PROBLEMS IN THE COMPILATION OF INPUT–OUTPUT TABLES IN THE NETHERLANDS

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This article deals with some aspects of the compilation of input–output tables (I.O. tables). A global view is given of the way in which I.O. tables are compiled in The Netherlands. It is indicated that in The Netherlands a number of developments are in progress that have led to an extension of the uses that are made of I.O. tables. The changing demands on I.O. tables that result from these developments can be met in future to an important degree. This has been made possible by extending and improving basic statistics and by increasing the uses made of automation facilities. Some problems remain, however, and one of these problems takes a central place in this article. This is the problem of accuracy and continuity: how can yearly I.O. tables be compiled that combine accuracy with consistency over time. Accuracy means here that the tables should be as complete as possible and in optimal accordance with all available information. Consistency over time means that estimates of details of I.O. tables compared with the same estimates for previous years reflect real economic developments. It is obvious that those two demands may conflict, particularly for years in which new information becomes available. It then must be decided whether accuracy or consistency in time deserves priority. What problems result from this decision and what are the consequences for the yearly I.O. tables? The problems arising from the conflicting demands of accuracy and continuity apply to the Netherlands in the last few years. This led to a revision of I.O. tables and national accounts for 1977. This revision resulted in an increase of estimated national income of more than 6 percent. For some components the adjustments have been much larger; this is particularly true for the services sector. More information on the 1977 revision is given in an annex.

1. INTRODUCTION AND SUMMARY

This article deals with problems concerning the compilation of input-output tables on which we are working at present in the Netherlands. It emphasizes organizational problems, which arise on the one hand from the increasing demands made on the tables, and on the other hand from the development of the compilation facilities. In this connection may be mentioned the development of basic statistics, manpower and computer facilities. This article deals mainly with "problems" and with indications of the solutions on which work is progressing; at the present stage it is not yet possible to report on finalized solutions. In a few years' time more detailed papers on specific questions may be expected. It will then also be possible to take into account the experience gained up to the stage of what may then be seen as the final solution.

The central problem may be summarized in the following questions. How do we compile input–output tables which are detailed, of recent date and fully consistent with similar tables of preceding years, and that are accurate as well? Accurate in this connection means as much as possible in accordance with *all* information available for the reporting year. How can these demands made on input–output tables, which are to some extent conflicting, be reconciled? What are the priorities? How should the compilation process of such tables be organized?

Section 2 of this article gives a brief history of input–output tables in the Netherlands. Section 3 sketches how until recently the compilation of input–output tables was organized and the limitations to which that organization led in practice. Section 4 deals with some external developments, in particular users' preferences and available basic statistics. Section 5 is concerned with problems of quality improvement of the results in relation to the demand for consistency over time. The central question here is what has priority in the compilation of annual input–output tables, the comparability (in detail) with tables of previous years or merely the level of the actual estimate for the reporting year by itself? The short-term solution chosen in the Netherlands led to a revision of the input–output table and the national accounts for the year 1977. The results of this revision are shown in annex 2. Section 6 deals with the general criteria used in the design of the computerized system which is being developed and which will play an essential role in the solution of the problems described.

2. Thirty Years of Input–Output Tables

Input–output tables were initially developed in the Netherlands as an aid in the compilation of the national accounts. Experiments were initially carried out during the Second World War. The tables were seen as an important aid for obtaining consistent estimates of supply and demand of goods and services. Quite soon it was realised that input–output tables could also be used as instrument of analysis, e.g. for planning and extrapolation and for determining the accumulated cost coëfficients. This development took place in the Netherlands during the fifties. As this went on, the need for complete input–output tables at constant prices became apparent. Until now, however, tables at constant prices have not been drawn up. The main problems have been incomplete price statistics and lack of resources. As regards the latter it should be stated that a manually compiled table at constant prices is very labour-intensive. Tables of this kind are now being developed. The Netherlands does, however, have a nearly complete series of annual input–output tables at current prices from 1948 onward, in which approximately 35 branches of industry are distinguished. These are tables drawn up annually from a large quantity of detailed basic data; they are therefore not products of interpolations made with the aid of RAS methods or similar devices.

The existence of these tables over this long a period has stimulated the use of the detailed data in time series form, and this sometimes caused problems. The balancing of the tables, the rectification of earlier mistakes and the application of new basic data sometimes led to inadequate comparability of the detailed information over time. When the Central Bureau of Statistics (C.B.S.) instituted a new standard industrial classification of all economic activities in 1969, it became clear how preponderant the use of the data in the form of time series had become. Even at present the C.B.S. is under pressure from users to restore the consistency of these time series before and after 1969, but unfortunately the resources to achieve this are lacking. The method of compilation of the input–output tables has hardly changed in the past thirty years, nor have any major changes been introduced in the organization of the compilation process. At present, however, drastic changes are anticipated in the near future. Before considering their background and content an outline of the traditional procedure will be sketched.

3. The Organization of the Compilation of Input–Output Tables

Input–output tables in the Netherlands are compiled by the National Accounts Department of the C.B.S. The collection of statistics in the Netherlands is highly centralized. For this reason the main statistical sources of the input–output tables are compiled and elaborated annually or more frequently by the C.B.S. These include, among others: detailed production statistics, including cost structure surveys; foreign trade statistics; and labour and wage statistics. In addition there are a very large number of specific statistics that are used as sources for input–output tables, which are prepared outside the C.B.S. An exhaustive enumeration of all these statistics is not feasible in the context of this article.

