used in the review for progressively more sophisticated purposes—from a simple analysis of changes in the industrial distribution of real output to an analysis of the relationship between business investment and output by industry of origin and, most recently, as part of a longer-term review of the relationships between output and employment by major sectors, to estimate unit labor costs by industry and trends in the value, volume, and price components of current dollar value added by industry.

In 1963, the Economic Council of Canada was established by federal act of Parliament and directed to study and advise upon the medium-

[38] See, for example, "Budget Papers presented by the Honourable Mitchell Sharp, M.P., Minister of Finance, for the information of Parliament in connection with the Budget of 1966–67," *House of Commons Debates,* March 29, 1966, Ottawa.

and long-term development of the Canadian economy in relation to the attainment of the goals of full employment, a high rate of economic growth, reasonable stability of prices, a viable balance of payments, and an equitable distribution of rising income. The first annual review of the Council, released in January 1965,[39] was devoted to an appraisal of the prospects and problems of the Canadian economy over the five-year period to 1970 in order to provide a basis for the development of public policies and private decisions favorable to, or consistent with, the achievement of these goals. The Council's estimates of potential output to 1970 for the total economy were a composite of direct projections and estimates derived as the product of potential man-hours and potential man-hour productivity.[40] These were in turn based on historical data for the commercial nonagricultural economy, agriculture, and public administration and community services for the period 1946 to 1963. Thus, while the results were not intended to provide more than broad guidelines for potential growth over the period in question, the availability of this industrial detail made it possible to take into account important differences in output, labor input, and productivity trends in the components of the total.

In a related study prepared for the purpose of projecting the levels of investment consistent with a high rate of growth of output to 1970 considerably more detailed components of real output by industry of origin were used.[41] Historical capital-output ratios were prepared for a broad range of industry groups, which accounted for more than three-quarters of the 1963 real output of the commercial nonagricultural economy and over 80 per cent of business nonresidential investment. Projections of 1963 real output by industry division to 1970 consistent with the growth of total real output were then combined with projections of the corresponding capital output ratios to provide annual estimates of capital-stock levels. Constant dollar gross investment for each year to 1970 was then calculated as the sum of discard replacements and gross capital stock changes.

The Council's second annual review provided an appraisal of the

[39] Economic Council of Canada, First Annual Review, *Economic Goals for Canada to 1970,* Ottawa, December 1964.

[40] See B. J. Drabble, *Potential Output, 1946 to 1963,* Staff Study No. 2, Economic Council of Canada, Ottawa, December 1964.

[41] Derek A. White, *Business Investment to 1970,* Staff Study No. 5, Economic Council of Canada, Ottawa, December 1964.

recent performance of the economy in relation to the goals listed above, with particular emphasis on manufacturing which had not been singled out for special attention in the first reveiw.[42] The results of a number of studies of significant factors bearing on the achievement of the goals were also presented. These included some of the basic determinants of productivity, the forces contributing to sustained and stable growth, and the question of regionally balanced economic growth. These studies drew extensively on the real output by industry of origin estimates and have also focussed attention on the need for certain obvious refinements and extensions, for instance, the improvement of the cyclical sensitivity of the Index of Industrial Production and the provision of regional detail.

Following a reference from the Government of Canada, the Council is currently studying the factors affecting price determination and the interrelation between movements in prices and costs, and levels of productivity and incomes. This study, the results of which were published in the Council's third annual review late in 1966, has drawn extensively on detailed industrial data of real output. As part of its longer-term research program, the Council will extend its estimate of potential output to 1975, and it is expected that the program of revisions and refinements to the real output measures which is currently going forward will provide a sounder statistical basis for this exercise than was possible in the earlier case.

In addition, the industry of origin real output estimates have been extensively used in a variety of short-term forecasting exercises by the Departments of Trade and Commerce, and Labour. Studies of this kind are prepared for internal use only, but their methodology is based on simple arithmetic relationships between output, labor input, and productivity, on the basis of which either labor demand or potential output is estimated, using assumptions about the short-term behavior of productivity and the other related variable, in as much industrial detail as possible.

