NOTES AND COMMUNICATIONS

PRICE DIFFERENTIATION AND COMPUTATION OF NATIONAL ACCOUNTS FIGURES AT CONSTANT PRICES

BY PER SEVALDSON

Central Bureau of Statistics, Norway

We are in this note concerned with the problems which arise in the computation of national accounts figures at constant prices, when goods are sold to different users at different prices.[1]

When there are differences between users in the price per physical unit paid for a good, the average price per physical unit will be a weighted average of the prices per physical unit delivered to each user. A change in the average price will result both when there is a change in price for deliveries to one or more users under constant relative distribution of quantities and when there is a change in the relative distribution of quantities among users under constant (but unequal) prices. If there is a change in the relative distribution of physical units of the good among users the constant price value of total supply deflated by the average per unit price will diverge from the sum of constant price values for all users, when the value in each use is deflated by a price index for that particular use. We will consider here how this discrepancy may be reconciled in national accounting, so that the fundamental book-keeping identity between supply and demand may be maintained.

Price differences may be due to one or more of the following causes:

(a) Differences in quality, including differences in relative magnitudes of components for a composite commodity;

(b) Differences in the amount of distributive services associated with the commodity in different uses;

(c) "Pure price discrimination", i.e., identical, homogeneous goods are sold to different users at different prices, due to imperfections of the markets. Such discrimination could be practiced by the producer(s) or (and) by the distributors of the good. Here we will restrain the discussion to price discrimination by producers.

(d) Differences in indirect taxes per unit of the commodity in different uses.

As we shall see, it is primarily the causes under (c) and (d) which give rise to problems in constant price computations. And it is our experience that these problems have to be dealt with explicitly in order to obtain meaningful results of constant price computations. Now we assume that we can isolate and treat separately each of these causes of change in the average per unit price. A change in the average price per unit caused by change in the price for one or more users under a constant relative distribution of quantitities must be considered to be a genuine price change and causes no theoretical problem: We can deflate total current year value by an index of the average price change from the base year and get a "current year value at base year prices" which will be equal to the sum of deliveries to all users deflated by indexes of the change in price for each user.

The balancing problem emerges when there is a change in the average price per physical unit which is caused by a change in the relative distribution of quantities, and we must consider the solution in relation to the specific cause of the difference in prices as listed under (a)–(d) above.

[1]We will not be concerned with problems connected with the possibility that prices for the same commodity may vary between different producers, but assume that all producers of a given commodity in this context may be considered as a unit.

(a) *Differences in quality.* When the difference in prices is due to differences in quality, we do not in reality have one homogeneous product, and we cannot logically add physical quantities indiscriminately. The only solution which is consistent with the general assumptions underlying the system of accounts and the concept of fixed-price values is then either to treat the various qualities as separate goods, and to deflate them separately, or to find a conversion rate between physical quantities of the different qualities. A convenient candidate for such a conversion rate is the price ratio in, say, the base year (if the price difference is really due to quality difference, then this price ratio might be assumed to remain relatively stable over time). Both of the suggested solutions will imply that a shift to higher (lower) price qualities will be interpreted as an increase (decrease) in volume, and are in accord with common sense and (even) the preference of economists.

The practical consequence is that the value of deliveries from the producer at constant prices is found as the sum of receipts by users, at constant prices, and the constant price value deflated by "average price per unit" received by the producer has no meaning and is not used. There is consequently no balancing problem.

(b) *Differences in distributive services.* When the price difference is caused by differences in distributive services associated with identical physical units of a commodity, the prices that the producer receives will be identical for all units and a shift in distribution among users will not affect his average price. From his point of view, therefore, a mere shift in distribution ought not to be interpreted as a change in volume. But if prices are unchanged, and the reduction in the number of phyiscal units taken by one user is exactly the same as the increase in the number taken by another user, who (both in the base year and in the current year) pays a different price, then the sum of deliveries to these users in base year purchaser's prices will change as an effect of the change in distribution.

Here it appears to be useful to bring into the argument the fact that due to the addition of distributive services the commodity delivered by the producer is not in an economic sense the same as the commodity received by the user at the time and place where he receives it. In national accounting practice we split the latter into two component parts; one is the commodity "itself" as delivered by the producer ("at producers' prices") and the rest is an entity representing the distributive services employed in bringing the commodity to the user. It is not difficult to accept that the volume of such distributive services per physical unit of the commodity may be different in different uses. Thus, a change in the distribution among users need not affect the quantity of the commodity measured "at producers' prices" and recorded as deliveries from producer to user, but it should affect the volume of distributive services (usually channelled through the trade sector) which are delivered to the users of the commodity.

(c) *Pure price discrimination.* When identical goods sold to different users bring different prices to the producer we face a real problem.[2] When there is price discrimination in the sense we are facing here, the results of calculations of fixed price values will in general be different when calculated on the basis of average price received per unit by the producer from what they will be when fixed price values are calculated for each user and then summed (unless there are no changes in the relative distribution of the product between users from the base year to the current year).

Such an imbalance between the total volume supplied and the total volume disposed of is of course illogical and we must face the problem of "what to do about it". Let us survey some possible solutions.

(i) We may accept the fixed price values computed from the user side and ignore the measurements on the producer side. This will mean that we treat pure price discrimination in exactly the same way as price differentiation caused by quality differ-

[2]This is, of course, a consequence of the fact that this situation is in conflict with the basic assumption that relative prices measure unique marginal substitution rates between all goods both in production and in all uses, a hypothesis which seems to be necessary for a meaningful use of national accounts figures at constant prices as measures of volume, and which prohibits the coexistence of different prices for one and the same good.

