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THE USE OF CHAIN INDICES

FOR DEFLATING THE NATIONAL ACCOUNTS *)

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*) This study has been prepared under a contract with Eurostat. A survey to ascertain the extent to which the Statistical Offices of the Member States of the European Community use chain indices formed part of this study. A summary of the results can be obtained from the authors. On the basis of a preliminary theoretical study and the results of the survey, the authors exchanged views on both the theoretical aspects and the practical implications with representatives of the Statistical Offices of the Federal Republic of Germany, France and the United Kingdom. Both the answers to the questionnaire and the discussions proved useful in performing this study.

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THE USE OF INDICES FOR DEFLATING THE NATIONAL ACCOUNTS

Abstract

The present paper is devoted to the problem of deflating national accounts and input-outputtables. This problem is approached from the theoretical as well as from the practical side. Although the theoretical argument favors the use of chained Vartia - I indices, the current practice of compilating national accounts restricts to using chained Paasche and Laspeyres indices. Various possible objections to the use of chained indices are discussed and rejected.

1. Introduction and summary

A consistent method for deflating goods and services transactions in the national accounts and input-outputtables must both be practicable and have a sound theoretical basis. The choice of such a method is discussed from both these angles in this study. One of the main considerations is that regardless of whether data from the national accounts or the input-outputtables are used directly or as material for further study, it is the yearly changes which are of most interest, particularly if the value change over time is decomposed into a volume component and a price component. On the other hand, however, the levels, with the price change component eliminated, are of relevance for certain kinds of structural studies. It appears from the relative frequency of the various types of use, however, that a clear picture of the yearly changes is more important than the accuracy of the levels indicated. This does not mean, of course, that no effort should be made to obtain accurate figures for the levels and it will be seen that this presents us with a particular dilemma where deflation is concerned.

Chapter 2 deals with the deflation of the national accounts data from the theoretical point of view. Practical considerations are taken into account only insofar as they arise from the typical way in which the national accounts are being composed. The first section of this chapter deals more specifically with the problem of decomposing the value change. The problem is examined in the light of the objective of distributing the effects resulting from aggregation into a price and a quantity component. Section 2 deals with the requirements which the deflation method must fulfil in view of the specific nature of the national accounts. This is followed by a review of various index number formulae which might be suitable and can be applied. The combinations of the Paasche and Laspeyres formulae and the Vartia-I formula are found to be the most suitable. Section 3 is devoted to the theoretical considerations which must be taken into account when selecting an index formula to be applied to a single period. It is concluded that the Vartia-I formula would be the most suitable in situations - which would presumably occur frequently - where structural changes take place simultaneously in both quantities and prices, since this formula allows the effects of these changes to be distributed over the two components. A practical disadvantage of this formula however, is that the indices thus obtained would not yield a table exhibiting additive consistency in real values. Section 4 concerns the choice of formula for calculation over several periods. The linking of changes from year to year to form chain indices is found to be the best option since the course of development of the aggregates in the input-outputtables and the national accounts is of most relevance to users. Section 5 examines the suitability of the Vartia-I index number formula and the chain index system, which have hitherto been advocated on theoretical grounds, for the compilation of national accounts. The integrated nature of the national accounts is of particular relevance in this context and it is unfortunately found that the Vartia-I formula is inappropiate in the light of the essential feature of the integration process, i.e. the comparison of supply and demand or resources and expenditure. No such problem arises, however, in the case of the chain index system. The Laspeyres and Paasche formulae would therefore appear the obvious choices for the volume and prices indices respectively. To round off the theoretical part, this section also discusses issues of publication of the volume and price indices and the deflated tables.

Chapter 3 deals in greater detail with the practical aspects of the use of chain indices for deflating national accounts. First, we examine the question whether the need for an annual base year change, which is a direct result of the use of chain indices, leads to any particular problems. It is concluded that the same basic data are required for both direct and chain indices and that in principle the same approach and effort are needed to integrate these data. These problems are discussed in Section 2 of this chapter. Second, there is the question of whether the use of chain indices rather than direct indices in itself poses any specific problems if it is not possible to use the entire detailed system of accounts and tables when preparing national accounts. Aspects of this question include the level of aggregation, the preparation of provisional estimates for the most recent years on the basis of inevitably limited data and the situation which arises if input-outputtables integrated into the national accounts are unavailable or at least not available for each year. These aspects are discussed in Sections 3 - 5 of this chapter. It is found that the situations described do not provide any particular argument against the use of chain indices, except in situations where value data in current prices and deflators are not both available, as can happen, for example, in the preparation of provisional estimates for the most recent years.

2. Theoretical aspects of deflation

2.1. Decomposing the value change

The transaction totals for various periods, which derive from the fact that given quantities of goods are sold at given prices, are usually expressed in terms of value. The change in these values in two consecutive periods is made up of two components, a change in the prices and a change in the quantities. In the case of transactions in a single homogeneous product the value change can in general be broken down into a price change and a quantity change. If "quantity" is defined as the number of units of the product in question and "price" defined as the number of money units per unit of product, "quantity" and "price" provide a good basis for effectively decomposing the value change between two transactions involving the same homogeneous product.

The data contained in the national accounts and input-outputtables, however, always relate to aggregates of transactions in various goods and services and of various economic groups. As soon as aggregates of this kind come into play, the terms "quantity" and "price" cease to be clear and unambiguous since quantities of different products cannot be added and prices of different products are not comparable with each other. Thus the aggregation problem adds a further dimension to the difficulties already inherent in decomposing a value change into quantity change and price change components.

On the subject of price indices and quantity indices, economic theory and statistical theory differ both in the way this problem is perceived and in the way it is dealt with. In economic theory, the aggregation problem is approached from the assumption of optimizing behaviour, given the production and utility functions. Viewed in these terms, the change in level of production or utility serves as the yardstick for the overall quantity effect of the quantity changes in transactions in individual products (1). Thus, micro-economic theory provides us with a conceptual framework within which the quantity and price changes in an aggregate of transactions in various goods may be defined for the individual economic subjects. In this way the method of aggregation always depends on the form of the production function or utility function for the economic subject in question. If the transactions of the various economic subjects are then taken together in order to obtain macro- or meso-economic totals, an aggregation problem arises once more. Less progress has been made towards a theoretical solution of this problem than at micro level, although interesting studies have been carried out (2). There must either be recourse to interpersonal utility comparison, for which there is no universally accepted basis, or fairly stringent requirements must be set in order to arrive at a meaningful macro-index on the basis of micro-functions. These requirements may relate both to the form of the micro utility and production functions and to the distribution of the utility and production coefficients over units. In both cases the requirements are too restrictive to serve as a starting point in statistical practice. In addition, there is the question of whether or not the assumption of optimal (rational) behaviour, which is applied in the economic theory of indices, provides an appropriate basis for statistical data.

For this reason, there is room for a statistical theory of indices. In what follows, therefore, economic theory will be set aside in favour of the statistical approach to the problem. In statistical theory, the problem of aggregation is approached directly at a macro- or meso-economic level since the aim of economic statistics is to obtain information of the total transactions involving certain economic groups, product groups and transaction categories. Viewed from the statistical angle the aggregation problem involves the selection of a system of weights which will permit joint evaluation of changes in non-additive quantities and non-comparable prices. Consequently, the statistical theory of index numbers concentrates primarily on the characteristics of the indices to be obtained in connection with the system of weights.