PRICE-COST ANALYSIS BY INDUSTRY

In the introduction, we affirmed our conviction that a set of establishment-based current dollar estimates of the income and cost components

[42] Economic Council of Canada, Second Annual Review, *Towards Sustained and Balanced Economic Growth*, Ottawa, December 1965.

of gross domestic product by industry of origin is an indispensable accompaniment of the constant dollar production-based estimates. To a significant extent, this view reflects the importance which we attach to the analysis of price change in value added by industry and the underlying cost-profit structures developed by Schultze [43] and exemplified by Marimont in his 1962 article presenting the new set of GNP by industry of origin accounts developed by the Office of Business Economics. Efforts along these lines in Canada have so far been fragmentary, both in regard to the number of industries and the kinds of factor income or nonfactor cost covered. Typically, they have been concerned with labor costs and corporate profits per unit of output by major industrial groupings such as manufacturing.[44] The limited and tentative nature of these studies reflects an awareness by their authors of the underlying data limitations but, even so, the available figures may be carrying more weight than they can properly bear. In the present climate of acute and increasing concern about the relationship of prices, costs, and incomes to sustained economic growth,[45] it would be extremely valuable to be able to identify problem areas by industry and by type of factor or nonfactor share; although an understanding of the underlying causes undoubtedly goes beyond this kind of statistical evidence into the areas of structure and institutional arrangements. It nevertheless seems a useful and timely exercise to review the available current dollar (income) and constant dollar (product) measures to indicate the major lines of development needed before truly comprehensive analysis in this field can be undertaken.

An industrial distribution of current dollar gross domestic product at factor cost and certain of its components is published annually as a supplement to the basic national accounts' income and expenditure tables.[46] The distribution is, for the greater part, at the industry division level of the 1948 Standard Industrial Classification and differs in minor detail from that of the real domestic product by industry of origin

[43] Charles L. Schultze, *Prices, Costs and Output: 1945–57,* New York, 1960.

[44] See, for example, Economic Council of Canada, *Second Annual Review,* Table 2-4, page 18 and Chart 2-5, page 19, also "Budget Papers," *House of Commons Debates,* March 29, 1966, Charts 15 and 16. As noted on page 73, the latter also contains (Table 23) a series of annual average growth rates of the value, volume and price components of GDP by industry.

[45] See page 474, above.

[46] *National Accounts, Income and Expenditure, 1926–56* and *National Accounts Income and Expenditure* (Annual), Tables 21, 22, 23 and 24.

estimates.[47] However, the availability of a detailed set of base-year weights for the latter makes it possible to recompile them to conformity with the national accounts' distribution.

Data on wages, salaries, and supplementary labor income by industry are published, as well as investment income, accrued net income of farm operators from farm production and net income of nonfarm unincorporated business. (It should be noted that the industrial distribution of corporation profits as published is not completely on a domestic basis, so that the figures cannot be subtracted from those of investment income to derive rent, interest, and miscellaneous investment income.)[48] The incomplete details of this distribution at the present time thus constitute the first obstacle to a comprehensive price-cost analysis of gross product by industry of origin.

However, the most serious difficulty arises out of the fact that all components of the national accounts' distribution by industry of origin of current dollar gross domestic product at factor cost, except for wages, salaries and supplementary labor income, net income of unincorporated businesses, and the inventory valuation adjustment, are compiled on a company basis of classification, following the Department of National Revenue's taxation statistics from which they largely derive. To the extent that manufacturing enterprises are integrated backward into resource industries and forward into wholesaling, retailing, finance, or other service industries, an industrial distribution of gross domestic product so importantly influenced by company statistics will show a larger proportion of productive resources engaged in manufacturing than if profits, capital consumption allowances, etc., were based on establishment statistics.