The delimitation of responsibilities between the National Accounts Department and the other Departments of the C.B.S. is as follows. The basic statistics are compiled by specialized Departments of the C.B.S. and not by the National Accounts Department. They are usually collected through surveys which cover selected branches of industry or part-sectors and which are often of the "cut off" type, i.e., the smallest firms are excluded. One of the responsibilities of the National Accounts Department is the preparation of estimates for the many non-observed branches of industry and sectors and the preparation of additional estimates for partly observed branches of industry. In addition the Department is responsible for estimating all relevant data which do not appear at all in the available statistics or appear only with insufficient specifications. It is also responsible for the integration of all data. In essence this is its basic responsibility, though the first mentioned elements of responsibility take up a much larger part of its resources. As a result of this integration process input–output tables and other national accounts data are fully consistent. Recently the distribution of responsibilities between the National Accounts Department and the other Departments of the C.B.S. has begun to change. The latter Departments are gradually taking over the responsibility for covering the field completely and supplementing the "cut-off" statistics with sample data regarding groups which have not been included because of their small size. In addition, improved statistical coordination relating to statistical units, their subdivisions, classifications, nomenclatures and definitions is under discussion. In this respect the needs of the integration process are increasingly taken into account. This is, however, a very gradual development, so that in practice for the compilation of input–output tables the above-indicated division of responsibility is still relevant.

The responsibilities of the National Accounts Department in connection with input–output tables have in broad lines been divided as follows. On the one hand there are "specialists" engaged in the preparation of estimates for a limited number of branches of industry or sectors. On the other hand there are "integrators" who take care of the consistency of the input–output tables as a whole. Until now the responsibilities of the specialists have included:

1. the estimation of the level and composition of output and input;
2. the determination of the global sales distribution of the output with special reference to exports and to the destination of specific products (products with a limited number of destinations) in consultation with the specialist of the consuming branch of industry or sector;
3. the determination of the global origin (branch of industry or foreign countries) of the input with special reference to the origin of specific products in consultation with the specialist of the supplying branch of industry or sector.

The specialists' calculations are carried out in great detail (some thousands of commodity groups and many hundreds of industry groups). Their final result has not, however, been a fully balanced table, as the balancing has been restricted to specific supplies. This final result forms the point of departure for the integrators. They complete the balancing process, if necessary in consultation with the specialists. They do this, however, at a highly aggregated level (appr. 60 branches of industry) without using any systematic distinction among the various kinds of commodities.

It will be clear that only the broad lines of the estimating process have been described. Other aspects of the distribution of responsibilities, such as coordination, planning and shaping of activities are not under discussion. For the activity as a whole there is an extremely limited degree of computerization. The task of the specialists is therefore very labour-intensive. Each input–output table compiled at the National Accounts Department takes up approximately 18 man-years. Another consequence of the mainly manual compilation process is the high level of aggregation of the final balancing. All this is not without consequences for the flexibility of the estimating process and for the quality of the results. The most important consequences are:

1. only one fairly small (aggregated) table becomes available;
2. the work is divided into phases with little flexibility; and the order of work has in some cases a significant impact on the results achieved;
3. the possibilities of repeating earlier steps on the basis of results in later phases are limited;
4. the final balancing cannot possibly take complete account of all available detailed information.

Additional consequences are:

5. in practice it is almost impossible to ensure that similar operations are carried out in the same manner by different specialists;
6. given the previous limitations it is difficult to arrive at reliable descriptions of methods;
7. it is extremely labour-intensive to prepare alternative specifications of input–output tables retrospectively.

Recently, in anticipation of future computerization, some adjustments of the methods have been introduced. In practice, however, the restrictions mentioned have remained in effect.

4. Recent External Developments

The external developments that are the subject of this section are concerned with developments in the uses of input–output tables (4.1. and 4.2.) and developments regarding basic statistics (4.3). These are "external" in the sense that they take place outside the National Accounts Department which compiles the tables. The developments described in 4.1. and 4.2. reflect general trends inside and outside the sphere of economic policy, among others in scientific research uses of input–output data.

4.1. *Selective Growth Policy*

Some five years ago a government policy memorandum appeared which had two titles: (1) Economic Structure Memorandum, and (2) Memorandum Concerning Selective Growth. The first title relates to the "continuity" element of policy formulation. This is considered in greater detail in section 4.2. The second title relates to the "selectivity" which was added to the traditional growth objective. Economic growth had to be selective in the sense that weight had to be given to a number of so-called "aspects" of economic growth: (1) environmental pollution; (2) energy and raw materials shortage; (3) town and country planning and (4) division of labour in respect of developing countries. This extension of the objectives of economic policy was not unexpected. A variety of discussions particularly stimulated by research groups such as the Club of Rome had preceded them.

In support of these policy objectives the C.B.S. National Accounts Department carried out input–output studies that focussed on the use of energy and on environmental pollution. The aim of these studies was to compile a so-called "aspects matrix". This aspects matrix would include accumulated coefficients calculated by commodity group—with the aid of input–output analysis—with regard to different types of environmental pollution, kinds of energy and raw materials consumption. It would also include accumulated coefficients of employment (specified according to professional group, level of education, etc.), types of income and net foreign trade. Within the framework of the selective growth policy these studies are considered to be of great importance. The statistical implications are twofold:

- the necessary information on the various aspects will have to be collected in such a manner that it can be linked to the input–output table detail; this requires a good deal of statistical coordination;
- the input–output tables may have to be amplified in detail; the policy makers generally hold the view that tables with 50 to 60 commodity groups for which up till now a concise aspects matrix could be published are too aggregated and that a disaggregation to approximately 250 groups is required. It is also considered to be of great importance that possibilities are created for analysing intertemporal developments of the accumulated coefficients as a consequence of changes in (1) the pattern of expenditure, (2) structure of production (direct input coefficients of intermediate consumption) and (3) direct aspect coefficients. Thus the question can be answered to what extent the aspect intensity (e.g. energy intensity) of national expenditures has been altered as

a result of developments in the pattern of expenditure, the structure of production or the aspect intensity (energy intensity) of the individual production processes. The demands made on statistics will therefore have to be supplemented by the requirement of consistency over time of both the input–output tables and the data on aspects.

