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THE CHOICE OF INDEX NUMBER FORMULAE AND WEIGHTS IN THE NATIONAL ACCOUNTS

A sensitivity analysis based on macro-economic data for the interwar period

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Summary

In this paper the sensitivity of growth estimates to variations in index number formulae and weighting procedures is discussed. The calculations concern the main macro-economic variables for the interwar period in the Netherlands. It appears, that the use of different formulae and weights yields large differences in growth rates. Comparisons of Gross Domestic Product growth rates among countries are presently obscured by the use of different deflation methods. There exists an urgent need for standardization of deflation methods at the international level.

Contents

1. Introduction

1.1. The scope of this study

In 1987, new macro-economic data for the interwar period have been published (Den Bakker, Huitker and Van Bochove, 1987). These data are important for analysing economic developments in this period. In addition, they are interesting from a statistical point of view, for instance with regard to the procedure for compiling price and volume series in the national accounts. For that purpose, a large number of index number formulae can be used and there exist several possibilities with respect to the choice of weights. Each one has its own merits and drawbacks and it is not possible to pinpoint in general the 'best' method (see Al, Balk, De Boer and Den Bakker, 1986). In national accounting practice, different methods for compiling price and volume series are used, and therefore it is important to know the differences between growth rates arising from the use of different deflating methods. The interwar figures provide a very interesting data set for testing this. A rapid growth of gross domestic product (GDP) in the twenties was followed by a modest slowdown and, in the thirties, by a period with negative or near-zero growth and, finally, a partial recovery. In the interwar period inflation as well as deflation occurred and the composition of macro-variables changed considerably. These volatile movements imply that, if ever the choice of index number formulae and weights does make a difference, it must be during this period.

The first chapter of this study contains a summary discussion of the major theoretical aspects of deflating national accounting data. Chapter 2 reports on the calculation of price indices for the most important macro-economic variables based on five index number formulae: those of Paasche, Laspeyres, Fisher, Törnqvist and Vartia I. In addition to annual price mutations, indices coveribg more than one year have been calculated using several weighting schemes. The yearly price changes have been linked to arrive at so-called chain indices. In comparing the deflation methods, the influence of the choice of the weighting year and the difference between application of the formulae over several years and chain indices come up for discussion. The results of the calculations are analyzed and compared with those of some other studies. In chapter 3 the price indices are used as deflators to estimate the growth rates of the macro-economic aggregates. Finally, some conclusions are presented in chapter 4.

1.2. Conceptual aspects of deflating national accounting data

Index number theory will not be discussed in this study. An introduction to the index number theory can be found in Allen (1975). Various aspects of index number problems have been under discussion at the Ottawa conference in 1982 devoted to 'price level measurement', cf. Diewert and Montmarquette (1983). An outline of deflating problems within a national accounting framework is given in CBS (1984).

Basically, a value change of an economic aggregate can be decomposed into three components: 'pure' quantity and price changes and a component consisting of changes in the quantity and price structures. There are three possible ways of dealing with the structural change component. It may be included first in the quantity component, secondly in the price component or thirdly in both components. In the first two cases, a pure price component and a pure quantity component are isolated respectively[1)]. The index number formulae differ with respect to the way in which they take account of the structural change component.

In deflating national accounting data two requirements can be formulated:

1) The value change should be divided into a volume and a price component (without remainder). In this way, the internal consistency of the system can be maintained when the data are deflated. In turn, that facilitates plausibility checks;
2) The index number formula should meet the consistency in aggregation requirement, i.e. the result of an aggregate index number must always be the same irrespective of the way it is calculated, that is either by

1) If changes in quantity are accompanied by structural changes and the mixed component is (partially) included with the quantity component, that will no longer be a pure reflection of quantity changes. In this study - and in the present Netherlands national accounts (CBS, 1984) - this combined quantity and composition changes are referred to as volume changes.

applying the formula to the individual data making up the aggregate, or by first applying it to data belonging to two or more subgroups and then to these sub-indices. thus obtained are subsequently aggregated using the same formula.