The distribution of 1949 gross domestic product by industry of origin which provides the weighting system for the real output measures was based largely on a recompilation of the national accounts' distribution along establishment (or, in some cases, activity) lines for the purposes

[47] In the industrial distribution of real domestic product by industry of origin estimates (also based primarily on the 1948 SIC), repair service is excluded from manufacturing; contract drilling (excluding drilling for oil and gas) and prospecting are excluded from mining, quarrying and oil wells; and water and sanitary services from public utility operations. These industries are then brought together in a separate division "other goods producing industries, n.e.s."

[48] *National Accounts, Income and Expenditure, 1926–56,* Tables 27 and 50, par. 194.

of the 1949 input-output table.[49] Thus, in addition to major regroupings of data relating to corporation profits, capital consumption allowances, etc., due to the reporting unit and classification differences just noted, the distribution reflected a different treatment of construction, in which the own-account new construction of other industries was also included so as to provide a measure of all construction activity regardless of where it originated. The greater part of this adjustment was effected in the wages, salaries, and supplementary labor income component, where the national accounts' figure of 523 million dollars for 1949 was increased by deductions from public administration and defense, public utilities, communication, transportation, and manufacturing amounting to 150 million dollars.

These examples, while not an exhaustive list, are sufficient to demonstrate the hazards of attempting to derive significant price-cost relationships from currently available data, even in the limited area of unit labor costs where the requisite figures are ostensibly prepared on a mutually consistent basis. Progress towards the solution of these difficulties will no doubt emerge as the developments such as those noted at various points in this paper are carried forward.

Statistical Integration

For some years the prevailing view in DBS has been that it would be unnecessarily restrictive to insist that all the basic systems of economic statistics utilize identical building blocks at their most detailed levels. Such an insistence would achieve a semblance of integration at the expense of the primary purposes the separate systems are designed to serve. Either explicitly or by implication, systems such as the inter-industry flow studies, domestic product by industry of origin measures, industry prices and productivity-price-cost relationships are most conveniently based on establishment data, while the income and expenditure accounts and the financial flow systems relate more naturally to company data. These systems should be capable of being integrated and reconciled at various levels of aggregation.

[49] See DBS Catalogue No. 13-513, *Supplement to the Inter-Industry Flow of Goods and Services, Canada, 1949*, Ottawa, 1960.

COMMENT

MICHAEL GORT, State University of New York at Buffalo

I am told that there are two classes of people in the world: those who classify people into two classes and those who don't. Apparently I belong to the first category, for I had always thought there were two classes of social accountants: the "thick-skinned" and the "thin-skinned" accountants. Those who are "thick-skinned" devote themselves to generating the best estimates of observable phenomena that their resources and tools permit without being unduly concerned about asymmetry in definitions and methods of measurement. Those who are "thin-skinned" find such conceptual inelegance intolerable and devote themselves to resolving the inconsistencies. Messrs. Garston and Worton, it seems, belong to both categories—which, I suppose, destroys my classification system. They are, however, considerably more successful in their capacity as "thick-skinned" than as "thin-skinned" social accountants.

The authors and their colleagues at the Dominion Bureau of Statistics have developed an extremely valuable body of data on industry real product, and have achieved this objective despite very serious deficiencies in the basic data available to them. In general, the methods they have used permit industry comparisons of Canadian output and of input–output relations with those developed by the Office of Business Economics for the United States. The methods they have used differ in a number of respects from those used by the Office of Business Economics, mainly because the same classes of data have not been available to them. For example, the authors would have preferred to rely more heavily on measures of real output based on value data deflated by price indexes for individual industries instead of on quantity indexes with base-year price weights. Conceptually the two approaches should yield the same results though, of course, there may be serious measurement discrepancies. As additional price data become available and as further improvements in industry estimates particularly of investment flows and of capital are carried out both in the United States and in Canada, a number of interesting comparisons should become possible. For example, we might learn if the consistently higher capital-output ratios that have

been observed for Canadian as compared with American industries represent real differences or only a statistical illusion.