From a statistical point of view, quantities of different products can be added only by weighting them by prices, while prices can be averaged only by weighting them by quantities. However, this gives rise to an additional element in the decomposition of the value change, i.e. the weighting structure. Viewed in this way, it is possible, on the basis of the quantities and prices before and after the change, to distinguish three basic components in each value change of an aggregate, i.e.:

- a "pure" price component, calculated on the basis of the initial basket of quantities and prices;
- a "pure" quantity component calculated on the basis of the initial basket of quantities and prices;
- the changes in the quantity and price structures (structural-change component).

These components are discussed in greater detail in the annex, where it is shown that the structural component is significant only if changes occur in the structures of both the quantities and the prices. Thus, this component always relates to both prices and quantities. Only if this structural change component is insignificant the value change can be decomposed entirely into a pure price component and a pure quantity component. This situation occurs if there have been no structural changes in one of the two areas or if there is no correlation between the relative quantity changes and the relative price changes.

In practice, structural changes will occur more or less regularly, albeit gradually, in the economic process. Thus, when considering the choice of method for deflating the economic aggregates in the national accounts and input-outputtables, account must be taken of the existence and magnitude of the structural change component, since this means that the value change cannot be entirely decomposed into a pure price component and a pure quantity component. However, if we require that the value change be decomposed without remainder, there are basically three possible ways of dealing with the structural change component, i.e. it may be:

- included with the quantity component
- included with the price component
- distributed over the two components.

In the first two cases either a pure price component or a pure quantity component are obtained. If changes in quantity are accompanied by structural changes and the mixed component is (partially) included with the quantity component, this will no longer be a pure reflection of the quantity changes. In economic analysis this is usually referred to as "volume". If the structural change component is included with the price component, this is no longer a pure reflection of price changes. There is no equivalent, in the field of price changes, to the term "volume" as used in connection with quantities. For the sake of clarity, we refer to the results of including (part of) the structural change component in the price change component as the "aggregated price change".

The following notation will therefore be used in the remainder of this paper:

at the level of individual transactions:

value = quantity x price per unit

$$v = q \times p$$

at the aggregate level:

value index = volume index x aggregated price index

$$V = Q \times P.$$

The mixed nature of the structural change component has led to the development of a number of methods which permit the value change of aggregates to be split into a volume change and an aggregated price change. These methods may be found in index number theory. The index number formulae differ from each other with respect to the way in which they take account of the structural change component. This is the reason for the differences in the way in which the weightings are compiled on the basis of the available value, quantity and price data.

A great number of index formulae can be found in the literature. Since our aim here is to decompose the value change of aggregates of the kind found in the national accounts and input-outputtables, we should obviously first of all examine what formulae are applicable to data contained in such a specific system. This question will be examined in the following section where a preliminary selection will be made from the various index formulae available. Thus, the question of how the structural change component is dealt with for all known index formulae will not be examined exhaustively.

2.2. The specific nature of the national accounts and input-outputtables and the available index number formulae

Both the national accounts and the input-outputtables describe the transactions of certain economic groups. This is done always in terms of the incomes and expenditures of the various groups and hence specifically reflects the interrelationships. Thus, the tables are always twodimensional. This can be seen most clearly in the usual type of input-outputtable, but also the national accounts themselves are a double-entry system. In view of this specific character of the data contained in the national accounts and the input-outputtables, a requirement for deflation purposes must be that the value change is decomposed into a volume component and an aggregated price component without remainder, since only in this way the internal consistency of the systems can be maintained when the data are deflated. Thus the aim is not to isolate pure price components or pure quantity components. The primary concern when decomposing the value change in aggregates in the national accounts and input-outputtables is to reflect the real (volume) change in the transaction aggregate. In the statistical theory of index numbers, the aim of dividing the value change without remainder into a volume component and an aggregated price component is formalized in the factor reversal test, i.e. $Q \times P = V$. Two versions of this test are distinguished in the literature,

- Strong factor reversal test, which requires that the formulae for Q and P have the same form;

- Weak factor reversal test, whereby the formulae for Q and P need not have the same form.

The fact that the national accounts and the input-outputtables are two-dimensional additive systems, in which both the rows and the columns add up to known sub-totals and a known total, leads directly to a second requirement which the index number formulae must fulfil. The value change of the various (sub)totals must be decomposed in a mutually consistent manner, while the method used for decomposing the value change of the subtotals making up a total must be consistent with the method applied to the total itself. In the theory of indices this is known as the consistency-in-aggregation requirement, i.e. the result of the index formulae must always be the same regardless of whether the index for the aggregate is calculated by applying the formula to all the individual data forming the aggregate, or whether it is first applied to two or more subgroups and the indices thus obtained are subsequently aggregated using the same formulae. If the aggregate consists of n elements, then

$$I\,(1;.....;n) = I\,(I\,(1;.....;f)\;;\;I\,(g;\;.....\;;n)\;).$$

These two requirements must be fulfilled if the value change between two input-outputtables is to be decomposed into volume change and aggregated price change components in a manner consistent with the peculiarities of the tables in question.

Most of the index number formulae can be divided very roughly, but nonetheless meaningfully, into two groups. The first comprises the arithmetical means whereby the change in the value of the magnitude to which the index relates is calculated as a weighted arithmetical mean of the changes in the constituent elements. Indices of this kind take the following form:

Volume-index $\sum_i w_i \left[\frac{q_{i1}}{q_{i0}}\right]$

Aggregated price index $\sum_i w_i \left[\frac{p_{i1}}{p_{i0}}\right]$

where: $\sum_i w_i = 1$

i = 1,....,n denote the individual elements making up the aggregate, 0 denotes the base moment and i the comparison moment.

The best known examples of this kind of index are the Laspeyres and Paasche formulae (subscript i deleted),

Laspeyres $Q^L = \sum \frac{p_0 q_0}{\Sigma p_0 q_0} \times \left[\frac{q_1}{q_0}\right] = \frac{\Sigma p_0 q_1}{\Sigma p_0 q_0}$,

$P^L = \sum \frac{p_0 q_0}{\Sigma p_0 q_0} \times \left[\frac{p_1}{p_0}\right] = \frac{\Sigma p_1 q_0}{\Sigma p_0 q_0}$,

Paasche $Q^P = \sum \frac{p_1 q_0}{\Sigma p_1 q_0} \times \left[\frac{q_1}{q_0}\right] = \frac{\Sigma p_1 q_1}{\Sigma p_1 q_0}$,

$P^P = \sum \frac{p_0 q_1}{\Sigma p_0 q_1} \times \left[\frac{p_1}{p_0}\right] = \frac{\Sigma p_1 q_1}{\Sigma p_0 q_1}$.

The combinations (Q^L, P^L) and (Q^P, P^P) do not satisfy the factor reversal test, whereas both this test and the consistency-in-aggregation requirement are satisfied by the combinations (Q^L, P^P) and (Q^P, P^L).
The fact that the former combinations do not satisfy the factor reversal test is due to the fact that these indices represent a pure quantity component and

a pure price component respectively. In both cases, the mixed structural change component is disregarded. This component constitutes the difference between P^L and P^P.

The second group of index number formulae comprises the geometrical means, whereby the change in the value of the magnitude to which the index relates is calculated as a weighted geometrical mean of the changes in the constituent elements.

