NOTES AND MEMORANDA

ON THE QUANTITY CONCEPT OF PRODUCTION
(a contribution to current discussions)

BY HARRY SCHIMMLER*

Recent discussions at international level (UN, EEC, OECD) on quantity and price elements of values in general and also on non-market services have raised a number of issues for which no standard solutions or conventions exist so far. This note deals with only one point common to these discussions: the coverage of underlying quantities by aggregate values, in particular of production; seen however, successively from two separate standpoints: (a) at what point in the economic process quantities are produced, which may be different from the point of creation of (their) values; and (b) which part of aggregate values is considered as the quantity component. Some of the points presented here take up new ideas which may make it necessary to re-consider certain of the positions taken so far. In any case, present practice needs to be revised, since the implicit theoretical concept cannot in fact be applied.

(*a*) *The Production Boundary*

The manuals[1] of the international system of national accounts describe only the way in which *values* are to be registered in this system, but they do not exactly define the point in the economic process at which *quantities* of goods and services are to be considered for the purpose of accounting. This was probably regarded as unnecessary because the system was defined above all through its market values. Underlying (physical) quantities have not been defined; but values at constant prices (called: "volumes") are widely used as proxies, usually calculated by deflating values with price indices sampled per quantity unit and appropriately adjusted for price changes due to other reasons, e.g. changes in quality. These volumes are usually thought to represent "real" movements, since the product of volume index and price index equals the value index. This value of production was set as the value it fetches on the market; together with the definition of production as the activity which adds to the supply of goods and services,[2] the boundary at which production is

*This note is a summary abstract of some points made in a paper for the 14th IARIW Conference, which was a first draft of one chapter of a book on basic principles for national accounting. It represents the personal views of the author independently of the fact that he has already expressed some of them in his former capacity as Head of the Concepts and Syntheses Section of the Economic Statistics and National Accounts Division of the OECD. He is at present Consultant at OECD's Development Centre.

[1] *A System of National Accounts*, United Nations, New York, 1968 (abbr. SNA), used for reporting national accounts data for all UN and OECD Member countries;

European System of Integrated Economic Accounts, Statistical Office of the European Communities, Brussels, 1970 (abbr. ESA), the "community version" of the SNA, used to report national accounts data of EEC Member countries to the Community authorities.

The concepts of the two systems are basically the same, but certain aggregations are different, so that different magnitudes appear in the two versions for aggregates with similar names.

[2] SNA, para. 6.10

counted as such can be (and has been) interpreted to lie at the point of the possible incurrence of profit or loss, i.e. at the point in the economic process at which production is valued by exchanges between producers and users.[3]

Accordingly, it has been argued in some cases that production is completed when the goods or services are sold or, more generally, handed over to the user or consumer. In other words, output is measured in terms of transactions between producers and users. On this basis it would not be sufficient for goods and services to be created in a purely physical sense for them to be counted as output; there must also be users who would be prepared to pay for them. The occurrence of transactions between producers and users would be an indication that a real demand or use for them exists whether the transactions are money or barter, or market or non-market. As a consequence, identical physical activity in different circumstances would count as productive, non-productive or differently productive, depending on the number of users or recipients of the output, so that the measurement of that output would be based on the extent of the usage.[4]

However, such a definition of production, though possible and meaningful in a framework *exclusively* based on values and for purposes of comparing only values with values, will lead to most serious inconsistencies in "real" terms, if these are to measure underlying quantities or their relationships (e.g. productivity), or their movements over time. If the measurement occurred only at the transaction point between producer and user,[5] identical services and identical products may represent more or less "quantity", depending on how much "transaction" there was. This is clearly unsatisfactory for certain analyses (e.g. production records, productivity measurement, input–output coefficients, etc.), and it has also been recognized that it leads to incongruent treatment of identical activities or products at different stages of the production process (e.g. growing flowers by (i) a gardener in agricultural activities, i.e. in industries, where flowers become "goods", or (ii) a gardener working for a household, where the flower-growing activity is usually counted only as a service purchased but not in terms of the results achieved).