A few words are, perhaps, appropriate on questions of measurement as distinct from the logical structure of the accounts. It seems to me that the authors place undue emphasis on the errors that arise from industry estimates that pertain to establishments but that are derived from company data. As the development of company statistics [1] in recent years in the United States has shown, the discrepancy between company- and establishment-based data is not large for most sectors—mining and some other extractive industries are an exception—at least at the level of industry detail used in the current Canadian measures of output. Relatively simple methods of adjustment should reduce the error to tolerable dimensions. Thus I am somewhat puzzled by the fact that the authors consider this a serious obstacle to the measurement of capital consumption for an establishment-based industry classification. Surely this source of error is negligible by comparison with the information gaps to which capital consumption estimates are subject quite apart from errors in industry classification. Parenthetically, the authors' implicit endorsement of the perpetual inventory method of estimating capital consumption is, I think, premature. All of us who have indulged in the sport of measuring capital stocks and capital consumption by perpetual inventory techniques will, I think, agree that the method is simply a rule of thumb which is used for want of better information. From the standpoint of logical consistency it is far better than the customary accounting values of depreciation. Its superiority over the latter, or over other potential estimating techniques, as an empirical measure of the underlying phenomenon is, however, yet to be proven. It would be unfortunate if what is now done for convenience became a convention.

The authors' discussion of the conceptual problems in the measurement of real product covers most of the standard questions discussed in the literature. They deviate from the conventional view on two issues—namely on the definition of output for the financial and real estate sectors and on the way in which price indexes should be used to adjust for quality change in measuring real product. On both matters their position, I believe, is untenable. In addition, they express a strong preference on

[1] U.S. Bureau of the Census, *Enterprise Statistics: 1958,* Part I, 1963.

conceptual grounds for a factor-cost rather than a market-value measure of industry output. I am inclined to think that, for most analytical uses, the choice among these alternatives depends on data quality and thus I favor the market-value approach.

Messrs. Garston and Worton are uncomfortable about the fact that revenues minus purchases from other industries are considered output for most sectors but not so for financial intermediaries and real estate firms. They propose, therefore, that interest and rents be deemed factor returns to the owners of assets rather than to the industries in which the physical assets are used. One would hardly wish one's measure of the output of an industry to be affected by the choice of financing methods, and debt financing is simply an alternative to equity financing. Consequently, to carry the authors' suggestion to its logical conclusion, the same classification should be applied at least to dividends on common stock as to interest, if not also to retained earnings. Moreover if the interest or dividends paid to the holders of financial assets represent factor returns, they can hardly cease to be factor returns if paid to households rather than to business firms. The effect, therefore, of the authors' proposal, if carried out consistently, would be to attribute a large fraction of output to households while subtracting from the estimate of industry output most of the returns to capital. I doubt that the authors would wish to go this far, but any alternative interpretation of their proposal leads to far more arbitrariness than they seek to avoid by their suggestion. However, a user need not be unduly disturbed about how interest payments and rents are classified as long as the statistician shows enough detail in his breakdown to permit someone with different convictions or tastes to reclassify these items. In all the debates over definitions in the social accounts, this may well be the most important point to remember.

In their discussion of factor-cost versus market-value measures of industry output, the authors show much concern about the current statistical inconsistencies in the allocation of indirect taxes by industry and how these affect market-value estimates. They are also troubled by the conceptual issue of whether indirect taxes should be ascribed to buyers or to sellers. Thus they express a preference for factor-cost estimates. Whatever arbitrariness exists in the allocation of indirect taxes, it affects more the measure of the level of industry output than the

measure of change in output over time. As long as we consistently use actual market values to measure all inputs as well as sales, double deflation in conjunction with correct price indexes should deflate out changes in tax rates that are shifted to product prices, thus leaving the measure of output unaffected. To be sure, accurate price indexes, especially for purchased materials, are difficult to construct without a detailed breakdown of the composition of all inputs. However, estimates of indirect taxes paid through the purchase of intermediate products cannot be made at all without detailed and currently applicable data on input–output relations.