These indices take the following general form:

Volume index: $$\prod_i \left[\frac{q_{i1}}{q_{i0}}\right]^{w_i}$$

Aggregated price index: $$\prod_i \left[\frac{p_{i1}}{p_{i0}}\right]^{w_i}$$

where: $\sum_i w_i = 1$

Since for our purposes indices must satisfy the factor reversal test and the consistency-in-aggregation requirement, the choice is limited in this category too. Only the index formula known as Vartia-I satisfies both requirements. The indices read

$$Q^V = \prod_i \left[\frac{q_{i1}}{q_{i0}}\right]^{\varepsilon_i}$$

$$P^V = \prod_i \left[\frac{p_{i1}}{p_{i0}}\right]^{\varepsilon_i}$$

in which $$\varepsilon_i = \frac{p_{i1}q_{i1} - p_{i0}q_{i0}}{\ln p_{i1}q_{i1} - \ln p_{i0}q_{i0}} \Bigg/ \frac{\Sigma p_{i1}q_{i1} - \Sigma p_{i0}q_{i0}}{\ln [\Sigma p_{i1}q_{i1}] - \ln[\Sigma p_{i0}q_{i0}]}$$

This is even an example of strong factor reversal since the formulae for P and Q are identical in structure.

Outside these two groups is the Fisher index, which occupies an intermediate position in that it is the geometrical mean of the Paasche and Laspeyres indices. This formula satisfies the factor reversal test but does not meet the consistency-in-aggregation requirement and can therefore, in our view, be disregarded for present purposes.

If more than one period is taken into account, there are two ways of decomposing the value change between initial and final moment. A situation of this kind may be described as n moments of observation separated by n-1 periods. One possibility is to apply the index formulae directly to the total length of all the periods. In this case, moment of observation 0 becomes the base moment and moment of observation n the comparison moment. This will be referred to as "direct application of the index formula". Alternatively, the formula may be applied to each period separately, after which consecutive values of the indices obtained for each period are multiplied to form an index for the total of the periods. This is known as linking and the result is a chain index.

The choice between the direct application of index number formulae and the chain system is entirely different from the choice between the various index number formulae. The choice of the most appropiate index number formula concerns the way in which simultaneous changes in values, quantities and prices must be aggregated. The choice between the direct application of index number formulae and the chain approach concerns the question how consecutive changes must be treated to form a time series.

There are therefore four possibilities left for decomposing value changes between two or more consecutive input-outputtables. As regards the form of the index formulae, the combinations of the Paasche and Laspeyres formulae or the Vartia I formula may be used. These two possibilities may then, if several periods are taken into consideration, be applied either directly or in the form of chain indices.

2.3. Calculation over a single period: theoretical considerations

If a Laspeyres-type volume index and a Paasche-type aggregated price index are used, the change in volume is calculated on the basis of the composition of the basket at observation moment 0 and the aggregated price change on the basis of the composition of the basket at moment 1. This means, in more precise terms, that the price structure at moment 0 is assumed to be characteristic when calculating the volume change, and the quantity structure at moment 1 is assumed to be characteristic when calculating the aggregated price change. Stated otherwise, use of the Laspeyres formula for the volume index yields the pure quantity component. If the structural-change component has a value different from 1, i.e. if correlated structural changes have taken place in prices and quantities, this component is now implicitly included entirely in the price component. This combination would therefore be less likely to give an accurate picture of a real situation in which structural changes occurred in both components. The combination of Paasche-type volume indices and Laspeyres-type aggregated price indices gives rise to an analogous situation, i.e. the entire structural change component is implicitly included with the quantity component.

If the component relating to structural changes in the prices and quantities is to be distributed more evenly, the composition of the basket at moment 0 and at moment 1 must both be taken into account. In other words, an average of the relative values of the individual goods in both baskets must be used. Many index number formulae use an average of the relative values. The well-known Fisher index is in effect an index of this kind, although here indices are first calculated with the Paasche and Laspeyres formulae, taking the final basket and the initial basket respectively as the reference for the weights, after which the geometrical mean of these indices is taken. In the case of the Vartia-I index number formula, the weights are also based on both baskets and take the form of a logarithmic mean.

On the one hand, the choice of the type of average is relatively arbitrary as long as no further information is available on the structural changes themselves. On the other hand, the Vartia-I formula is the only known index formula using an average basket for the weights which is consistent in aggregation. Since, however, this is an essential requirement, as explained above, the only choice still to be made is between the combinations of Paasche and Laspeyres formulae and the Vartia-I formula. Since the Vartia formula distributes the structural component, it is more appropriate in a situation where structural changes take place in quantities and prices simultaneously. Quite simply, it may be argued that subsuming the entire structural component into either the quantity or price component is fundamentally indefensible and that adopting an intermediate position must therefore be regarded as relatively less arbitrary.

The use of an average basket for the system of weights can also be defended on the grounds that an average basket of quantities and prices is likely to be a more representative reference for the decomposition of the value change than either the initial or the final basket. In statistical practice, the probable representativity will be an important factor influencing the choice of index number formula, since both for practical reasons and in the interests of continuity frequent changes in the index number formula used are not desirable.

For these reasons, the Vartia-I formula would appear to be the most suitable for deflating the data contained in the national accounts and input-output-tables, since the structural change component is distributed over the two other components. The degree of preference thus depends on the relative significance of this component, which in turn generally depends on the length of the interval for which the calculations with the index number formula are carried out. The interplay of theory and practice will be further discussed in section 2.5. Then we will discuss also the practical disadvantage of the Vartia-I formula, i.e. its multiplicative character, which means that with this formula the multiplication of the initial value table by the volume indices table need not result in a table which exhibits additive consistency in real values. Thus if the Vartia-I formula is used, a table showing the transaction totals for a particular moment of observation in terms of the prices of the previous moment of observation can exhibit statistical or aggregation discrepancies.

2.4. Calculation over several periods: theoretical considerations

Calculation over several periods involves t observations including t-1 periods. It is assumed that a calendar year can be regarded as a single moment of observation. The choice of index number formula thus primarily depends on whether the formulae are to be applied to the entire interval made up by a number of consecutive periods or in the form of a chain index, whereby the formula is always applied to a single period between two consecutive moments of observation, after which the indices thus obtained are multiplied to obtain an index for the entire interval. The choice can be expressed as follows:

$$I\ (o,t) \quad \text{or} \quad \prod_{\tau=o}^{t-1} I\ (\tau,\tau+1) \quad ,$$

where the variable τ stands for a moment of observation, the prices and quantities of which are taken as the basis for the application of the index number formula. In the previous section, the aim was unambiguous. The value change between two consecutive moments of observation had to be decomposed into a volume change and an aggregated price change. At the same time the two observations were made comparable in terms of deflated value. When several moments of observation separated by several periods are involved, the choice of aim is wider. One aim might be to deflate the value of an aggregate at moment t in such a way as to afford optimum comparability with the data relating to moment 0. Alternatively, the aim might be to gain as clear a picture as possible of the changes in volume and aggregated price from one moment to the next.

The former of these two aims, i.e. determining a deflated value for moment t which will be comparable with the observation for moment 0, does not pose any problems other than those described in the previous section. In this case, the observation moments between 0 and t are irrelevant. Direct application of the Vartia-I index number formula would appear the obvious choice. The increasing likelihood of simultaneous structural changes in quantities and prices which results as the length of the time interval separating the two moments of observation increases can only strengthen the case in favour of the Vartia-I formula.

If the index number formula is applied directly in order to compare two moments of observation which are widely separated in time, the second aim is not achieved, i.e. no picture of the changes between the various intermediate moments is obtained. If structural changes occur in the quantities and prices during the intervals under consideration we will in general find that

$$\frac{I\ (o,t+1)}{I\ (o,t)} \neq I\ (t,t+1).$$

In the case of direct application of the index number formulae, the change for the period (t,t+1) is calculated on the basis of I(o,t) and I(o,t+1). Clearly, if there are structural changes the composition of the basket at moment 0 will "contaminate" the change calculated. In the interest of the greatest possible accuracy in the calculations, the change in question should be calculated on the basis of the formula I(t,t+1), since then only the composition of the baskets at t and t+1 will determine the system of weights. The way in which the changes take place is best determined by calculating the volume changes and the price changes for each pair of adjacent moments of observation. In this way the second aim is achieved. If this is carried out on an annual basis, series of annual changes are produced. These can easily be converted into chain indices by multiplication.