4.2. *Structural Policy*

The "continuity" element, which was the other main theme of the Economic Structure Memorandum, relates to the objective of full employment. New ideas on economic policy with regard to individual sectors and directed at the strengthening and renewal of the economic structure were being developed. An important instrument was the stimulation of investments through premiums, directed among others at the strengthening of the competitive position *vis-a-vis* the rest of the world. This policy has afterwards been elaborated in greater detail in other government policy memoranda.[1]

This development has resulted in a very large demand for statistical data because "sector" in sector policy has the same meaning as "industry group" in the Standard Industrial Classification of the C.B.S. (3rd digit level).[2] For each of these sectors there is a need for a large quantity of statistical information to be made available in such a form that it can be interlinked. In other words, the data have to be coordinated and to a large extent made available in integrated form. One clear requirement with respect to the input–output tables was explicitly formulated: they should be specified in great detail (at least at "sector" level); they should become available annually; they should be timely (the present period needed for compilation—publication $2\frac{1}{2}$ years after the reporting year—was considered much too long). Furthermore there was the need to use detailed data of the input–output tables in the form of time series.

4.3. *Basic Statistics*

Apart from the external developments in the uses made of input–output tables, there are also important developments in the basic statistics from which the tables are compiled. It goes without saying that alterations in the availability of basic statistics have consequences for the comparability of input–output tables over time. Major alterations of this kind have occurred in the Netherlands during the seventies. The C.B.S. has been able to establish a number of important new statistics covering fields where in the past very rough estimates had to be made. It appears that these rough estimates have not always been perfect so that there is cause for considerable adjustment in the level of a number of estimates. Additionally, as part of the C.B.S.'s statistical coordination programme, industrial classifications have been adjusted in many statistics. This sometimes led to the elimination of gaps in the existing statistical observations, resulting in considerable alterations in the basic data. In the more distant past the annual production

[1]Among others in the Progress Memorandum Economic Structure Policy (sector memorandum), 1979.

[2]This level of aggregation is considerably more disaggregated than the level of aggregation of the "Major group" of the ISIC (3rd digit).

statistics did not provide an accurate time series, first because the informants were always approached in accordance with the actual circumstances so that in the event of a change in the main activity the informant received a different questionnaire, and secondly because those compiling the basic statistics at the C.B.S. were (and still are) only seldom inclined to compile supplementary estimates in addition to the data based on inquiries. Furthermore—and this is an additional consequence—users in the past 30 years tended to concentrate on the more consistent series from the national accounts.

It is expected that newly available statistics which are either drastically changed or entirely new will be—in the near future—the main reason for revisions of the input–output tables. Other reasons may be the improvement of estimating methods and changes in classifications and methods of registration. The latter two reasons do not cause the most difficult problems. In the case of changes in classifications etc., particularly, it is fairly easy to apply corrections for a number of years so that comparability over time may be restored. In the meantime it cannot be denied that such corrections, where operations are manual, may lead to organizational problems. Restoration of continuity of the time series after a revision of the input–output table might become particularly difficult when entirely new information becomes available which leads to estimates which are considerably different from those made in the past. Newly obtained information does not throw fresh light on the more distant past. The basic question here is whether the old estimates were mistaken because they were always made at an incorrect level or because, possibly from a correct level, an incorrect development was estimated. As long as this question has not been answered, it is doubtful whether it is meaningful to estimate a new time series. What matters is the objective of the revised estimate. If it is a question of providing information on an unimportant element of a larger entity, e.g. a higher aggregate, the answer to the question posed is less relevant. However, if it is a matter of estimating detailed series, the answer is of vital importance.

4.4 *Conclusions*

The developments in the use made of input–output tables point to a strong need for timely tables which are considerably more detailed, the details having to be reliable and comparable over time. The developments in the basic statistics for the tables make possible significant improvements in the reliability of the data, but the comparability over time will be harmed as a result. The type of solutions that are sought with respect to the improvement in quality and the implied interruption of the continuity as a result will be dealt with in the next section. Section 6 will then be concerned with the combination of these problems with the requirement of timeliness and the disaggregation of the input–output tables.

5. Revisions and Time Series

This section gives a rough sketch of the manner in which the problem of quality improvement and hence interruption of the continuity of the input–output data is being handled. The following subjects will be discussed: the priority assignment (5.1.); some of the technical aspects (5.2.); and the organizational implications (5.3.). Annex 2 shows results of the revision of the input–output table and the national accounts for 1977.

5.1. *The Dilemma*

The central question is what deserves priority in the compilation of annual input–output tables: comparability (in detail) over time with tables of previous years, or accuracy of the estimates for each reporting year. The theoretical ideal of unsurpassable quality of estimates has not been achieved; nor is the theoretical "next best" solution practicable whereby all discontinuities arising from annually accurate level estimates are restored immediately in a consistent manner in the details of a long series of annual input–output tables. The allocation of priorities is therefore inescapable in the Dutch situation, where two circumstances are of particular significance. The first one is that the compilation of input–output tables forms part of the estimation process of national accounts. The tables are always fully consistent with the national accounts. Therefore assignment of priorities with regard to input–output tables cannot be dissociated from the allocation of priorities in the national accounts. Furthermore the frequent use of input–output tables in the form of time series, together with the increasing tendency to further disaggregation of the tables, implies that discontinuities which may be small in absolute value will lead to greater relative distortions of time series. Priority has therefore been given to comparability with tables of preceding years. The resulting concessions which have to be made in the accuracy of the annual level estimates can, needless to say, only be of a temporary nature.