In fact, many "services" involve a process of physical transformation which is not very different from that involved in the production of goods and it can be shown that the technology of producing certain "services" need not be intrinsically different from that for goods. But their output is considered as a product different from goods, because it involves simultaneously two different economic units (producer and user), impinging directly on the person or goods belonging to the user unit, with the agreement of the latter, whereas the production of a good is thought to take place within a single unit.[6]

The general distinction, however, is not *where*, i.e. in which or in how many units, the actual production occurs (the units may actually be the same in both cases); the basic distinction lies in the fact that (market) services usually add very little physical input to any material product with which they may be linked *and* that their product is sold with the *agreement* of the buyer, i.e. it already becomes payable at the moment it is produced, and usually cannot be undone or taken back. Services, in principle, are *produced* directly at the (present) production boundary, while goods are only *valued* (or re-valued) there.

[3]Although the SNA manual literally states that "the gross output of goods is to be recorded at the moment the goods are made "(para. 6.11), goods (and services) are, in fact, so defined that they are linked with the transaction between a "producer" and a "user".

[4]T. P. Hill, "Price and Volume Measures for Non-market Services", Working Document, Statistical Office of the European Communities, 1975.

[5]In fact, the "sale" criterion is imputing a "user", independently of whether there will ever be a final use, in all those cases where the result of production is not demanded directly by the actual final user but is indirectly delegated to some other producing agent, e.g. investment (including change in stocks), research, etc. Actually, general government production may also represent such delegated expenditure decisions.

[6]cf. footnote 4.

The following reasoning distinguishes three different "stages" in the production of goods and services; these stages correspond, however, to different dimensions, viz., stage 1 is a process; stage 2 is a situation; and stage 3 is a point of time:

Production Stages

time →	stage 1	stage 2	stage 3	
material input	being produced	ready for trade	actually traded	product
	goods (costs)		profit or loss	
	services			
producer				user

While in the present system market values for both goods and services originate only at stage 3, quantities of goods are available at the end of stage 1. Quantities of services become available in principle at stage 3 also; in fact, the value of services is known before stage 3 is completed. When the producer of a service is also its "trader", the three stages collapse into one, so that in this case the end of stage 1 is identical with the other two stages, and the situation is the same as for goods made on order and immediately turned over to the user. The situation is substantially different however, when the actual producing agent, i.e. normally a salaried employee, is not identical with the trading agent, i.e. some other employee, or the employer.

In this case even for services there is a product which passes through the different stages before reaching the present production boundary, and it would be advisable either to consider this product as a good or to distinguish several separate services. This can be particularly important for the interpretation of service quantities (and for the corresponding productivity measurement), e.g. in all cases where the same "service" is made available to a number of "users". The different stages are relevant, e.g. in writing books, in university lectures, in transport enterprises, in performances of theatre plays, etc.; the product of the (primary) producer does not depend on the number of readers, students, passengers, listeners, but it does for the product of the "trader" (publisher, university, seller of transport function, theatre owner, etc.). This difference between producing and "trading" would be important even for the registration of the production of goods:

production statistics usually register goods somewhere during stage 2 (which may include certain shipments, but not deliveries when these occur after the point of change of ownership);

the market value convention in national accounts, when strictly applied, would register them only at stage 3;

whereas the goods as such, i.e. as the sum of all inputs, already exist at the end of stage 1.