If this method is chosen, there is the question of the extent to which the first aim can also be achieved, i.e. comparing the observations made at two non-adjacent moments. Generally speaking, the change which has taken place in a particular magnitude between two non-adjacent points can be determined by direct measurement over the entire interval which has elapsed, or by accumulation of changes which have taken place in the periods making up the interval. In the latter case, the result of the calculation depends on both the magnitude and the timing of the changes. Theoretically, a line-integral index should be adequate in this case. In practice, a chain index represents an approximation to the line-integral index. A chain index can therefore be used to obtain an approximate value for the total change in volume and aggregated price over a number of years. Obviously, in practice discrepancies can arise between the results of using a chain index and applying an index formula directly.

In this sense, a chain index can be regarded as giving an approximation of the information required for a comparison of two non-adjacent moments of observation, as can be illustrated by the very specific case in which the quantities and prices change over a number of consecutive periods in such a way that the basket at moment t is the same as the initial basket at moment 0. In the case of a cyclical development such as this, the correct value, i.e. 1, will be obtained if an index number formula is applied directly. If, on the other hand, the chain-index approach is used the result will as a rule not come out at exactly this figure.

To summarize, direct application of an index number formula, while providing an adequate solution to the problem of comparing two non-adjacent moments, nevertheless fails to give a clear picture of the way in which the changes came about. If the changes are calculated from one moment to the next a picture of the course of development is obtained, and linking these changes to form a chain index gives an approximation of the information needed for comparision of two non-adjacent observations. Where the deflation of transaction totals in the national accounts and input-outputtables is concerned, the chain-approach would appear to be clearly preferable since users of such information are primarily interested in the way in which the changes in the aggregates came about. It is clearly only in a minority of cases that these data are used to make a comparison between two moments separated by a long time interval. However, attention should also be given to a practical disadvantage of the chain approach. It is not possible with this system to produce additively consistent tables in deflated values. The tables produced by multiplying the base basket by the volume chain index for an observation moment separated from the base moment by more than one period will exhibit aggregation discrepancies.

2.5. Practical implications

On the basis of the foregoing theoretical considerations regarding the greatest possible adequacy in the calculation of the volume changes and the aggregated price changes between two consecutive input-outputtables, we are in favour of the Vartia-I formula and the chain index system. What this means in practice, as far as the presentation of the calculations is concerned, is that no additively consistent tables, either in terms of real values relative to the previous year or in constant prices of a fixed base year, can be produced according to the scheme used for the input-outputtable. These tables will exhibit aggregation discrepancies. If we assume that, as posited in Section 1, adequacy of the yearly changes is the prime concern of the users of this information, the fact that only tables of indices can be produced would not appear to be an insurmountable problem.

However, the fact that in the case of two consecutive observations of transaction values this option does not yield additively consistent tables in real values does pose a major problem as regards statistical estimation, as can be best demonstrated by reference to the process of compiling input-outputtables. This problem of statistical methodology is related to the fact that the information available for deflating the tables is incomplete and to some extent inconsistent. The significance of this practical problem can hardly be overestimated since it is absolutely fundamental to the process of compiling input-outputtables. On the one hand, if the data are incomplete, the deflation of the input and output yields residual items in the columns of the input-output table, corresponding to value added in real terms, the change in which does not immediately stand up to critical analysis. The deflators originally used must reassessed on the basis of a plausibility analysis of these residual items. This gives rise to an interactive process. Inconsistency in the deflators also gives rise, on the other hand, to residual items in the rows of the table, which must be eliminated. Thus there are two aspects to the iterative process, and there must be a constant reassessment of both the deflators and the residual items if the best possible results are to be obtained.

If we opt for the Vartia-I formula the residual items must be assessed in terms of the multiplicative consistency-in-aggregation of index matrices, which is currently a far from simple matter. If an index number formula is selected that produces a table exhibiting additive consistency in real values, the reference for the iterative plausibility checks thus obtained is much simpler to assess. At the same time, the technique for integrating a table in current prices would be directly applicable to a table of this kind. This technical disadvantage must be balanced against the theoretical advantage of deflation by means of the Vartia-I index. The strength of the case in favour of this approach depends on the anticipated significance of the structural change component. On the one hand, it is important in this respect to note that the aggregates in the input-outputtables and national accounts are determined at a relatively high level of aggregation, at which structural changes tend to occur gradually. On the other hand, national accounts are mostly separated by only a year, so that the structural change component generally appears to play a relatively minor role in the changes between aggregates, even though effects of weather on harvests and sudden changes in raw materials markets, for example, can lead to substantial structural changes over a short period of time. In addition, the technical considerations outlined above imply that the theoretical advantages of various index number formulae are relatively less important.

Since, as will be clear from the foregoing, deflation by means of the Vartia-I formula would first of all require the development of a new and relatively complex statistical technique in order to modify tables which had originally been estimated on the basis of imperfect information, preference should for the time being be given to a combination of the Paasche and Laspeyres index number formulae for the compilations and publication of deflated input-outputtables and national accounts. Tables bases on such a combination exhibit additive consistency in real values. The theoretically less adequate treatment of the structural changes would appear acceptable in view of the fact that these changes would probably be relatively small.

This means that a choice must be made between the two possible combinations of the Paasche and Laspeyres formulae. Merely out of practical considerations of simplicity and interpretability of the results, we opt for the Paasche formula for deflation purposes and the Laspeyres formula for calculating the volume changes.

Deflation of the value in current prices by means of a Paasche price index yields

$$\frac{\Sigma\, p_1 q_1}{\dfrac{\Sigma\, p_1 q_1}{\Sigma\, p_0 q_1}} = \Sigma\; p_0 q_1 \;.$$

The interpretation of this magnitude is clear. The derived real values read in the previous year's prices. Deflation of values in current prices by the Laspeyres price index yields

$$\frac{\Sigma\, p_1 q_1}{\dfrac{\Sigma\, p_1 q_0}{\Sigma\, p_0 q_0}} = \frac{\Sigma\, p_1 q_1 \times \Sigma\, p_0 q_0}{\Sigma\, p_1 q_0} = \Sigma\; p_0 q_1 \times R \;,$$

which would be more difficult to interpret.

If the former approach is adopted, for each year a table can be produced in terms of the previous year's prices. Consecutive multiplication of the relevant indices yields indexes for longer intervals based on the chain system. These indices give a picture of the changes in the aggregates over time. Tables in real values can not be calculated without aggregation discrepancies arising. Clearly, the specific statistical problem of plausibility checks on the price and quantity data need only be solved on a yearly basis. There are thus no practical statistical objections to the compilation of chain indices.

Indeed, the use of chain indices is very much in line with statistical practice in the compilation of national accounts and input-outputtables, where the aggregates cannot as a rule be produced solely on the basis of direct observations, because the data are incomplete. The process of estimation consists in drawing together information of various types. Clearly, the tables relating to the previous year play an important part in this process. Thus, the compilation of the national accounts and the input-outputtables can itself already be regarded as a chaining process in which greater importance is attached to estimating changes with respect to the previous year as accurately as possible than to estimation of precise levels. In addition, the use of chain indices has a practical advantage in that it simplifies the treatment of disappearing or newly appearing goods or production processes.