Complementary to this allocation of priority is that periodical (probably once every five years) corrections of the level need to be implemented. These revisions lead to accurate level estimates for the reporting year for which the revision is implemented, and have to be followed by new estimates of input–output series which are consistent over time. In this manner the burden of the reassessment of a series of tables is reduced from once annually to once every five years without making concessions to continuity. However, even this procedure implies such a burden that all this cannot be fully realized in the short run. Before dealing with the organisational aspects some light will first have to be cast on the statistical aspects of continuity.

5.2. *What is Continuity?*

Continuity, as an aspect of the quality of a time series, can be described as perfect comparability of the estimates for period t with those for $t-1$. The change over time $(t, t-1)$ is then an accurate estimate of the development which has taken place in reality. A practical elaboration of this description is, however, not without complications. Annex 1 gives explanatory notes on some problems which will be touched upon in this section. Basically the following questions arise:

1. With reference to the changes $(t, t-1)$, should the absolute or the relative size (in regard to the estimated value in period $t-1$) be estimated accurately?

2. What is an accurate estimate of an element of an aggregate? At what level of aggregation should the estimate be accurate?

3. What is the meaning of an accurately estimated relative change within an integrated framework? In other words, should the accuracy of the estimate of the change in one of the elements of the table be considered by itself, in relation to the other variables on the same row, or in relation to the other variables in the same column? Are there rows and columns that, in the eventual search for a compromise, deserve priority?

The answer to the first question seems simple. If it is a matter of time series, priority will have to be given to the relative change. However, it will be understood immediately that this will give rise to problems. A matrix of perfectly estimated absolute changes gives the desired result, but a matrix of perfectly estimated relative changes based on an imperfect table for the previous period is in principle inconsistent. Nevertheless it seems that the answer given in the first place will have to be maintained. This being said, the other questions also need to be answered.

The second question is concerned with the problem that perfectly estimated relative changes of elements do not necessarily add up to a perfect estimate of the relative change in their aggregate. If the errors in the levels of the estimated elements are not correlated with the size of the relative changes, no serious problems need be expected with regard to aggregation. If the number of elements aggregated is not too small, the relative change of the aggregate will show no bias. This may be of some comfort to statisticians compiling input–output tables as an intermediate step to estimating the national accounts. In the case of aggregation of a small number of elements, however, such comfort is hardly justified. Users of input–output series should be aware of this. So far the argument has been "ex ante": the point of departure consisted of accurately estimated relative changes of elements which were then weighted with inaccurately estimated level data to arrive at the relative change of an aggregate. From the user's point of view the matter can also be considered "ex post". In that respect it may be asked to what extent erroneous estimates of the relative changes of elements give rise to erroneous estimates in the relative change of the aggregate. The question is then whether in the elements of input–output tables erroneous estimates in the levels are in fact uncorrelated with relative changes. Particularly if the tables are estimated in such a manner that they are as comparable as possible over time, it is probable that underestimates are also the result of changes for which the estimates were too low. With respect to question two the conclusion must be in principle that the choice of any aggregation level for estimating relative changes distorts the changes at any other level. This leads to consequences for data at aggregation levels containing a small number of elements for which correct relative changes were estimated. There is, however, not much reason to assume that distortions would not arise at the higher aggregation levels.

Finally the third question concerns integration. In an input–output table aggregation should hold along the rows as well as along the columns. This implies that the estimation of an individual element has in principle an impact on all other elements. Accurate estimation of the relative change of an intermediate transaction flow between an underestimated and an overestimated branch of industry will usually result in distortions of the relative change of other elements in the rows and columns of the two branches of industry concerned (see Annex 1).

Given the above mentioned consequences the selection of the estimation method is of particular importance. For those elements of the table for which more or less reliable estimates of level and relative change over time can be made before integration, there is no need to fear large distortions of relative changes of the main aggregates constructed from these elements. However if important vectors—such as operating surplus, private final consumption, change in stocks—are estimated as residuals, special care is required. The estimated changes of such vectors should always be checked carefully and in detail in order to judge their plausibility. Though this plausibility check should always be made with regard to the level of the residually estimated items in an input–output table, it deserves special attention when one tries to arrive at correct relative changes as is illustrated in Annex 1. The conclusion of this section must therefore be that making accurate estimates of the relative changes of all elements of an input–output table is impossible, unless the table serving as point of departure is perfect. For obvious reasons, most statisticians have never felt uncomfortable with this kind of conclusion. It remains, however, of interest to users of statistics that the objective of comparability over time of input–output tables be pursued as well as possible. Furthermore it is of equal interest to users of statistics to be aware of the defects in their data.

5.3. *Organizational Aspects*

In this section the following subjects will be discussed:

- how continuity in the Dutch input–output tables is being pursued (5.3.1.);
- how periodic revisions with restoration of continuity will be achieved (5.3.2.);
- what action should be taken in the short run (5.3.3.).

5.3.1. Continuity in Practice

In the compilation of input–output tables the emphasis has, as stated above, in recent years been put on maintaining comparability over time. As is illustrated in Annex 1, this is no simple matter. As a consequence of what was stated in section 3 with regard to the organisation of the compilation of the Dutch input–output tables, the following objective has been pursued. The specialists aim at accurate estimates of relative changes at the level of aggregation to which their most detailed estimates relate. As regards their responsibility, this is, given the aggregation level, a clear criterion. With regard to coordination the specialists generally arrive by common agreement at the most plausible compromises. However, as their field of observation is restricted, at the stage of integration they usually arrive at compromises which still include many residual items, particularly in the rows of the tables. The integrators deal with the data at a more aggregated level. In their interventions they are led—in addition to the advice given by the specialists—by the pursuit of accurate estimates of relative changes at their level of aggregation. The achievement of practical solutions to the continuity problem is based partly on plausibility judgements of the residual items. As many alternative estimates based on other sources as possible are compared with these residual items. The conclusion appears to be that the aggregation level at which continuity is defined cannot be fixed unambiguously, but is determined by reasons of an organizational nature. If total integration could be carried out at the most detailed level of aggregation, a more consistent procedure would be possible. Section 6 indicates how this situation can be achieved.