In this study, we consider the index number formulae of Laspeyres, Paasche, Fisher, Törnqvist and Vartia I. These formulae differ, among other things, in the choice of the weighting year. Therefore we will now first try to clarify the terms base year, reference year, weighting year and reporting year. Many times, these notions are confused, and this easily leads to wrong interpretations. The 'expert group' of the United Nations, preparing the revision of the System of National Accounts (SNA), proposes to use a set terminology in the new SNA. The year with respect to which the price movements are determined is called the base year. The reference year is the one which is set at 100 in the index series. The weighting year is the year from which the compositions for use in the indices are taken. The year which is compared with the base year is the reporting year. Especially for the chain approach the distinction is important. In this study, the terms direct index and chain index occur. In case of a direct index, the index number formula is applied to the entire interval made up by a number of consecutive years, while in the case of a chain index the formula is applied to two consecutive years, after which the indices thus obtained are (divided by 100 and) multiplied to obtain an index for the entire period.

Next, the index number formulae are presented. Price and quantity of a certain commodity i (i=1,...,N) in year t (t≥0) are denoted with p_{it} and q_{it} respectively. The reporting year is indicated with t and the base year with t-n, where n≥1.

Laspeyres $$P^L_{t,t-n} = \frac{\Sigma_i p_{it} q_{it-n}}{\Sigma_i p_{it-n} q_{it-n}} = \Sigma_i \frac{p_{it-n} q_{it-n}}{\Sigma_i p_{it-n} q_{it-n}} \frac{p_{it}}{p_{it-n}} .$$

This price index is a weighted arithmetic mean of the individual price mutations.

Paasche $$P^{P}_{t,t-n} = \frac{\Sigma_i p_{it} q_{it}}{\Sigma_i p_{it-n} q_{it}} = \left[\Sigma_i \frac{p_{it} q_{it}}{\Sigma_i p_{it} q_{it}} \left[\frac{p_{it}}{p_{it-n}} \right]^{-1} \right]^{-1} .$$

This price index is a weighted harmonic mean of the individual price mutations.

Fisher $$P^{F}_{t,t-n} = (P^{L}_{t,t-n} \times P^{P}_{t,t-n})^{\frac{1}{2}} .$$

This price index is a geometric mean of the Laspeyres and Paasche price indices.

Törnqvist $$P^{T}_{t,t-n} = \Pi_i \left[\frac{p_{it}}{p_{it-n}} \right]^{(w_{it}+w_{it-n})/2} ,$$

where $$w_{it} = \frac{p_{it} q_{it}}{\Sigma_i p_{it} q_{it}} .$$

This price index is a weighted geometric mean of the individual price mutations.

Vartia I $$P^{V}_{t,t-n} = \Pi_i \left[\frac{p_{it}}{p_{it-n}} \right]^{w_i} ,$$

where

$$w_i = \frac{p_{it} q_{it} - p_{it-n} q_{it-n}}{\ln p_{it} q_{it} - \ln p_{it-n} q_{it-n}} + \frac{\Sigma_i p_{it} q_{it} - \Sigma_i p_{it-n} q_{it-n}}{\ln \Sigma_i p_{it} q_{it} - \ln \Sigma_i p_{it-n} q_{it-n}} .$$

This price index is again a weighted geometric mean of the individual price mutations.

The requirements formulated above considerably reduce the choice of the most suitable index for deflating national accounting data. Only the Laspeyres, Paasche and Vartia I formulae are left. With regard to the last-mentioned formula, it applies that the product of volume and price indices gives the value index. The product of the Laspeyres volume index and the Paasche price index results in the value index too. The same holds true with respect to a combination of the Paasche volume index and the Laspeyres price index. These three index number formulae also satisfy the consistency in aggregation requirement. However, as a result of the geometrical nature of the formula, the Vartia I formula has no additive consistency in aggregation. This is the most important reason why the Netherlands Central Bureau of Statistics (CBS) decided not to use the Vartia I formula when deflating input-output tables.