If this approach is adopted, i.e. if the Laspeyres index is used for volume changes and the Paasche index for price changes, while the results for each year are linked to form chain indices, the following information is directly available. Firstly, the changes from year to year are shown. Secondly, chain indices ·bases on an arbitrarily selected reference year can be directly calculated. Thirdly, tables are available at the previous year's prices. However, tables in constant prices, i.e. the prices of a fixed base year, are not available and if they are calculated on the basis of the chain indices the tables will not be additively consistent and will generally show aggregation discrepancies. The directly available information corresponds to the demands of the majority of users of national accounts and input-outputtables, since these are primarily interested in changes from year to year, which can, as described above, best be calculated on the basis of a system of weights, which is as characteristic as possible.

However, there are two reasons why the information provided by this system may be regarded as inadequate. On the one hand, certain researchers, particularly those concerned with input-output relations, need data corrected for price changes in order to study the trends in the aggregates given the pure price components and other factors. They consequently require figures showing the pure price component in isolation and tables expressed in prices of a fixed base year. As will be clear from the foregoing, a direct application of the Laspeyres volume index would be one way of meeting this requirement, at least from the point of view of statistical theory. Thus, there is a difference between deflated data and data in constant prices. Since structural changes are most likely to be gradual, this discrepancy will as a rule be quantitatively small except when observations over longer periods are involved (3).

There is also a large group of users of the general data contained in the national accounts who, though being primarily interested in deflated data, have a strong preference for additively consistent tables in constant prices of a fixed base year for the sake of simplicity in the calculations they make on the basis of these data. It will be clear from what has gone before that this requirement cannot be met from the theoretical point of view. However, provided the period in question is not too long, a solution can be found by distributing the aggregation discrepancies, resulting when tables in "constant prices" are drawn up by means of chain indices, as statistical discrepancies over the various entries of the tables. This means, however, that if changes are calculated on the basis of additively consistent tables in "constant prices" calculated in this way, these changes will not as a rule coincide with the volume and aggregated price changes as provided by the chain indices. Both kinds of data, i.e. the changes calculated by means of the chain index and the "pseudo-consistent" tables in constant prices, should therefore be presented side by side, since no adequate percentage changes can be taken from the latter.

The aggregation discrepancies in the sense described above can be distributed over all the entries of the tables according to the RAS method (4), except that the negative elements are not affected. The use of this method is consistent with the nested character of the national accounts and input-outputtables. In the case of a one-dimensional table, this method means that the aggregation discrepancy is distributed proportionally over the (positive) elements. Although this demand for data at "constant prices" relates only to a number of general data on goods and services transactions in the national accounts, it is to be recommended that the RAS method be applied to the input-outputtables and the general data be compiled on this basis since this would ensure that the individual tables from the entire system would remain consistent.

3. Practical aspects of chain indices

3.1. Introduction

The argument set out in the previous chapter points towards using chain indices as the most suitable method of deflating the national accounts. From the theoretical point of view, the periods forming the links in the chain should be as short as possible, since in this way the effect of changes in the structure of prices and quantities is minimized. In practice, the periods will generally correspond to a calendar year, since the national accounts are usually drawn up on a yearly basis. Since the practical implications have been quoted as an argument against the use of chain indices, the question of whether there are in fact any practical problems which would preclude the use of chain indices is discussed in greater detail in this chapter. These problems may concern the quantity of data and the amount of processing required. The practical problems arising if chain indices would be applied at the lowest level of single homogeneous products will not be considered. For the purpose of this study, the attention can be restricted to a comparison between the use of chain indices and direct indices for deflation purposes at the level of the national accounts. The "basic level" of detail in the calculations is important for this analysis. The "basic level" can be defined as the lowest level of detail at which both data on values at current prices and deflators are available and at which the calculations are carried out. Thus, this basic level will differ from one country to another, and also depend on whether definitive or provisional estimates are involved.

3.2. The annual change of base

This section is based on the assumption that integrated national accounts and input-outputtables are compiled annually. This means that a complete set of detailed data expressed in current prices is available for each year and that annual adjustment of the weights at the detailed level is possible in principle. It is also assumed that price indicators are available at the same level of detail. In practice, these price indicators may be of various kinds. For example, they may be calculated on the basis of unit values or by means of price surveys. The comparison between the use of chain indices and of direct indices can be made in terms of the amount of data or processing required. Let us first of all consider the data requirement.

In accordance with the assumptions set out above, for determining the volume indices from year 0 tot year t we have available at the basic level both a series of data at current prices $p_o q_o$, $p_1 q_1$,.............., $p_{t-1} q_{t-1}$, $p_t q_t$ and a series of deflators

$$\frac{p_o}{p_x}\ , \frac{p_1}{p_x}\ , \ldots\ldots\ldots\ldots\ldots, \frac{p_{t-1}}{p_x}\ , \ \frac{p_t}{p_x}\ ,$$

where x is a specific reference period. If 0 is taken as the reference year, the latter series can also be written as

$$1, \frac{p_1}{p_o}\ , \ldots\ldots\ldots\ldots\ldots, \frac{p_{t-1}}{p_o}\ , \frac{p_t}{p_o}\ .$$

These data can now be used to produce both a series of direct volume indices and a series of chained volume indices. Clearly, these series are identical at the basic level. The direct Laspeyres volume index for year k $\in (0,t)$ can be calculated thus:

$$\frac{\Sigma p_o q_k}{\Sigma p_o q_o} = \frac{\Sigma p_k q_k \Big/ \frac{p_k}{p_o}}{\Sigma p_o q_o}$$

In other words, at the basic level the values are deflated and the results added. The corresponding chain index for year k is calculated as follows:

$$\frac{\Sigma p_{k-1}\, q_k}{\Sigma p_{k-1}\, q_{k-1}} \times \frac{\Sigma p_{k-2}\, q_{k-1}}{\Sigma p_{k-2}\, q_{k-2}} \times \ldots\ldots\ldots\ldots \times \frac{\Sigma p_o\, q_1}{\Sigma p_o\, q_o} =$$

$$\frac{\Sigma p_k\, q_k \Big/ \dfrac{p_k}{p_{k-1}}}{\Sigma p_{k-1}\, q_{k-1}} \times \frac{\Sigma p_{k-1}\, q_{k-1} \Big/ \dfrac{p_{k-1}}{p_{k-2}}}{\Sigma p_{k-2}\, q_{k-2}} \times \ldots\ldots\ldots\ldots \times \frac{\Sigma p_1 q_1 \Big/ \dfrac{p_1}{p_o}}{\Sigma p_o q_o} .$$

In the latter formula, a base year change is implicit at each step. However, it can be seen that no more data is required for the calculation of the series of chain indices than for the calculation of the series of direct indices. The same data are used in both cases.

Let us now turn to the extra cost and effort which the use of chain indices would entail in comparison with direct indices. A large part of the work of a statistician consists of collecting, processing and assessing the suitability of data. A particularly important aspect of this work is testing the consistency between the various price indicators. In the situation under consideration where annual integrated input-outputtables and national accounts are produced, this consistency testing will be performed with help of an input-outputtable. If series of direct indices are used, for each reporting year a table in prices of the reference year will be drawn up. In the case of chain indices, input-outputtables are always drawn up in the prices of the previous year. The number of times a table is drawn up at another year's prices and tested is the same in both cases. It could, however, be pointed out that drawing up an input-outputtable in the previous year's prices would presumably be a more straightforward matter than in prices of a different reference year. Thus there would appear to be little or no difference with respect to the cost and work involved in producing series of chain indices or series of direct indices.