5.3.2. Revision plus Continuity Requires Computerization

Implementation of complete integration in an input–output table up to the detailed level of thousands of commodity groups and hundreds of industry groups is impossible within the present organization. It requires computerization of the estimating (and particularly of the integration) process.[3] There is, however, another reason for introducing computerization which is at least as important. If we wish to carry out periodic revisions and have them followed by new, consistent series of input–output tables, a large number of input–output tables will have to be compiled within a relatively short period. In the event of a revision occurring once every five years and a time series of ten years, at least 15 tables will have to be made every 5 years. A ten year time series even seems a modest objective from the point of view of the users of statistics in the Netherlands. With the existing organization even the annual compilation of one input–output table is not without problems. It is therefore obvious that the problems discussed in this section can find no satisfactory solution without far-reaching computerization.

5.3.3. The Short-Term Solution

Under the limitations imposed by the present organization, a difficult choice had to be made. This choice resulted from the fact that on the one hand the computerization facilities required were not yet available while on the other hand a large need had been created for the short-term implementation of a first revision. In consultation, among others, with the most important users of input–output tables, it was decided to carry out a short-term revision, even if it could not immediately be followed by newly established time series. The need for this revision was felt because some significant estimation errors were found in a number of branches of industry (see section 4.3.). In addition, the Department of National Accounts did not wish to wait any longer with a first revision. The extrapolation of incorrect level estimates was unsatisfactory, and there was uncertainty regarding the time at which the computerization facilities required for the restoration of continuity would become operational. It was therefore decided to carry out a first revision which would be restricted in scope. This

[3]In theory so detailed annual input–output tables could be compiled manually. However, one should not have any illusions on the consistency of the decision-making process, nor on the organizational efficiency in the integration process. The relations between the input–output elements are too complicated to be checked manually in such a manner that acceptable solutions can still be expected. The quantity of information to be processed is too large for this.

revision had to include, for the reporting year 1977:

- an alternative complete series of national accounts data, so that for 1977 a "revised" estimate could be published jointly with the "old" 1977 estimate;
- a revised input–output table linked to the revised national accounts series which could be presented jointly with the previous unrevised table so that comparison with tables of preceding years would be feasible.

The year 1977 functions as a link-up year for the time being: up to and including 1977 there is a consistent series of input–output tables and from 1977 onward there will be a new series which will also be consistent.

The 1977 revision resulted in an increase of the estimated national income of more than 6 per cent. For some components the adjustments have been much larger; this is particularly true for the services sector. More detailed information on the revision is given in annex 2.

6. Computerization

About eight years ago concrete ideas were developed with regard to computerizing the compilation of input–output tables. This process led to a complicated and extensive design; for quite some time the National Accounts Department of The Netherlands Central Bureau of Statistics has been occupied with its realization. The main characteristics of the system that is to be computerized will be described in section 6.2. In section 6.1. the objectives of the system will be summarized.

6.1. *Objectives*

At the end of section 3 seven limitations were mentioned with respect to the manual compilation of input–output tables. In section 4 it was concluded that there is a strongly increasing demand for timely, considerably disaggregated tables that are comparable over time. A number of the restrictions mentioned in section 3 have therefore become serious limitations. In order to obtain a satisfactory solution of the problems of revisions and restoration of continuity, computerization is indispensable. This was one of the conclusions of section 5. The same conclusion applies to the removal of the restrictions mentioned in section 3. Summing up, computerization aims at achieving the following objectives:

1. Timeliness. On the one hand computerization should shorten the time needed for producing the tables. On the other hand computerization should create the possibility to produce—even at an early stage and proceeding from incomplete and very provisional basic data—a first version of an input–output table which in its detailed layout corresponds with the final version which is to be compiled later.

2. Improvement of quality. It would be illusory to believe that a computerization system could be developed embracing the statisticians' complete decision-making process that would result in empirically justified input–output tables. However, computerizing the complete administrative process as well as a few simple formalizations of the decision-making may lead to clarification and

improvement of decisions made in the estimating process. When a judgment has to be given on plausibility a large degree of disaggregation up to the final phase of compilation will make it possible to take account of all available information on details. In contrast to what is possible in the case of manual compilation this information, as well as the knowledge of the specialists, is taken account of, as fully as possible, in the final results. This may even be accentuated by creating the possibility of proceeding in an iterative manner; some previous decisions that led to less plausible results in a later phase should be re-examined. The estimating process should then start anew.

3. Continuity. The formalization of the estimating process which goes hand-in-hand with computerization makes it possible to gain a clearer view of the methods used. This implies that maintaining the continuity of the estimates can more easily be promoted than in the case of manual compilation by a great number of specialists. For obvious reasons statisticians, when excuting plausibility checks, starting with the evaluation of the proposed input of basic data, give special attention to considerations of continuity. The system will also have available a method that—in the case of discontinuity of the basic data—will lead to the best approximation of the change of input–output elements between the years $t-1$ and t on the basis of the latest data. When the continuity is interrupted as a result of revisions, the less time-consuming character of the computerized compilation process becomes important. Continuity can be restored by compiling a new series of tables. This may take place by calculating backward in time on the basis of the larger part of the basic data that was already used when the tables for the years concerned were compiled. Only the revised data, in the form required, have to be introduced into the computer.