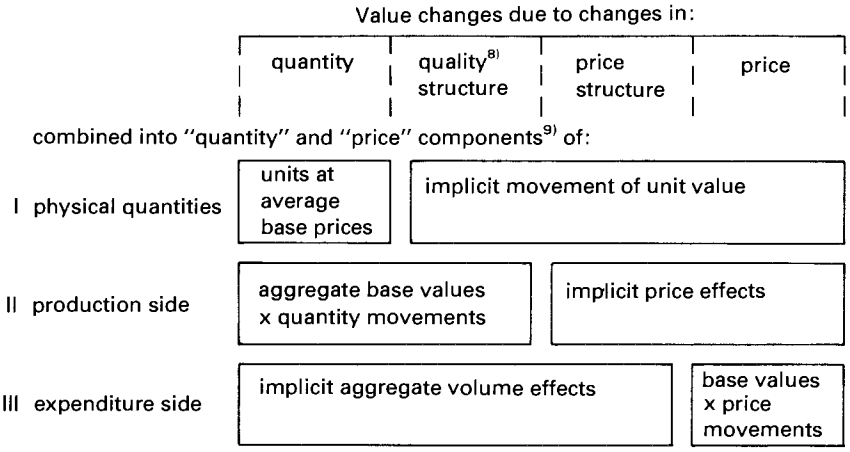
It is not hard to see why the conventional production boundary has been chosen at stage 3: it coincides (at least in most cases) with measurable money flows, and a valuation has actually been made by the market. In principle, even the corresponding quantities at this stage could be given—that they are not usually measured is a statistical shortcoming, which is not overcome by the deflation of values. Measurement of production at the other stages can be made only by defining the quantities (which has not been done) and by means of a uniform valuation (which also needs to be defined). The difficulties are not insurmountable, in particular since statistics at these stages already exist to a certain extent. In any case, appropriate productivity measurement will also have to take data at the other stages into account.

(*b*) *"Quantities" and "Prices"*

The concept of quantity depends, as well as on the way in which the production boundary is drawn, on the method by which values are divided into components. For a long time it has been thought that it is sufficient to eliminate "price" movements in order to arrive at the "quantity" component of values. However, it has recently been recognized that aggregate values cannot be divided into two components such that one represents quantities and the other one prices, nor is this possible for the movements of these values.

The belief that this may be possible was sustained for a long time by the apparently complementary nature of the Paasche and Laspeyres indices, which obviously on a formal theoretical level permit a clear separation into only two components. However, changes in aggregate values may occur independently of any change in price or in quantity because of structural changes, so that there would be at least one other component to be taken into consideration, if the purpose is to measure pure changes in prices and/or in quantities. In fact, dividing values into only two components (an aggregate "price" and an aggregate "quantity") leads to components that are the least "pure" in terms of their names, since they necessarily must include all structural effects. In addition, these two-component considerations apply only to theoretical formulae with complete coverage, i.e. at the greatest detail level of the two components. With decreasing coverage (which is the case when only representative or sample elements, which cannot include the purely structural effects, are used) the two components will not only no longer necessarily constitute the *only* components of value changes, they will also cover less and less structural change (since they will include fewer and fewer separate items among which shifts can occur), which will then have to be evaluated separately or as the difference between separate evaluations of the "quantity" and the "price" components and the total.

In a first article the author showed that there are at least four basic components[7] which may be combined into three different two-component breakdowns of an aggregate value, as summarized in the following graph:



[7]I.e.: quantity, quality structure, price structure, and price; cf. H. Schimmler, "On National Accounts at Constant Prices", *The Review of Income and Wealth*, December 1973, pp. 457–461.

The two structural effects, taken together, are known as the "composition effect"; however, they are separated here, because they have different explanatory values:

valuing quantities at base period values results in aggregates including the shift effects from changes in the structure of quantities of different *qualities*;

deflating values results in aggregates also including the shift effects from changes in the structure of quantities of identical quality which are sold at different *prices*.

It is, therefore, obvious that the other component (i.e. the implicit price in the first case, and the implicit volume in the second case) is not equivalent to the same component when this component is calculated directly.

Each of the three left-side components, which are all used as "quantity" proxies in different instances, are in fact "values at constant prices". Two-component data "at constant prices" may thus represent three different concepts: a basic quantity concept, a production concept, or a consumption concept; in each case, however, the implicit "quantity" underlying an "average price" is different. In fact, all three concepts are simply different combinations of the same four basic components. The "volumes" or "real" movements in categories II and III therefore actually represent combinations of changes in a basic quantity component and of value changes due to merely structural changes, while this is analogously true for price movements in categories I and II.