3.3. The aggregation level

In the national accounts, deflation is preferably carried out at as low a level of aggregation as possible, and data in current prices and deflators or volume indices must available at that level. In practice, even the lowest possible level of aggregation will still in many cases involve heterogeneous product groups and the level of detail will be greater in some parts of the national accounts than in others, depending on the sources available. When choosing the deflators, the aim is to find an indicator which is sufficiently representative for an entire product group. If these indicators are taken from price statistics, such as producer price indices or consumer price indices, they will in many cases be composite indices, i.e. weighted means of various series of partial price index numbers. Since no details about the composition of the item to be deflated are known (otherwise this would not be the basic level) a re-weighting within the deflator is not possible, let alone an annual adjustment of this internal weighting. Thus, in the case of chain indices only the "external weighting" can be adjusted from year to year, while the "internal weighting" of the product groups remaining fixed for a couple of years.

The question therefore arises as to whether direct indices are preferable to chain indices in this respect. In the case of direct indices, the weights used for calculating deflators must relate to the reporting year (Paasche price indicators). However, if a deflator is taken from a set of price statistics at the basic level, it will in practice be of the Laspeyres type, where the internal weighting relates to the base year for the series of price indices in question. It can be concluded, therefore, that the internal weighting below the basic level cannot be updated in the case of direct indices either.

Thus, there would not appear to be any difference between chain indices and direct indices as regards the problem of internal weighting below the basic level. Chain indices involve only a yearly adjustment of the external weighting (starting from the basic level) so that the conclusion drawn in the previous paragraph still stands, regardless of the degree of detail at the basic level.

3.4. Estimates for provisional reporting years

In many countries the data included in the national accounts become available in phases. In the case of recent periods, provisional estimates are made and improved in the course of time. Finally, definitive estimates are made. This system is also used for preparing volume and price indices. The main difference between provisional and definitive years is the availability of basic data. First, the basic statistical material is generally incomplete for a provisional year, and second, it will be less detailed, which means that in the case of provisional years the basic level generally corresponds to a higher level of aggregation than in the case of definitive years. In addition, the possibility of using the same source for the price indicators and for the values at current prices is probably less, and price indicators for provisional years will be taken from other statistics than in the case of definitive years. All this means that the basic level is more heterogeneous and that the weighting scheme will consist to a greater extent of internal weightings.

If provisional estimates must be made for more than one year at the same time, the preparation of a series of chain indices becomes problematic. The available data frequently take the form of volume indices relating, for example, to gross production value or the value of consumption of goods and services. These volume indices are weighted on the basis of the values of the previous year. This yields Laspeyres-type volume indices for aggregates. After the results have been tested for consistency, integrated data at prices of the previous year may be calculated for the provisional year as follows:

$$\sum \left[p_t q_t \quad \times \quad \frac{q_{t+1}}{q_t} \right] = \sum p_t q_{t+1} = \sum \left[p_{t+1}\, q_{t+1} \Big/ \frac{p_{t+1}}{p_t} \right] .$$

If indices are then to be produced for a second provisional year (t+2) using the chain-index system, this can only be done if data at current prices are available for year t+1. Year t+1 then forms the basis for calculating the volume changes between t+1 and t+2 and for t+2, values in prices of t+1 can be calculated. If no data in current prices are available for year t+1, year t must be taken as the base year for the estimates for both provisional years, which means that the direct method must be used for estimates relating to the second provisional year even if, overall, the chain-index approach has been adopted. However, in view of the provisional nature of the results this is not a serious problem, particularly as the number of provisional periods will be generally limited.

3.5. Non-availability of annual input-outputtables

Only a limited number of countries produce completely integrated yearly input-outputtables and national accounts. In most cases, an input-outputtable is compiled at a lower frequency. In some cases, such tables form an integral part of the national accounts while in others they do not.

We shall consider the situation in which an input-outputtable which is fully integrated into the national accounts is available every x years. National accounts must also be compiled for the intervening years and it is possible that detailed information is available for part of the national accounts for these years, e.g. data on imports and exports of goods. In other areas, only more general data will be available. In the following discussion of the problem we assume that if the national accounts for intervening years are prepared at a high level of aggregation, these aggregates will correspond to subtotals or totals contained in the input-outputtables produced every x years. It is also assumed that data at current prices are available for all the years involved.

The main difference between this situation and the one discussed in 3.2. and 3.3. is that, in the case of years for which no input-outputtable is available, the basic level will tend to be a higher, and sometimes much higher, level of aggregation. Thus, the problem of the heterogeneity of the magnitudes to be deflated becomes more acute. If we opt for Laspeyres volume indices and Paasche price indices, the weights for the deflators must be based on the reporting year. Under the circumstances described above, no further breakdown is possible below the basic level and there is therefore no way of avoiding the use of internal weightings based on the most recent input-outputtable and the basic data from which it was produced. In this way we can obtain Laspeyres price indices for the basic level, with the year to which the most recent input-outputtable relates as a fixed base. The corresponding volume indices are of the Paasche-type. When indices for higher levels of aggregation are calculated, a Laspeyres formula may be used for the volumes and a Paasche formula for the deflators. The results are of a mixed nature, i.e. partly Laspeyres and partly Paasche. This means in practice that the most recent input-outputtable is used to produce an internal weighting system below the basic level of the national accounts. Clearly, this in no way prevents annual adjustments being made to the external weighting system above the basic level of the national accounts for the computation of chain indices. The internal weighting system will inevitably have to be kept fixed for a number of years. If after x years a new input-outputtable comes available and input-outputtables for the intervening years are produced by interpolation, it would be possible retrospectively to produce chain indices at the level of the input-outputtables . This would also permit a revision of the originally estimated deflated data at the basic level of the national accounts.

Let us now assume that the input-outputtables do not form an integral part of the national accounts. If the input-outputtables and the national accounts are integrated, the input-outputtables can be used as a means of balancing the basic data for the national accounts at a low level of aggregation and thus form the instrument par excellence for consistent deflation of the data in the national accounts. If for various reasons, such as a high degree of decentralization in the statistical system, an instrument of this kind is lacking, the balancing of the national accounts becomes a serious problem as regards both the values in current prices and deflated values. Even if it is possible to eliminate statistical discrepancies, this can at best be done at a very high level of aggregation. It can be seen from practice that in some countries the various data are not balanced. For example, in the United Kingdom the GDP is estimated from the three usual angles, i.e. output, incomes and expenditure. The discrepancies between the results have hitherto not been eliminated.

In principle, a situation of this kind should present no obstacle to the computation of chain indices, since this method can be used in connection with each of the three approaches. However, there are a number of practical problems. For example, with the output approach a large proportion of the available data is likely to take the form of volume indices etc., and values in current prices are not or only partially available. An annual change of base would then be impossible. In the case of the income approach the opposite problem would arise, i.e. only data at current prices would be available, unless it were decided to deflate these data by means of indicators based on the expenditure approach to the GDP. As we see it, the chain-index system can be applied within the expenditure approach. If values at current prices and deflators are available for the individual final use categories at some level of aggregation - which may differ from one category to another - it is possible to compile series of direct indices and chain indices.

3.6. Conclusion

This chapter dealt with a number of practical aspects of the compilation of series of volume indices and deflators and of deflated data in the context of the national accounts, with particular reference to the question of whether the use of chain indices poses any particular problems compared with direct indices. It can be concluded that the basic material required is the same in both cases, i.e. a series of values at current prices and a series of deflators at the basic level. A second conclusion is that no more time and effort - indeed, possibly even less - would be required to balance and test the consistency of the deflated data with the chain index method than with direct indices.

These two conclusions apply regardless of whether input-outputtables integrated into the national accounts are available annually, thus permitting integration of the deflated data at a low level of aggregation, or whether they are not available for every reporting period or entirely lacking. In the latter situation, the use of chain indices generally presents no particular problems except that, just like direct indices, they would have to be applied at a higher level of aggregation. The use of chain indices poses problems only when the requisite series of data at current prices and deflators are incomplete or entirely lacking, as for example in the case of provisional estimates for recent periods.