4. Disaggregation and flexibility. Computerization will lead to a highly disaggregated input–output table (approximately 1,000 commodity groups, approximately 200 industry groups; a gradual increase of these numbers is envisaged). This will not only create the possibility of publishing detailed tables, it will also increase flexibility in various respects. It will become possible to compile tables with alternative classifications. A disaggregated table is an excellent starting point for the compilation of input–output tables at constant prices. Apart from greater detail, computerization will lead to increased flexibility in other respects. Tables with alternative valuations can easily be printed out. It is possible to experiment with alternative estimating assumptions. The shaping of the balancing process enables a first step to be taken in the direction of realistic estimates of the accuracy of the tables.

6.2. *Outline of the System*

The system for the computerized compilation of input–output tables that is now being developed comprises—in principle—all operations relating to the basic statistics, including the final stage of the elaboration of the complete table. A large and complicated system is involved of which almost all interesting details will have to remain undiscussed. In this article only a global review will be given.[4]

[4]A more detailed description is given in an annex of the original paper.

The input–output table to be produced by the computerized system is a table with more than 200 industry groups and final demand categories in the columns and 1,000 commodity groups in the rows. Each commodity group consists of at least 2 rows: one for the domestic production and one for the competitive imports. When domestic producers of the same commodity are classified in different industry groups, more rows of domestic production have to be distinguished within the commodity group. For this reason there exists a relation between the rows of a commodity group and the supplying industry groups/imports. (Therefore it is simple—starting from this basis—to compile an industry group x industry group table.) The interior of this table consists of the use-matrix. In this matrix the various commodity groups have been stratified according to the producing industry group/import. The supply column can be regarded as a column of row-totals of the transposed make-matrix (in which the stratification of commodity groups just mentioned also took place).

In principle the computerization system can be divided into two parts:

- operations that will lead to the various columns of the use-matrix or to the various columns of the transposed make-matrix;
- the actual integration.

The first part is concerned with the operations that are necessary to arrive at a first estimate of all elements of the input–output table, starting from the basic data. These operations are carried out by column. For each industry group two columns have to be estimated (one in the use-matrix, the other one in the transposed make-matrix); for each final demand category one column is estimated (in the use-matrix). This is also the case for each type of primary costs (in the transposed make-matrix). These columns are compiled on the one hand from the available basic data and on the other hand from some data bases that are copied from the previous year and changed if necessary. After plausibility checks the available basic data from production and foreign trade statistics are immediately introduced into the system, and more specific basic data are manually prepared for the computer. The computer operations that take place with the basic data—after introduction and checks—include estimates of data that are not available in the basic statistics. They also include the adaption of the basic data to the specifications of the input-output table.[5]

The second part includes the complete integration process, to produce a fully balanced table. This means that the elements (estimated for each column) of the internal part of the table add up to the independently estimated line totals (the transposed make-matrix aggregated into one column). There are not necessarily any residually estimated items such as changes in stocks which would automatically balance the table; the system does provide for that possibility, but it is not a rule. The change in stocks is in general estimated in the first part of the system on the basis of direct observation. The integration process refers particularly to intermediate and final demand broken down in commodity groups. In principle three categories of commodity groups may be distinguished.

[5]See section 3 on the division of tasks between the Department of National Accounts and the other Departments of the C.B.S.

The first category includes those commodity groups whose elements were estimated in the first part of the system; these elements are corrected in the integration process, bearing in mind the accuracy of the estimate, so that they add up to the row total. The correction of the elements is accompanied by a compensating adjustment of other elements of the non-factor inputs (belonging to the first two categories of commodity groups) in the same column.

The second category consists of commodity groups of which an element is estimated as the residual item. In this group the integration process consists particularly of the compensating corrections that are made in the course of the integration procedure of the first category of commodity groups. The residual items are generally private final consumption and fixed capital formation, though the computerized system does provide for the possibility of independent estimates of these items. This category will therefore largely disappear.

The third category includes commodity groups whose elements are estimated autonomously, as in the first category of commodity groups, but whose compensating corrections are applied to the operating surplus in the same column. The difference in procedure between the first and the third category is related to the nature of the basic data. The first category includes commodity groups that are specific inputs into production processes and which as a rule are explicitly covered in production surveys of the main users. The third category is concerned with the general inputs ("other costs") that are not specifically identified in production surveys. The treatment of this category of commodities is based on the assumption that production surveys generally include the exploitation surplus shown in the business accounts and that other costs are estimated as a residual item. Since the definition of operating surplus clearly differs from the business-accounting definition of exploitation surplus, there is no reason for keeping the operating surplus outside the integration process.

For all three categories of commodity groups the row totals will for the time being be regarded as final. In other words: total imports and total domestic production by commodity group will remain unchanged in the integration process. The system does permit, however, changing the row totals in the integration process. Once practical experience has been gained with the system, these facilities will no doubt be experimented with.

Annex 1. Some Practical Problems Related to the Maintenance of Continuity in Time Series

In this annex further consideration is given to the problems discussed in 5.2 with regard to the maintenance of continuity in time series, in the course of which the questions posed in 5.2 will be illustrated with some examples.

Example 1. Should the relative or the absolute change over time be estimated accurately (question 1)?

Example 2. What is the accurate estimate of a component of an aggregate and at what level of aggregation should the estimate be accurate (question 2)?

Example 3. What is an accurately estimated relative change over time in an integrated system (question 3)?

Example 1. Absolute Change vs. Relative Change

Assume: X^t_w = actual value, element X, period t
X^{t-1}_v = estimated value, element X, period $t-1$. (X^{t-1}_v forms part of the time series and X^t_v must be estimated in comparison with it.)

$$X^{t-1}_w = 40; \qquad X^t_w = 80; \qquad X^{t-1}_v = 20.$$

Question: What value must be estimated for X^t_v?