For some purposes, such as intercountry comparisons of production relations, the level of output is important. However, for most analytical uses of data on industry output, it is the movement in the series over time rather than its level that is crucial. The absence of suitable indexes for directly deflating factor returns, or alternatively, for deflating indirect taxes (which must then be subtracted from the deflated market value of output) seems to render the factor-cost estimate less reliable for measuring the movements in output. Once again, however, even if the factor-cost measure were adopted, users could be given their choice of measures through the simple expedient of showing the amount that has been subtracted from market values for indirect taxes—assuming, of course, that factor incomes are not deflated directly.

I now come to the most difficult problem of all—the allowance for quality change in the measure of output. There are a number of approaches to this problem. One can, for example, deflate output by price indexes that ignore quality change in output, as most price indexes currently in use tend to do. Changes in inputs and in output will then measure changes in the quantities of units, and estimates of productivity change will reflect only those technical advances that permit a larger physical quantity of output to be produced from the same quantity of inputs, with both unadjusted for quality change. Alternatively, one can try to adjust all outputs and inputs for quality change, as measured by the valuations of buyers, and thereby allocate to each industry changes in productivity that arise both from increases in the quantity and the quality of output from a given (quality-adjusted) constant-dollar value of inputs. Still a third alternative is to deflate output by quality-adjusted price indexes and then impute to the factors of production all measured

changes in the quantity or quality of output.[2] In this way, the value of inputs would be derived from the value of output, with technical advance allocated among the factors of production in accordance with independent information on various capital and labor augmenting variables such as education, research and development expenditures, etc.

Messrs. Garston and Worton take none of these approaches. Instead they prefer to measure quality change only when such quality change is associated with an increase in the quantity of inputs used. Thus, for example, if an automobile tire lasts twice as long but its production entails no increase in the quantity of labor or capital or materials, the authors would make no allowance for such quality change in their measure of output. It is only if the amount of rubber used in the tire, or some other input, increased that the quantity change would be reflected in measured output. This is a step in the direction of decomposing all outputs and inputs into their constituent particles, and the particles into their energy equivalents. Then by the law of the conservation of energy, outputs will always equal inputs. Since all definitions are arbitrary, the authors commit no logical error if they choose to define real output in terms of real inputs. But on the same principle, they should also exclude from their measure of output all increases in the quantity produced if unaccompanied by commensurate increases in the quantities of inputs. The measures would then be logically consistent though their usefulness for the analysis of economic problems would certainly be open to question.

REPLY

GARSTON AND WORTON

It surprises us that Professor Gort has found sufficient substance in our passing reference to the Canadian work on historical capital-output ratios to regard it as an endorsement of the perpetual inventory method of estimating fixed capital stocks. We can, however, admit that if it had been appropriate to pursue this question in the paper, our position would have been basically sympathetic. The fact that the main thrust of official

[2] This approach has been taken in a recent paper by Z. Griliches and D. W. Jorgenson, "Sources of Measured Productivity Change: Capital Input," *American Economic Review,* May 1966.

effort in Canada and the U.S. has been, and will probably continue to be, through the perpetual inventory method, must be a prime consideration in any realistic assessment of the possibilities in this field.

In both countries, some of the most fundamental criticisms of the validity of the method have been acknowledged by the use of alternative assumptions as to economic service lives, retirement patterns, and so on. The results so far are necessarily crude and tentative, but most users would surely agree that if the basic data are relatively satisfactory and if the estimating processes are consistent and can be accepted as reasonable, then fairly reliable and analytically useful stock estimates can be produced.