All national accounts data at constant prices today are still mixtures of these three kinds of constant price data, with no precise indication or distinction; the different kinds of constant price data will necessarily be incompatible when all basic elements are non-zero—which is the normal case; but only few countries have so far realized that the differences between the production side and the expenditure side of GDP are systematic and due to different methods and not accidental and due to statistical errors. Constant price data of the production side normally belong to a category other than those of the expenditure side (cf. graph).

Since the structural weights differ on the production side and on the expenditure side, it would be unrealistic to assume that the two sides would yield the same results—even when the same indices are used. The only possibility of obtaining identical results lies in establishing the production and expenditure sides from the same constant price data (which should, of course, all be defined at the same level), possibly in an input-output table, which is, in fact, the method used—at least for reference—in more and more countries.

However, in a two-component approach all data would then be of category I, *or* II, *or* III *throughout*, each of which will always reflect only one view at the expense of the others. A four-component system,[10] on the other hand, can (i) explain the different concepts, (ii) permit a conceptual evaluation of these differences, (iii) produce data better adapted to different purposes, and last but not least (iv) give rise to a more "physical" measure of the"quantity" component of values, while different views can be (re)produced as different combinations of the components.

Concluding, it can be said that large discrepancies exist between required analytical quantity measures and the proxies used in practice. Even in its pure theoretical form the usual two-component model—mostly represented by complementary Laspeyres and Paasche indices—comprises changes in one or both components, which are not due to these components but to structural changes.[11] Also the observed[12] wide divergencies in results derived from the same set of data by Laspeyres and Paasche forms of indices—if the calculations are made at a highly disaggregated level—can be interpreted as structural

[8]Quantities and prices should be properly adjusted for quality changes; value changes due to changes in quality structure, i.e. among quantities of different quality, however, should be defined as a separate element, which cannot be called structural change in physical quantities only because not all quantities have the same unit.

[9]The designation of these components follows actual practices rather than new theoretical procedures for combinations of the four basic elements above; such procedures will, however, have to be defined separately.

[10]Or five-component system with productivity as a separate component, when output proxies are derived from inputs (cf. also the article mentioned in footnote 7). Once the different components have been separately defined, they may then explicitly be combined for certain purposes.

[11]For example, a change in the structure of physically identical goods sold at different prices will show changes in the aggregate "quantity" and/or "price" component in a two-component system, even if the total quantity and the individual prices remain unchanged, while the quantity and price component in a four-component system will not change (cf. also the numerical example in the article mentioned in footnote7).

[12]E.g. by Alterman and Marimont, Horner, and Coleman; cf. *The Review of Income and Wealth*, 1970 and 1971.

components. The Fisher, Edgeworth, Stuvel, Iklé, and Best Linear[13] indices are merely different ways of averaging or distributing the spread of the Laspeyres and Paasche indices for the same data, while this spread represents a separate, important explanatory variable. Since, as outlined, the theoretical indices themselves contain structural effects, the total structural component is even wider than this spread, and the pure quantity and price components are even narrower than any one of these indices. Analyses based on proxies containing the structural components are therefore biased to the same wide extent and differently according to the importance of structural changes. Measurement of pure elements needs to be defined by the stage in the economic process at which they are to be recorded and by the procedure by which they are to be distinguished, while implicit or residual elements will always be mixed.

[13]N. T. Jazairi showed that Fisher indices "are very close to Best Linear Index Numbers", which may obviously be taken both ways; cf. *Bulletin of the Oxford University Institute of Economics and Statistics*, 1971.

ANNOUNCEMENTS

ABRAHAM AIDENOFF
1913–1976

Abraham Aidenoff, Deputy Director of the Statistical Office of the United Nations from 1963 until October 1975 when he became its senior technical adviser, died on January 9, 1976 at the age of 62. In spite of great personal discomfort he had continued to work up to the week of his death.