ANNEX

On the basis of two moments of observation 0 and 1 including one period, the pure quantity component can be expressed in terms of the prices at one of the moments, e.g., and the pure price component in terms of the quantity structure at that moment. The three above-mentioned value change components of an aggregate can be written as follows:

$\Sigma\,(q_1 - q_0)p_0$ = pure quantity component,

$\Sigma\,(p_1 - p_0)q_0$ = pure price component,

$\Sigma\,(p_1 - p_0)(q_1 - q_0)$ = structural change component.

The relative value change of the aggregate can be decomposed as follows:

$$\frac{\Sigma\, p_1q_1}{\Sigma\, p_0q_0} = \frac{\Sigma\, p_1q_0}{\Sigma\, p_0q_0} \cdot \frac{\Sigma\, p_0q_1}{\Sigma\, p_0q_0} \cdot \frac{\Sigma\, p_1q_1 \quad x \quad \Sigma\, p_0q_0}{\Sigma\, p_0q_1 \quad x \quad \Sigma\, p_1q_0} ,$$

where

$$\frac{\Sigma\, p_0q_1}{\Sigma\, p_0q_0} = \text{pure quantity component ,}$$

$$\frac{\Sigma\, p_1q_0}{\Sigma\, p_0q_0} = \text{pure price component ,}$$

$$\frac{\Sigma\, p_1q_1 \quad x \quad \Sigma\, p_0q_0}{\Sigma\, p_0q_1 \quad x \quad \Sigma\, p_1q_0} = R = \text{structural change component .}$$

If the prices and quantities at moment 1 are taken as reference the corresponding expressions are as follows:

$$\frac{\Sigma\, p_1q_1}{\Sigma\, p_1q_0} = \text{pure quantity component ,}$$

$$\frac{\Sigma\, p_1q_1}{\Sigma\, p_0q_1} = \text{pure price component ,}$$

$$\frac{\Sigma\, p_0q_1 \quad x \quad \Sigma\, p_1q_0}{\Sigma\, p_1q_1 \quad x \quad \Sigma\, p_0q_0} = R^{-1} = \text{structural change component .}$$

It can be shown, see Allen (1975), that

$$R = 1 + r \cdot \frac{\sigma p}{\frac{\Sigma p_1 q_0}{\Sigma p_0 q_0}} \cdot \frac{\sigma q}{\frac{\Sigma p_0 q_1}{\Sigma p_0 q_0}},$$

where: r = the correlation coefficient of the relative price changes and the relative quantity changes,

σ_p = the standard deviation of the relative price changes,

σ_q = the standard deviation of the relative quantity changes.

It is now directly apparent that R = 1 if

- there are no relative price changes, or
- there are no relative quantity changes, or
- there is no correlation between the relative price changes and the relative quantity changes.

Only in these situations the outcomes of the "pure" price component and the "pure" quantity component will be independent of the weights.

Notes

1) Samuelson and Swamy (1974) use the following definitions:

Price index: This must equal the ratio of the (minimum) costs of a given level of living in two price situations.

Quantity index : This measures for two presented quantity situations Q^0 and Q^1, the ratio of the minum expenditure needed, in the face of a reference price situation, P, to buy their respective levels of well-being.

2) In the Solow-Fisher approach to the aggregation problem the microfunctions should be approximately identical. See inter alia Fisher (1971). The approach based on the distribution of the utility and production coefficients has been developed by Sato (1975) among others.

3) An indication of the order of magnitude of discrepancies of this kind can be obtained by calculating various price index numbers over a long period. The following table may serve as an example.

Price index numbers for private consumption, The Netherlands, 1953 = 100

Year	Laspeyres		Paasche	
	Direct	Chain	Direct	Chain
1956	107	106	105	106
1961	121	119	117	118
1966	152	148	141	144
1971	200	192	178	187
1976	312	296	269	286
1977	331	315	283	304

Source: C.B.S. (1982).

4) See Bacharach (1970).

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Available National Accounts Occasional Papers

NA/01 **Flexibility in the system of National Accounts**, Van Eck, R., C.N. Gorter and H.K. van Tuinen (1983).
This paper sets out some of the main ideas of what gradually developed into the Dutch view on the fourth revision of the SNA. In particular it focuses on the validity and even desirability of the inclusion of a number of carefully chosen alternative definitions in the "Blue Book", and the organization of a flexible system starting from a core that is easier to understand than the 1968 SNA.

NA/02 **The unobserved economy and the National Accounts in the Netherlands, a sensitivity analysis**, Broesterhuizen, G.A.A.M. (1983).
This paper studies the influence of fraud on macro-economic statistics, especially GDP. The term "fraud" is used as meaning unreporting or underreporting income (e.g. to the tax authorities). The conclusion of the analysis of growth figures is that a bias in the growth of GDP of more than 0.5% is very unlikely.

NA/03 **Secondary activities and the National Accounts: Aspects of the Dutch measurement practice and its effects on the unofficial economy**, Van Eck, R. (1985).
In the process of estimating national product and other variables in the National Accounts a number of methods is used to obtain initial estimates for each economic activity. These methods are described and for each method various possibilities for distortion are considered.

NA/04 **Comparability of input-output tables in time**, Al, P.G. and G.A.A.M. Broesterhuizen (1985).
It is argued that the comparability in time of statistics, and input-output tables in particular, can be filled in in various ways. The way in which it is filled depends on the structure and object of the statistics concerned. In this respect it is important to differentiate between coordinated input-output tables, in which groups of units (industries) are divided into rows and columns, and analytical input-output tables, in which the rows and colunms refer to homogeneous activities.

NA/05 **The use of chain indices for deflating the National Accounts**, Al, P.G., B.M. Balk, S. de Boer and G.P. den Bakker (1985).
This paper is devoted to the problem of deflating National Accounts and input-output tables. This problem is approached from the theoretical as well as from the practical side. Although the theoretical argument favors the use of chained Vartia-I indices, the current practice of compilating National Accounts restricts to using chained Paasche and Laspeyres indices. Various possible objections to the use of chained indices are discussed and rejected.

NA/06 **Revision of the system of National Accounts: the case for flexibility**, Van Bochove, C.A. and H.K. van Tuinen (1985).
It is argued that the structure of the SNA should be made more flexible. This can be achieved by means of a system of a general purpose core supplemented with special modules. This core is a fully fledged, detailed system of National Accounts with a greater institutional content than the present SNA and a more elaborate description of the economy at the meso-level. The modules are more analytic and reflect special purposes and specific theoretical views. It is argued that future revisions will concentrate on the modules and that the core is more durable than systems like present SNA.

NA/07 **Integration of input-output tables and sector accounts; a possible solution**, Van den Bos, C. (1985).
The establishment-enterprise problem is tackled by taking the institutional sectors to which the establishments belong into account during the construction of input-output tables. The extra burden on the construction of input-output tables resulting from this approach is examined for the Dutch situation. An adapted sectoring of institutional units is proposed for the construction of input-output tables.

NA/08 **A note on Dutch National Accounting data 1900-1984**, Van Bochove, C.A. (1985).
This note provides a brief survey of Dutch national accounting data for 1900-1984, concentrating on national income. It indicates where these data can be found and what the major discontinuities are. The note concludes that estimates of the level of national income may contain inaccuracies; that its growth rate is measured accurately for the period since 1948; and that the real income growth rate series for 1900-1984 may contain a systematic bias.