Elaboration: If it is desired to make an accurate estimate of the absolute change, the following applies:

$$X^t_v = X^{t-1}_v + (X^t_w - X^{t-1}_w) = 60.$$

If it is desired to make an accurate estimate of the relative change, the following applies:

$$X^t_v = X^{t-1}_v \cdot X^t_w / X^{t-1}_w = 40.$$

In practice the accurate estimate of the relative changes will receive priority.

Example 2. Relative Change—Which Level of Aggregation

Assume:

$$\begin{array}{lll} X^{t-1}_w = 40; & X^t_w = 80; & X^{t-1}_v = 20 \\ R^{t-1}_w = 40; & R^t_w = 40; & R^{t-1}_v = 40 \\ \hline \sum^{t-1}_w = 80; & \sum^t_w = 120; & \sum^{t-1}_v = 60 \end{array}$$

Question: Which values must be estimated for X^t_v and $\sum^t_v$ (these values must be comparable with X^{t-1}_v and $\sum^{t-1}_v$)?

Elaboration: Assuming an accurate relative change of X, the following applies: $X^t_v = 40$ (see example 1).

Assuming an accurate relative change of the aggregate ($\sum$) the following applies:

$$\sum^t_v = \sum^{t-1}_v \cdot \sum^t_w \Big/ \sum^{t-1}_w = 90.$$

In this case the result for X^t_v would be a value of 50 ($\sum^t_v - R^t_v$) and this does not result in an accurate relative change for X. At other levels of aggregation we can always find different values for X^t_v. It is therefore necessary to define at which level of aggregation it is desired to have an accurate estimate of the relative change and when this choice has been made, it is good to realize that the relative change at a different level of aggregation need not be accurate.

Example 3. Relative Change in Input–Output Table

Assume:

Matrix X^{t-1} $(=(x_{ij}^{t-1}))$: input–output table, actual value, period $t-1$

	$j=1$	$j=2$	Σ
$i=1$	50	50	100
$i=2$	50		
Σ	100		

Matrix Y^{t-1} $(=(y_{ij}^{t-1})$: input–output table, estimated value, period $t-1$

	$j=1$	$j=2$	Σ
$i=1$	45	75	120
$i=2$	35		
Σ	80		

Matrix X^{t} $(=(x_{ij}^{t}))$: input–output table, actual value, period t

	$j=1$	$j=2$	Σ
$i=1$	50	60	110
$i=2$	40		
Σ	90		

Question: Which are the correct estimates for the elements in the matrix $Y^{t}(=y_{ij}^{t})$: input–output table, estimated value, period t? This table must be comparable with the input–output table, estimated value, period $t-1(Y^{t-1})$.

Elaboration: For y_{11}^{t} the following estimates may be made:

- as a direct estimate:

$$y_{11}^{t}=y_{11}^{t-1}\cdot x_{11}^{t}/x_{11}^{t-1}=45$$

- as a residual estimate on the row:

$$y_{11}^{t}=\sum_{j} y_{1j}^{t}-y_{12}^{t}=\sum_{j} y_{1j}^{t-1}\cdot\sum_{j} x_{1j}^{t}\Big/\sum_{j} x_{1j}^{t-1}-y_{12}^{t-1}\cdot x_{12}^{t}/x_{12}^{t-1}=42$$

- as a residual estimate in the column:

$$y_{11}^{t}=\sum_{i} y_{i1}^{t}-y_{21}^{t}=\sum_{i} y_{i1}^{t-1}\cdot\sum_{i} x_{i1}^{t}\Big/\sum_{i} x_{i1}^{t-1}-y_{21}^{t-1}\cdot x_{21}^{t}/x_{21}^{t-1}=44$$

At least three estimates are therefore possible for y_{11}^{t}. The direct estimate of the element is in this case higher than the two residual estimates, which shows that estimating items residually may be risky.

For y_{12}^t and y_{21}^t different estimates may also be made:
- as a direct estimate:

$$y_{12}^t = y_{12}^{t-1} \cdot x_{12}^t / x_{12}^{t-1} = 90$$
$$y_{21}^t = y_{21}^{t-1} \cdot x_{21}^t / x_{21}^{t-1} = 28$$

- as a residual estimate where y_{11}^t is also residually estimated (average of the residual estimates in row and column)

$$y_{12}^t = \sum_j y_{1j}^t - y_{11}^t = 132 - 43 = 89$$

$$y_{21}^2 = \sum_i y_{i1} - y_{11}^t = 72 - 43 = 29$$

- as a residual estimate where y_{11}^t is estimated directly

$$y_{12}^t = \sum_j y_{1j}^t - y_{11}^t = 132 - 45 = 87$$

$$y_{21}^t = \sum_i y_{i1} - y_{11}^t = 72 - 45 = 27.$$

Other estimates are also possible.

Depending on the strategy of continuity pursued, (which assigns higher priority to the accuracy of some input–output elements and a lower one to the accuracy of others) a choice will have to be made between the alternatives. Such a choice is even more complicated by some other factors. The above example assumed complete independence of the input–output elements to be estimated. In practice this assumption is not satisfactory as there exist input–output relations between the elements within the rows and columns. It is furthermore possible that for specific cells no direct estimate can be made because reliable data are not available. In this latter case it is tempting to estimate the cells concerned residually, but this may be risky. Assume that in the example row 2 relates to operating surplus, and column 2 to private final consumption and that no reliable independent basic data are available for these items. Residual estimation based on the last mentioned alternative 3 would result in underestimation of both the national income and the consumption and this underestimation is not compensated elsewhere. It is important to determine under which circumstances such underestimates or overestimates would occur.