From the two aforementioned combinations of the Laspeyres and Paasche formulae the former has been chosen: the Laspeyres formula for the volume index and the Paasche formula for the price index. This choice leads to an simple interpretation of the deflated values: these are values in prices of the weighting year. When using the Laspeyres volume index and the Paasche price index, the volume change of an aggregate is estimated on the basis of the relative values of the components in the weighting year, while the price index uses the structure in the reporting year. As a consequence, the volume index reflects a pure quantity component, while the structural changes (also with respect to the quantities) have entirely been included in the price index.

In practice, in the economic process structural changes with regard to quantities and prices will often occur simultaneously, and therefore an average weighting scheme stands to reason. There are a number of index number formulae which make use of an average scheme. The Fisher index, the geometric mean of the Laspeyres and Paasche indices, utilizes implicitly an average weighting scheme. The Vartia I formula weighs individual mutations with a logarithmic mean of the weights at the beginning and at the end of the period. Since the Vartia I formula divides up the structural changes, this formula is very appropriate when structural changes simultaneously occur in quantities and prices. Especially when comparisons over longer periods are made, the Vartia I's average weighting scheme is relatively less arbitrary for the period as a whole. In the case of yearly comparisons, the choice of the weighting scheme plays a less important role. Here, an important aspect of the choice of an index formula comes up: the length of the period for which the mutations are calculated.

Usually, it is taken for granted that in calculating yearly volume and price mutations, the results of the different index number formulae do not deviate very much. In that case, preference is given to the most simple formulae, and this leads to the above mentioned combination of Laspeyres and Paasche. In a comparison over several years the choice of the formula is also dependent on the objective of that comparison. If one is out for an optimal comparison of two years, the formula to be selected is the one which utilises the best possible weighting scheme for the period concerned. In this case, the Vartia I formula is the most suitable one, although the formula's multiplicative character prevents an easy application to the (additive) national accounts. In practice, the Vartia I formula can be approximated with the help of the Fisher formula, which is simpler than the Vartia I formula and which is almost consistent in aggregation. However, if one is out for an optimal description of the time path of the volume and price over the period concerned, the best method is a repeated calculation of volume and price mutations for two consecutive years. In this way, a serie of yearly mutations is built up and the products of these changes yield a series of chain indices. These indices can be seen as an approximation of the line-integral index, the theoretically most adequate index to describe a volume and price path. In situations where only yearly mutations of volumes and prices are available, the chain approach can be used as an approximation when comparing non-adjacent years.

1.3. Deflating historical national accounting data

In the previous section, a number of aspects of deflating national accounting data have been discussed. In compiling historical national accounting figures an additional factor may be important: the availability of data. For instance, the calculation of yearly volume and price developments on the basis of the Laspeyres and the Paasche formula respectively, requires information about quantities and prices which is not always at hand. In that case it may be necessary to work with a fixed weighting scheme, based on a year for which sufficient data are available. That year may be situated at the beginning or at the end of the period, although it can be an arbitrary intermediate year as well. It is also possible to use a weighting scheme which is an average of those two or more years. Because of its clearness, a Laspeyres index formula stands to reason.

In chapter 3, a number of formulae are applied to examine what kind of differences in the outcomes arise.

Another situation in which the weighting year may be selected which is non-adjacent to the reporting year, concerns a comparison of historical and more recent figures. In this case, the use of chain indices is typically not possible since at least some interjacent years are missing. Therefore, one has to opt for either a historical or a recent weighting scheme.

1.4. Deflating national accounting data in practice

At the international level, arrangements concerning national accounting concepts and methods have already been made for more then fourty years. Examples are the SNA (United Nations, 1968), and the ESA, the 'European System of Integrated Economic Accounts' Eurostat, 1980), of the European Community. With regard to the calculation of price and volume mutations however no stringent guidelines are available. In fact, the SNA contains the requirement that a value change has to be decomposed into a volume and a price change without remainder, but a specific index number formula is not prescribed. The SNA only states that in practice the Laspeyres and Paasche formulae tend to be used for calculating volume and price developments respectively. According to the SNA, the explanation is that those formulae are easy to calculate and their interpretation is simple. Moreover, they have some features which are important in a national accounting framework.