NA/09 **The structure of the next SNA: review of the basic options**, Van Bochove, C.A. and A.M. Bloem (1985).
There are two basic issues with respect to the structure of the next version the UN System of National Accounts. The first is its 'size ': reviewing this issue, it can be concluded that the next SNA must be 'large ' in the sense of containing an integrated meso-economic statistical system. It is essential that the next SNA contains an institutional system without the imputations and attributions that pollute present SNA. This can be achieved by distinguishing, in the central system of the next SNA, a core (the institutional system), a standard module for non-market production and a standard module describing attributed income and consumption of the household sector.

NA/10 **Dual sectoring in National Accounts**, Al, P.G. (1985).
Following a conceptual explanation of dual sectoring, an outline is given of a statistical system with complete dual sectoring in which the linkages are also defined and worked out. It is shown that the SNA 1968 is incomplete and obscure with respect to the links between the two sub-processes.

NA/11 **Backward and forward linkages with an application to the Dutch agro-industrial complex**, Harthoorn, R. (1985).
Some industries induce production in other industries. An elegant method is developed for calculating forward and backward linkages avoiding double counting. For 1981 these methods have been applied to determine the influence of Dutch agriculture in the Dutch economy in terms of value added and labour force.

NA/12 **Production chains**, Harthoorn, R. (1986).
This paper introduces the notion of production cains as a measure of the hierarchy of industries in the production process. Production chains are sequences of transformation of products by successive industries. It is possible to calculate forward transformations as well as backward ones.

NA/13 **The simultaneous compilation of current price and deflated input-output tables**, De Boer, S. and G.A.A.M. Broesterhuizen (1986).
A few years ago the method of compiling input-output tables underwent in the Netherlands an essential revision. The most significant improvement is that during the entire statistical process, from the processsing and analysis of the basic data up to and including the phase of balancing the tables, data in current prices and deflated data are obtained simultaneously and in consistency with each other.

NA/14 **A proposal for the synoptic structure of the next SNA**, Al, P.G. and C.A. van Bochove (1986).

NA/15 **Features of the hidden economy in the Netherlands**, Van Eck, R. and B. Kazemier (1986).
This paper presents survey results on the size and structure of the hidden labour market in the Netherlands.

NA/16 **Uncovering hidden income distributions: the Dutch approach**, Van Bochove, C.A. (1987).

NA/17 **Main national accounting series 1900-1986**, Van Bochove, C.A. and T.A. Huitker (1987).
The main national accounting series for the Netherlands, 1900-1986, are provided, along with a brief explanation.

NA/18 **The Dutch economy, 1921-1939 and 1969-1985. A comparison based on revised macro-economic data for the interwar period**, Den Bakker, G.P., T.A. Huitker and C.A. van Bochove (1987).

NA/19 **Constant wealth national income: accounting for war damage with an application to the Netherlands, 1940-1945**, Van Bochove, C.A. and W. van Sorge (1987).

NA/20 **The micro-meso-macro linkage for business in an SNA-compatible system of economic statistics**, Van Bochove, C.A. (1987).

NA/21 **Micro-macro link for government**, Bloem, A.M. (1987).
This paper describes the way the link between the statistics on government finance and national accounts is provided for in the Dutch government finance statistics.

NA/22 **Some extensions of the static open Leontief model**, Harthoorn, R. (1987).
The results of input-output analysis are invariant for a transformation of the system of units. Such transformation can be used to derive the Leontief price model, for forecasting input-output tables and for the calculation of cumulative factor costs. Finally the series expansion of the Leontief inverse is used to describe how certain economic processes are spread out over time.

NA/23 **Compilation of household sector accounts in the Netherlands National Accounts**, Van der Laan, P. (1987).
This paper provides a concise description of the way in which household sector accounts are compiled within the Netherlands National Accounts. Special attention is paid to differences with the recommendations in the United Nations System of National Accounts (SNA).

NA/24 **On the adjustment of tables with Lagrange multipliers**, Harthoorn, R. and J. van Dalen (1987).
An efficient variant of the Lagrange method is given, which uses no more computer time and central memory then the widely used RAS method. Also some special cases are discussed: the adjustment of row sums and column sums, additional restraints, mutual connections between tables and three dimensional tables.

NA/25 **The methodology of the Dutch system of quarterly accounts**, Janssen, R.J.A. and S.B. Algera (1988).
In this paper a description is given of the Dutch system of quarterly national accounts. The backbone of the method is the compilation of a quarterly input-output table by integrating short-term economic statistics.

NA/26 **Imputations and re-routeings in the National Accounts**, Gorter, Cor N. (1988).
Starting out from a definition of 'actual' transactions an inventory of all imputations and re-routeings in the SNA is made. It is discussed which of those should be retained in the core of a flexible system of National Accounts. Conceptual and practical questions of presentation are brought up. Numerical examples are given.

NA/27 **Registration of trade in services and market valuation of imports and exports in the National Accounts**, Bos, Frits (1988).
The registration of external trade transactions in the main tables of the National Accounts should be based on invoice value; this is not only conceptually very attractive, but also suitable for data collection purposes.

NA/28 **The institutional sector classification**, Van den Bos, C. (1988).
A background paper on the conceptual side of the grouping of financing units. A limited number of criteria are formulated.

NA/29 **The concept of (transactor-)units in the National Accounts and in the basic system of economic statistics**, Bloem, A.M. (1988).
This paper provides a fundamental discussion of the dual actoring as used in the 1968 SNA. Special attention is paid to the transformation of legal entities into units more suitable for economic.analysis. Criteria for a precise delineation of the units are formulated. 'Establishment-type units and 'institutional units' turn out to be both institutional, that is both are really decision-making entities.

NA/30 **Regional income concepts**, Bloem, Adriaan M. and Bas De Vet (1989).
In this paper, the conceptual and statistical problems involved in the regionalization of national accounting variables are discussed. Examples are the regionalization of Gross Domestic Product, Gross National Income, Disposable National Income and Total Income of the Population.

NA/31 **The use of tendency surveys in extrapolating National Accounts**, Ouddeken, Frank and Gerrit Zijlmans (1989).
This paper discusses the feasibility of the use of tendency survey data in the compilation of very timely Quarterly Accounts. Some preliminary estimates of relations between tendency survey data and regular Quarterly Accounts-indicators are also presented.

NA/32 **An economic core system and the socio-economic accounts module for** the Netherlands, Gorter, Cor N. and Paul van der Laan (1989).
A discussion of the core and various types of modules in an overall system of economy related statistics. Special attention is paid to the Dutch Socio-economic Accounts. Tables and figures for the Netherlands are added.

NA/33 **A systems view on concepts of income in the National Accounts**, Bos, Frits (1989).
It is argued that different purposes and actual circumstances lead (and also should lead) to the use of different concepts of income. Thus, in the National Accounts several concepts of income could be employed, e.g. differing with respect to the production boundary. Furthermore, these concepts do not necessarily constitute an aggregation of income at a micro-level.

NA/34 **How to treat borrowing and leasing in the next SNA**, Keuning, Steven J. (1989).
The use of services related to borrowing money, leasing capital goods, and renting land should not be considered as intermediate inputs into specific production processes. The proposals in this paper entail that the way of recording the use of financial services in the present SNA remains largely intact.

NA/35 **A summary description of sources and methods used in compiling the final estimates of Dutch National Income 1986**, Gorter, Cor N. and others (1989).
Translation of the inventory report submitted to the GNP Management Committee of the European Communities.

NA/36 **The registration of processing in make and use tables and input-output tables**, Bloem, Adriaan M., Sake De Boer and Pieter Wind (1989).
The registration of processing is discussed primarily with regard to its effects on input-output-type tables and input-output quotes. Links between National Accounts and basic statistics, user wishes and international guidelines are also taken into account.

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