454

ences, and it relieves us of the difficult problem of identifying which of these two types of price differentiation we are faced with in each concrete case. It also leaves us with measures of changes in volume for the users which are meaningful. However, the effects on the measurement of output for the producers may be disastrous. For the production of even a completely homogeneous product, we will now have an output measure which cannot be expected to reflect with any precision the changes in quantities produced. For the most important uses in economic analysis and planning the usefulness of constant prices figures which do not properly measure changes in production will be doubtful. The figures will be useless for the analysis of production functions (the relationships between quantities of output and use of productive resources).

It might be argued that this is a negligible problem, that it constitutes part of that "noise" with which any system of national accounts will have to live, and that anyhow, it is not possible to distinguish between pure price discrimination and price differentiation caused by quality differences. Unfortunately, this argument does not hold when figures at a moderate level of disaggregation are of interest. In the Norwegian economy there are several examples[3] of price differentiation which are clearly discrimination, and where we would obtain quite meaningless output measurements if we treated them as caused by quality differences. Indeed, it was just the apparently meaningless output figures which emerged when these sectors were subjected to standard procedures which brought the problem into focus. Thus, whereas, the "noise" solution of treating price differences as if they were caused by quality differences may be acceptable as the general rule, one must be prepared to make exceptions for the cases where the consequent error in output measurements becomes non-trivial.

(ii) The other extreme solution would be to use the average price on all deliveries as a deflator both for total production and for all uses. However, in this way we should only move the problem to the measurement of uses. Now our measures of inputs to different uses would in general stand in no fixed relation to changes in the physical quantities actually used. This would then be damaging for the analysis of quantitative behaviour in the using sectors.

(iii) A possible compromise may be to deflate total production by the average price and each use by its appropriate price. What we do then is in reality to use different units of measurement for the same product; we will necessarily get imbalances between constant price values of production and corresponding sums of uses at constant prices, and we must seek a method for reconciling these imbalances. It is difficult to see that there is any other acceptable way of handling them than by splitting the transactions in the problematic good into two parts, one being the value at some, arbitrarily chosen, accounting price, which may, for instance, be the average price for total production, and the other being an adjustment item, which may be positive or negative and which may be looked upon as a "gain or loss from price discrimination".

It is important to note that, in order to have commensurable volume figures, this operation must be performed also on figures for the base year.[4]

The question remains how the adjustment items should be treated in the national accounts. A simple solution would be to treat them as positive and negative deliveries from a dummy sector. For such a sector the sum of positive and negative items would balance in the base year, but might be positive or negative for other years, and the net should be considered as an adjustment to GNP.

(d) Price differences caused by differences in indirect taxes represent a special problem mainly because of the choice of concepts in the new SNA. If we were concerned only with production values at so called "approximate basic values" and uses at pur-

[3]Coal used domestically or exported, fish used for further processing or to be consumed fresh, electricity from different producers, etc.

[4]It can be shown that necessary and sufficient information for the computation of all the required figures is the following: price ratios between the different uses in the base year, price indexes for each use from the base year to the current year, and the transaction values actually recorded in the base year and in the current year.

chasers' prices, we might use a solution corresponding to the one suggested under (b) above.[5]

Unfortunately, according to the standard the basic value concept for production measurements (gross production and gross product) is *value in sellers' prices*, which equals approximate basic value *plus* commodity taxes, and since commodity taxes may vary between uses, we get unequal seller's prices. Consequently, when we deflate deliveries to each use in sellers' prices by its own price index and when we deflate total production in sellers' prices by an index of average sellers' price per unit delivered, we will obtain deflated values for the various uses which do not add up to total deflated production (unless proportions of total deliveries subject to different tax rates remain unchanged). Thus we have again a problem of imbalance to which there is no correct solution, and it is a problem which we would not have had to deal with if the basic production measurement had been approximate basic value.

In the Norwegian economy, where exports are of the order of 40 percent of GNP, and exempt from a value added tax of 20 per cent, it would be directly misleading to ignore this problem. The solution chosen is to deflate all uses by price indexes in sellers' prices in a regular way. The production value is then deflated in such a way that the constant price value is unaffected by a mere redistribution among users, i.e., by a price index which also reflects the effect on average sellers' price of a changed distribution of deliveries on uses subject to different tax rates. The difference between constant price production and sum of constant price uses is then carried to a dummy sector. If the changes in relative distribution among uses are small, the balance items will be small. The procedure has so far only been put to use in computing preliminary 1971 values in 1970 prices. In the 1970–71 computations the sum of positive items was 300 million kroner and of negative items 230 million kroner for a total of 140 product groups. The net balance was thus only 70 million kroner, which is of the order of less than one-tenth of one percent of GNP.

It should be noted that the solution chosen reconciles the accounting imbalance, but it does not solve the problem of nonhomogeneous units of measurement for the same good. The accounts figures in constant price sellers' price values are consequently not good for use in analyses where quantitative relationships between producer and users of a good are of importance. For such analyses it is proposed to use figures at constant prices in approximate basic values.

---

[5]Compare for instance the paper prepared by Professor T. P. Hill for the Statistical Office of the European Communities: A System of Integrated Price Volume Measures (Indices). OS/21/72–E. §§ 213–216.