On the problem of adjusting real-output measures for quality change, we remain unrepentant, in spite of Professor Gort's amusing *reductio ad absurdum* of our proposals. Undoubtedly we were arguing in our "thick-skinned" capacity, although a respectable "thin-skinned" case could be made if space permitted. Let us merely repeat that we wish to close some of the more obvious loopholes in our present measurement procedures which have resulted in a failure to capture the effects of changes in the characteristics of the flow of real goods and services. Partly this can be done within the scope of the average-unit-value deflation approach if sufficiently fine detail is available in the source material. However, our main concern is to see much greater emphasis placed in the future within DBS (Dominion Bureau of Statistics) on the deflation of value data by industrially classified selling- and purchase-price indexes, adjusted for quality according to the convention described.

In this kind of price index, the transactions unit is the product itself and not the service it provides. Thus, if an automobile tire lasts longer, the price quotation cannot be directly adjusted to take account of this increase in the store of services, even if this could be unequivocally assessed, because it is tires and not tire-miles which are priced in the market place. Hence, it seems to us that the most feasible "thick-skinned" way of measuring the difference in quality arising out of changes in the characteristics of a product is by the comparison of their relative costs, whether by the limited and arbitrary conventions commonly in use, or by the more sophisticated technique of regression analysis.

In our proposals for the treatment of interest and rents, we can appreciate as keenly as Professor Gort the very far-reaching and possibly

awkward implications for the rest of the system. However, what has prompted us to rush in where angels fear to tread is the feeling that all of us, angels and lesser breeds, may be accepting too complacently the widening "credibility gap" between the national accounts treatment of these income flows and economic reality in the business sector. The growing importance of the financial intermediaries indicates very strongly to us the need for a revival of the discussion of these problems and for a solution that follows natural accounting practices.

The implications for the personal and government sectors of the proposed treatment of interest and rents do not seem to us difficult to deal with in principle or practice. The effects on the financial-flows accounts would almost certainly be beneficial in that changes in a sector's aggregate balance sheet could be related more meaningfully to changes in its investment income. The invariance argument is by no means one-sided and cannot, in our opinion, be reconciled very well with the concept of the *total activity* of an industrial establishment which Canadian real-output measures will eventually reflect. In this context, the differences between debt financing and equity financing are more important than their similarities. Interest is an intermediate cost involving a mandatory obligation to outsiders, whereas dividends are the discretionary distribution of a residual return to owned capital.

We would agree with much of what Professor Gort says regarding factor-cost–market-price measures but we must take exception to at least two points. In the case of international comparisons, it should be noted that many countries use the factor-cost concept, indeed, most European SNA countries utilize it. Of course this difficult matter is now under consideration by the U.N. Statistical Commission and by a number of countries, including Canada, and it may thus be premature to say too much more about it at this time.

While it is true that deflated values for individual commodities will move similarly (assuming properly matched price indexes are available) whether valued inclusive or exclusive of indirect taxes levied at the industry level, this is not necessarily so of any combination of commodities unless indirect taxes as a percentage of market value are similar for all commodities, or all commodities move similarly. These conditions are not met with in Canada at either the commodity group or industry levels. Thus the question of reliability of the factor-cost

industry measures, when viewed in the light of industry of origin measure uses, has never been seriously questioned in Canada.

Finally, a further comment on the company-establishment unit classification problem might be useful. In Canada there are substantial differences in the industrial distribution of gross domestic product at factor cost when this distribution is based on establishment data instead of company data. Even a rough comparison of the Canadian data for a weight-base year such as 1949 (bearing in mind that the main component, salaries and wages, is on an establishment basis in both distributions) will indicate the possible range of difference. For example forestry in that year was affected by about 20 per cent, while mining differed by 10 per cent. Other industries were affected by a lesser percentage with manufacturing affected by only 2 per cent. However, within manufacturing some individual industries would be substantially different. Vertical integration by companies across industrial lines in Canada is thus considered to be important and is subject to continual change.