Annex 2. Results of the Revision of the 1977 Dutch National Accounts

It is impossible to present in a nutshell a complete picture of all changes in the national accounts data that resulted from the revision of the 1977 figures. For this reason only a few important adjustments will be shown. Table 1 shows data on gross domestic product and expenditures before and after the revision. Apart from change in stocks all corrections are positive. This illustrates the well-known

TABLE 1

GROSS DOMESTIC PRODUCT AND EXPENDITURES, 1977

	Before revision	After revision	Difference
		(10^9 guilders)	
1. Compensation of employees	153.3	158.2	4.9
2. Operating surplus	57.3	65.8	8.5
3. Consumption of fixed capital	24.1	24.2	0.1
4. Indirect taxes less subsidies	26.7	26.7	—
5. (1+2+3+4) Gross domestic product, in purchasers' values	261.4	274.9	13.5
6. Imports of goods and services	127.4	127.4	—
7. (5+6) Available for expenditures (gross)	388.8	402.3	13.5
Final consumption expenditure			
8. of households	153.8	164.3	10.5
9. of government	47.6	47.9	0.3
Gross fixed capital formation			
10. of enterprises	45.9	48.6	2.7
11. of government	9.0	9.3	0.3
12. Change in stocks	1.8	1.5	−0.3
13. (8+9+10+11+12) National expenditure (gross)	258.1	271.6	13.5
14. Exports of goods and services	130.7	130.7	—
15. (13+14) Total expenditure (gross)	388.8	402.3	13.5

fact that if hardly any information is available, estimates tend to be on the cautious side.

It must be stressed that the adjustments do not mainly result from improved estimates of transactions in the so-called hidden economy. In the estimating process before the revision parts of these transactions were included. With regard to this segment of the economy the revision did not affect the existing estimating procedures fundamentally. The main adjustments relate to compensation of employees, to operating surplus, to private final consumption expenditure and to fixed capital formation of enterprises. The revised figure for operating surplus, especially, shows a remarkable difference from the unrevised one. In the estimating process operating surplus is treated as a residual to a considerable degree. Table 2 gives a clear picture for branches of industry.

The increase of compensation of employees is mainly to be found in the trade sector, in business services and in medical and other services. The table shows some negative adjustments as well. The main causes of these adjustments are improved wage statistics, some new data sources (especially with regard to domestic services) and improved estimating procedures.

The increase of operating surplus is mainly in construction, trade, catering, business services and ownership of dwellings. Important decreases are to be observed in the chemical industry and in the metal industry. As operating surplus is mainly treated as a residual, the adjustments have various causes. A few important considerations may be mentioned in this connection:

- New information became available for construction, trade, catering and business services. Estimating procedures were improved.

TABLE 2

COMPONENTS OF INCOME BY BRANCHES OF INDUSTRY, 1977

(10^9 guilders)

	Before Revision		After Revision		Difference	
	Compensation of Employees	Operating Surplus	Compensation of Employees	Operating Surplus	Compensation of Employees	Operating Surplus
Enterprises						
0 Agriculture and fishing	2.0	7.9	2.0	7.8	—	−0.1
1–4 Mining and quarrying, manufacturing and public utilities	40.8	22.9	40.3	22.2	−0.5	−0.7
5 Construction	13.6	2.3	13.8	3.7	0.2	1.4
6 Trade, hotel, restaurant and repair services	21.2	8.9	22.3	13.3	1.1	4.4
7 Transport, storage and communication	12.2	3.3	12.2	3.4	—	0.1
8 Banks, insurance, business services and ownership of dwellings	12.3	13.0	13.2	15.9	0.9	2.9
9 Other services	17.1	5.8	19.8	6.2	2.7	0.4
Government	35.5	—	36.0	—	0.5	—
"Lump sum" contributions by employers to pension funds	−1.4	1.4	−1.4	1.4	—	—
Imputed bank service charge	—	−8.2	—	−8.1	—	0.1
Total	153.3	57.3	158.2	65.8	4.9	8.5

- New information became available for manufacturing industry relating to the running costs involved. Also, the estimating procedure for enterprises that are not covered by C.B.S. questionnaries was improved.
- New information on "rental value" became available. Therefore it was possible to re-assess the rent imputed to owner-occupied dwellings.

The adjustment of private final consumption expenditure results mainly from improvement of estimating procedures concerning branches of industry that manufacture consumer goods. Table 3 gives a global picture of the adjustments. The decrease in the food, beverages and tobacco sector resulted mainly from the revision of consumption in the catering sector (other sectors were also involved). The increase of durable consumer goods relates mainly to clothing and second-hand cars. The considerable increase in the "other goods and services" sector is attributable to catering, rent of dwellings (owners of dwellings), medical services, domestic services and expenditure relating to cultural activities and recreation.

TABLE 3

PRIVATE FINAL CONSUMPTION EXPENDITURE, 1977

(10^9 guilders)

	Before Revision	After Revision	Difference
Food, beverages and tobacco	35.5	34.8	−0.7
Durable consumer goods	41.9	43.7	1.8
Other goods and services	74.6	83.9	9.3
Total domestic expenditure	152.0	162.4	10.4

The increase of fixed capital formation of enterprises relates mainly to the maintenance of buildings (especially the big overhauls), to trade margins and to services relating to transactions in used capital goods.

Finally, the estimates of labour volume that are presented in the national accounts have been revised. As a result, the labour volume for 1977 rose from 4,659,000 man-years (before revision) to 4,675,000 man-years (after revision) which means a rise of 0.3 percent. The difference results from an increase of employees of approximately 1 percent (44,000) and a decrease of the number of self-employed and the members of their families by approximately 4.5 percent (−28,000).

The conclusion is inevitable: considerable adjustments are involved in the 1977 revision process. These adjustments change the overall picture of the Dutch economy more than marginally. They affect the whole system and cause severe discontinuities in almost all series.