To maintain the weights up-to-date, the weighting schemes are renewed every five or ten years. The figures for the period in between the old and the new weighting year (in the SNA the general term period is used) should be revised, for example by means of the Fisher formula. In the SNA, it is noted that this 'refinement' is not worth the effort in case that the two weighting years are close together. This method leads to a series with different index formulae before and after the new weighting year. According to the SNA the only alternative is to recalculate the whole existing series on the basis of the new weighting scheme unless a complete set of price and quantity information is available for each year. This procedure is not only very time-consuming but it also leads to weighting schemes which can be considered as an anachronism for the older years of the time series.

More or less hypothetically, the SNA takes notice of the question what should happen if this method is carried through to its extreme, that is that for every year a new weighting scheme is designed. In this way, chains arise whereby non-adjacent years are compared not directly but through the links of the chain. The SNA says that, in general, the outcomes of the direct application of index number formulae and the chain appraoch do not deviate much. A certain preference is expressed for the chain approach. However, this appraoch is not recommended forcefully because in that case many more data are needed than in the case of a direct application of the formulae over several years. In the ESA, the Laspeyres and the Paasche formulae are recommended for volume and price mutations respectively. To prevent that the used weighting schemes get out of date, the ESA advises to update them every five years.

At the international level the discussion is continuing about the way deflators and the concomitant volume growth rates have to be estimated. The mentioned 'expert group' of the United Nations pays much attention to the way value changes have to be decomposed into a price and a volume component. Again, no specific index number formula is laid down. The 'expert group' proposes that in the new SNA the advantages and disadvantages of indices with fixed weights on the one hand and of chain indices (yearly mutations) on the other should be discussed.

The Netherlands CBS has made an inventory of the use of chain indices in the national accounts of the Member States of the European Community. It turns out that the Laspeyres index is generally used for the calculation of volume mutations. Concerning the uses of chain indices in the national accounts, different positions were taken.

In the Netherlands the defating method for national accounting figures has been changed as of the reporting year 1981. The new method boils down to using the Laspeyres formula for volume mutations and the Paasche formula for price mutations. The crux of the method is that the weighting schemes are based on the most recent information: the weights for the volume changes are taken from the previous year and those for the price development from the reporting year. Longer series of volume and price developments are made as chain indices of yearly mutations. Indeed, this method can be considered as optimal for the estimation of volume mutations, but a disadvantage is that it is not possible to make 'true' series in constant prices of a fixed base year. If this is done on the basis of the chain indices, aggregation differences emerge. The elimination of those differences causes a bias in the yearly mutations in the subseries within an aggregate. However, for short periods this problem is not so serious because then the aggregation differences are usually relatively small.

In the construction of historical national accounts too, the method of estimating growth rates is important. At the 1987 conference of the International Association for Research in Income and Wealth, it turned out that different deflating methods were used in estimating GDP growth. Sometimes, the choice has been dictated by the availability of data. The above-mentioned method, in use at the CBS has been adopted as well with regard to the historical national accounting figures.

In compiling figures in constant prices of a previous year, a value development has to be decomposed into a price and a volume component. In principle there are two possibilities. If an indicator for the price adjustment is available, the volume can be obtained from the value changes. If an indicator for the volume is at hand, the price can be derived. In general, a representative indicator can easier be found for the price than for the volume. Mostly, data in prices of a previous year result from a deflation of values with the help of price indicators. This holds true as well for the Netherlands' interwar series. An exception are the estimates concerning the imports and exports of goods. From the foreign trade statistics, volume developments have been calculated and then the price mutations were determined. The plausibility of the deflated values has been checked, among other things, from an analysis of the yearly volume mutations.

2. The estimation of price index numbers

2.1. Introduction

Sources used to estimate the deflators are:
- CBS, 1951, 'Hoeveelheids- en prijs-(unit-value) indexcijfers van de buitenlandse handel voor de periode 1921-1939' ('Volume- and price-(unit-value) index numbers for the period 1921-1939');
- Barten, 1966, 'Het verbruik door gezinshuishoudingen in Nederland, 1921-1939 en 1948-1962' ('Private consumption in the Netherlands, 1921-1939 and 1948-1962');
- CPB, 1953-1956, Data compiled in a joint research project of the Central Planning Bureau and the CBS, financed by 'ZWO', the Dutch foundation for 'Zuiver Wetenschappelijk Onderzoek' (Pure Scientific Research). Part of these unpublished data have been used in building the econometric models of the Central Planning Bureau.