Aidenoff graduated from the University of Chicago in 1934, and subsequently worked for a number of years for various governmental organizations in Illinois. After World War II he went to China as chief statistician of the China Mission of UNRRA. From 1947 to 1949 he was an economic statistician with the U.S. Census Bureau, and in 1949 he joined the UN as chief statistician for industrial statistics and national accounts.

As the readers of this Review know, Aidenoff made a most important contribution to the work of the United Nations in the field of national accounting. Of course, he would be the first to point out that he was only one of several people engaged in this work; he was, above all, a modest man. But his was a leading role and one which he had continued to exercise in an eminent and authoritative way as recently as the very widely attended interregional seminar on national accounts held last December in Caracas. It will not be easy to fill the place left empty by his death. Abe's encyclopedic knowledge and his wide-ranging comprehension of literally all fields of statistics are irreplaceable. He had an incredibly retentive memory and like a computer he sorted in his mind every significant detail that crossed his attention. But more important, he did this in an orderly and systematic way; he was a true scientist in that his thought processes were in the form of systems and interrelations. Random and apparently meaningless facts took on unsuspected meaning through his ability to arrange them in significant order and structure. He was able to respond to any question or problem with a wealth of facts and details carefully organized into a useful synthesis or overview. Any recitation of Abe's qualities would be incomplete, furthermore, if it did not note that his door was always open and he was unstinting of his time to those who sought his advice and counsel. No one who came into contact with him in his work failed to learn something new or understand something better or be stimulated to think through problems more completely.

The international statistical community is diminished by his death. He was tremendously admired the world over, and he has left an indelible impact through the conferences, seminars and working groups in which he took part and through his many writings.

S. A. Goldberg

INTERNATIONAL ASSOCIATION FOR RESEARCH IN INCOME AND WEALTH
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FIFTEENTH GENERAL CONFERENCE, 1977

The Fifteenth General Conference of the International Association for Research in Income and Wealth will be held at York University, York, England, August 20–25, 1977. The tentative program is given below. Persons who are not members of the Association and who would like to attend are invited to write to the Secretary of the Association for further information.

Tentative Program
as of September 1, 1976

Session 1. The evaluation of services and non-marketable activities
Organizer: Jiri Skolka, Austrian Institute for Economic Research, Postfach 91, A-1103 Vienna, Austria

Papers:

a. Discussion Papers:

1. John W. Kendrick, U.S. Department of Commerce Imputations in economic accounts, with estimates for the U.S., 1948–73
   Discussant: Christopher Saunders, Centre for Contemporary European Studies, University of Sussex, England
2. Robert Eisner, Northwestern University, Evanston, Illinois, U.S.A. Actual estimates of the "Total Income System of Accounts"
   Discussant: Christopher Saunders
3. O. Arkhipoff, Institut National de la Statistique et des Etudes Economiques, Paris, nad Henri Duprat
   The general concept of output
   Discussant: Derek Blades, OECD
4. Maurice WEINROBE, Federal Home Loan Bank Board, Washington, D. C.
   Federal programs to stimulate housing in the United States: The analysis and measurement of the contribution to net economic welfare
   Discussant: Egon Matzner, Institut für Finanzwissenschaft und turopolitik an der Teschischen Universität Wein
5. F. Thomas Juster, Institute for Social Research, University of Michigan, U.S.A.
   The functional division of time among households.
   Discussant: Christopher Saunders
6. T. P. Hill, University of East Anglia, Norwich, England Measurement of do-it-yourself activities in households
   Discussant: Alfred Franz, Austrian Central Statistical Office
7. Hans J. Adler, Oli Hawrylyshyn, Statistics Canada
   Value of household services in Canada: Some time series estimates
   Discussant: Christopher Saunders
8. Nestor E. Terleckyj, National Planning Association, Washington, D.C.
   Measuring output of industrial R&D as increments to production of economic sectors
   Discussant: Jean-Pierre Poullier, OECD
9. Jeremy Hurst, U. K. Department of Health and Social Security Sectoral input, output, cost and productivity in the health and personal social services
   Discussant: Alfred Franz

b. Contributed Papers:

1. D. J. Cogan, University College Dublin
   Measurement of the output from R & D
2. A. J. Culyer, University of York, England
   Measurement of the output and performance of the health services
3. Reuben Gronau, Hebrew University, Jerusalem
   The household production function and the value of output at home
4. Eamon Henry, The Economic and Social Research Institute, Dublin
   Possible input-output approach to the measurement of output and performance of R&D activities
5. Egon Matzner, Technical University of Vienna
   A Note on "Baumol's Law"
6. Henry M. and Janice Peskin, Resources for the Future and U.S. Dept. of Health, Education, and Welfare
   A system of dual valuation in the absence of optimal allocation of non-marketable activities
7. A. D. Tussing, Economic and Social Research Institute, Dublin
   Contributions of religious communities to education in Ireland.

Session 2. Redistributional effects of inflation in the national accounts
Organizer: Andre Vanoli, INSEE, 18 Blvd. Adolphe Pinard, 75675 Paris XIV, France

Papers:

1. Solomon Fabricant, National Bureau of Economic Research, New York
   Title to be announced
2. United Kingdom Central Statistical Office
   Title to be announced
3. Kul Bhatia, University of Western Ontario, London, Canada
   Capital gains and losses
4. Edward N. Wolff, New York University and National Bureau of Economic Research, New York
   The redistributional effects of inflation on household balance sheets
5. Angelo de Souza and Janes de Souza, Vargas Foundation, Rio de Janeiro
   The case of Latin America
6. Hiroshi Niida, Yokohama National University
   The redistributional effects of the inflationary process in Japan, 1955–75
7. Raymond Courbis, Universite de Paris X, Nanterre, France, and Philippe Temple, INSEE, Paris
   Inflation, relative prices and income transfers
8. Andre Babeau, University de Paris X, Nanterre and Centre de Recherche economique sur l'epargne
   Inflation and the distribution of surplus: The case of households
9. To be announced

Session 3. Special accounting problems of developing countries
Organizer: Bernardo Ferran, Banco Central de Venezuela, Caracas, Venezuela

Papers:

1. Yoshimasa Kurabayashi, Hitotsubashi University, Tokyo
   The national accounting framework for developing countries: Asian perspectives and experiences
2. S. G. Tiwari, United Nations Economic and Social Council for Asia and the Pacific
   Estimational problems of non-monetary production in the island countries in the Pacific
3. Dudly Seers, Institute for Development Studies, University of Sussex, England
   Topic to be announced
4. Michael Ward, Institute for Development Studies, University of Sussex, England
   Topic to be announced
5. Kazim Sabzewari
   Topic to be announced

   Additional papers to be announced,

Session 4. Income redistribution through taxation and expenditure
Organizer: J. L. Nicholson, Department of Health and Social Security, 151 Great Titchfield St., London W1P 8AD, England

Papers: To be announced

Session 5. Systems of price and quantity indexes, including quality change
Organizer: Laszlo Drechsler, Institute of Economic Planning, 1132 Victor Hugo utca 18–22, Budapest, Hungary

Papers:

1. Joel Popkin, National Bureau of Economic Research, Washington, D.C.
   The integration of a system of price and quantity statistics with data on related variables
2. Ake Tengblad, National Central Bureau of Statistics, Stockholm
   The integrated price index system in the Swedish national accounts
3. Bryan D. Haig, Australian National University
   An input-output analysis of price changes in industry sectors
4. Dietrich Kunz, Federal Statistical Office, Wiesbaden
   The revision of price indexes
5. M. Picard, INSEE, France
   The problem of the changes of products and of the introduction of new products in the compilation of the consumer price index

   Additional papers to be announced

Session 6. Contributed papers

1. Peter Hampton and A. C. Rayner, University of Canterbury, Christchurch, New Zealand
   The regional distribution of wealth in New Zealand, 1860–1960
2. John M. Quigley, Yale University and National Bureau of Economic Research
   The geographical incidence of central government revenues in the U.S.