In addition to these sources, archives have been consulted for data underlying the published figures.

Different index number formulae may be needed for different purposes. It is also possible, especially in the case of historical data, that a certain deflating method must be used due to the lack of sufficient information. The question arises what variations in the outcomes may result from the use of different index number formulae and weights. The interwar period is very appropriate to test this because it has been characterized by turbulent economic developments. For example, a great influence on the outcomes are only to be expected in use of different weights. To gain an understanding of possible differences in outcomes, price mutations have been estimated according to several methods. Some will hardly be utilized in practice, they serve as an illustration what differences can come up.

First of all, the formulae have been used to calculate yearly mutations. These mutations were used to construct chain indices as well. Furthermore, direct price indices have been calculated for all interwar years. The Laspeyres formula has been used with 1921, 1930 and 1939 weights. The Paasche formula has been applied to price series with 1921 and 1939 as reference years. Based on the Laspeyres formula with 1921 as weighting and reference year, and the Paasche formula with 1921 as reference year, Fisher indices have been calculated. Törnqvist and Vartia I price indices have been computed with the reference year 1921. For the sake of the comparison, the outcomes have been re-scaled to 1921=100. Yearly mutations have been calculated from the series of direct indices, and these can be compared with the mutations based on the yearly usage of the index formulae.

2.2. Summary of the five index number formulae

For the macro-economic aggregates, yearly price mutations have been calculated on the basis of the index formulae of Laspeyres, Paasche, Fisher, Törnqvist and Vartia I. In this section, the results with regard to private consumption are analysed. Next, the outcomes with respect to the other variables are considered as far as they deviate from these results. The conclusions with regard to the yearly mutations are reinforced if one looks at the entire period. Table 1 presents price indices for 1939 which have been calculated by chaining yearly mutations. The chain approaches based on the Törnqvist, Vartia I and Fisher formulae give practically the same indices. The outcome of the Laspeyres formula is almost 7% higher than that of the Paasche formula.

Table 1. Chained price indices, private consumption, 1939

		Difference compared to Paasche
	1921=100	%
Paasche	62.0	
Laspeyres	66.3	6.9
Fisher	64.1	3.4
Törnqvist	64.1	3.4
Vartia I	64.1	3.4

The yearly price mutations which underlie the figures of table 1 are presented in table A1 in the appendix. That table also gives differences in outcomes between a number of formulae, and these are small, as expected. The maximum deviation between the highest and the lowest index is on average 0.35 index point. The average deviation as a percentage of the lowest value is 0.37%. The highest deviations are found for the results of 1922 compared to 1921: 0.82 index point or 0.91%. For those years, sharp price movements play an important role.

In situations, where goods, which become more expensive are substituted by the cheaper ones, the Laspeyres formula gives a higher outcome than the one of Paasche. Certainly, this substitution effect must appear in private consumption, and, indeed, the Laspeyres formula gives higher outcomes for the whole period. In theory, the results of the Fisher, Törnqvist and Vartia I formulae should be similar. The outcomes of the calculations are in line with the theory, see table 1 and table A1 in the appendix. Also in conformity with the theory, the difference between the price mutation according to the Fisher formula and the one based on the Törnqvist formula is smaller than the gap between the Paasche and Laspeyres formulae on the one hand and the Törnqvist formula on the other. The outcomes of the Fisher, Törnqvist and Vartia I formulae lie in between the Paasche and Laspeyres ones.

Not for all variables it applies that the yearly mutations according to the Laspeyres formula gives higher outcomes than those of the Paasche formula. For government consumption the outcome of the Paasche formula is in 5 years (a little) higher than that of the Laspeyres formula. For private investment, this is the case in 8 years and for government investment in 9 years. For exports and imports it occurs in 5 years. The differences between both formulae are of the same order concerning imports and private consumption. For the other variables, the deviations are smaller. The results of the Fisher, Törnqvist and Vartia I formulae are always rather similar.

2.3. Direct indices according to the five formulae

In addition to the yearly mutations discussed in section 2.2, direct indices have been calculated as well. The Paasche formula has been applied to price series with different reference years, namely 1921 (t/1921) and 1939 (t/1939). To compare the results, the series based on 1930 and 1939 have been recalculated to 1921=100. In this way, Laspeyres indices with 1921 as weighting and reference year are obtained.

Table 2 shows the results of the calculations, together with the chain indices. The table gives the greatest differences between the three indices too. The results are not the same for all variables. Apart from private investments, t/1939 is always higher than t/1921 These results point to the substitution effect: a higher price index when the weighting scheme is further back in the past. This does not apply to private and government investment where substitution plays no role at this level of aggregation. For imports and exports of goods the maximum difference is about twice as much as for private and government consumption. Minor differences are found for government investment. Except for private consumption and investment, the results of the chain indices are between those of t/1921 and t/1939. The chain approach gives the lowest result for the private consumption and the highest one for private investment.

Table 2. Results on the basis of Paasche price indices, 1939

	Formula			Maximum difference
	chain	t/1921	t/1939[1]	
	1921=100			%
Private consumption	62.0	62.8	65.9	6.3
Government consumption	75.0	71.7	75.2	5.2
Private investment	61.3	59.2	59.2	3.6
Government investment	53.8	53.2	54.0	1.7
Exports of goods	48.2	45.5	50.7	11.4
Exports of services	49.0	45.8	51.3	12.0
Imports of goods	48.9	47.7	52.9	10.9

[1] Due to the re-scaling to 1921=100, the formula in this column is the Laspeyres one.

It appears that the choice of weights can be of great influence on the results, especially when fixed weights are used for a long period. This is of course a well-known problem and in order to estimate its influence, the direct Laspeyres indices have been calculated with several fixed weighting schemes: based on 1921, 1930 and 1939 respectively. The 1939 results of direct and chain indices and the highest differences in results in using different weights are given in table 3. For 1939, the 1921 weights give higher results than the 1939 weights. The 1930 weights give results in between the 1921 and 1939 weights. These results point to the occurrence of the above-mentioned substitution phenomenon. Generally, the outcomes for other years present the same picture. For imports and exports the differences between the weights are higher than for the other variables. In 1935, for exports of goods the **maximum** difference between the 1921, 1930 and 1939 weights is nearly 18%.

Table 3. Results on the basis of Laspeyres price indices, 1939

	Weighting				Maximum difference
	chain	1921	1930 1)	1939 2)	
	1921=100				%
Private consumption	66.3	65.9	63.9	62.8	5.6
Government consumption	76.0	75.2	74.1	71.5	6.3
Private investment	61.8	59.2	59.0	59.2	4.7
Government investment	53.5	54.0	52.1	53.1	3.6
Exports of goods	50.0	50.7	47.0	45.5	11.4
Exports of services	50.9	51.3	47.6	45.8	12.0
Imports of goods	52.1	52.9	50.0	47.7	10.9

1) Due to the re-scaling to 1921=100, the formula in this column is of the form: $(\Sigma p_t q_{30})/(\Sigma p_{21} q_{30})$.
2) Due to the re-scaling to 1921=100, the formula in this column is the Paasche one.

With the Fisher, Törnqvist and Vartia I formulae too, direct indices have been calculated. The results for the private consumption, along with the chain indices, are shown in table 4. The differences between the direct indices and the chain indices are small. The greatest difference (1.53%) is found with the Vartia I formula for 1938. Generally, the differences are somewhat higher for the other macro-economic aggregates. The greatest differences occur with the exports of goods, particularly for the Vartia I formula where differences of over 5% are found in 1932 and 1933.

Table 4. Price indices, private consumption, 1939

	Chain index	Direct index
	1921=100	
Fisher	64.1	64.3
Törnqvist	64.1	64.5
Vartia I	64.1	64.8

From the direct indices, annual changes can be calculated. The mutual differences between the annual mutations are in many cases much greater than those between the 'real' annual mutations (in case of the use of different index formulae). This occurs because of the use of weights which are not associated with both successive years under consideration. The computation of annual mutations from direct indices can yield a substantial bias. An example is the price movement from 1921 to 1922 in case of the exports of goods. The Laspeyres formula with 1939 weights gives an index of 76.4 and that with 1921 weights 80.9, a difference of almost 6%.

2.4. A comparison with other studies

In this section, the results of four other studies which compare the outcomes of different index number formulae, are summarized. These are studies from Diewert (1978), Triplett (1981), CBS (1982) and Généreux (1983). Table 5 offers a survey of major features and results, while the outcomes of the present study are given as well. The results refer to the latest year of the period compared to the first one.

Table 5. Five studies to the deviations in outcomes using different index number formulae, private consumption

	Diewert	Triplett	CBS[1)]	Généreux	Den Bakker
Country	Canada	USA	The Netherlands	Canada	The Netherlands
Period	1947-1971	1972-1980	1951-1977	1957-1978	1921-1939
Index number formula applied:					
Laspeyres	x	x	x	x	x
Paasche	x	x	x	x	x
Fisher	x		x	x	x
ChainLasp	x	x	x	x	x
ChainPaasche	x		x	x	x
ChainFisher	x		x	x	x
Törnqvist	x		x		x
ChainTörnqvist	x		x		x
Vartia I	x		x		x
ChainVartia I	x		x		x
Results:					
Lasp-Paasche, %	3.8	3.0	16.8	10.0	4.9
ChainLasp-chainPaasche, %	0.5		3.6	4.0	6.9
ChainPaasche-Paasche, %	1.8		7.4	1.5	1.3
Lasp-chainLasp, %	1.4		5.1	4.2	0.6
Fisher-chainFisher, %	0.2		-1.1	1.4	0.3

1) Unpublished data of CBS (1982) are used.

The periods to which the formulae are applied, the lengths of those periods and the aggregation level used diverge strongly. Triplett has a short period in which two oil crises take place. The period of Diewert covers 25 years and ends before the first oil crisis. From a comparison of the outcomes it is clear that not all studies yield the same results. The differences between the outcomes are much smaller with Diewert than with Généreux and CBS. The periods of the latter two enclose the first oil crisis. The differences between the outcomes of the formulae of Laspeyres and Paasche are much greater with CBS than with Généreux who uses about the same period. CBS also covers the years 1951-1971 (not shown in table 5), roughly the same years as Diewert. For that period too, the differences with CBS are much greater than with Diewert; with CBS the difference between the Laspeyres and Paasche formulae is 12.4% in that case. Diewert uses the formulae of Fisher, Törnqvist and Vartia I too. He calculates direct indices and chains of annual mutations. Table 6 shows for 1971 the relative differences in outcomes for the formulae used by Diewert.

Table 6. Differences in outcomes according to Diewert, private consumption 1971, 1947=100

	Direct index Laspeyres	Paasche	Fisher	Törnqvist	Vartia I
Chain index	%				
Laspeyres	-1.4	2.3	0.4	0.3	0.7
Paasche	-1.9	1.8	-0.1	-0.2	0.2
Fisher	-1.7	2.0	0.2	0.0	0.5
Törnqvist	-1.7	2.0	0.2	0.0	0.5
Vartia I	-1.7	2.0	0.2	0.0	0.5

The outcomes of the Fisher, Törnqvist and Vartia I formulae are very similar. The differences between the direct indices and the chain indices of annual mutations are very small for those formulae, at most 0.5% for the Vartia I formula. For the Laspeyres and the Paasche formulae as well the differences between direct and chain indices are small, namely less than 2%.

The differences between the Laspeyres and Paasche based direct and chain indices in the present study are much smaller than Généreux and CBS (including the oil crisis). Our differences are similar to those of CBS, 1953-1871 and Diewert, 1947-1966. Usually, the deviations between direct and chain indices are rather small. Somewhat greater differences are found for periods including an oil crisis (Généreux, CBS).

From these studies it can be concluded that it does matter whether direct or chain indices are used. Obviously, this applies especially in periods with turbulent economic developments. It should be noticed however, that the differences in outcomes also depend on the aggregation level of the calculations.

3. The estimation of growth rates

On the basis of the computed price indices, the growth rates of the macro-economic variables can be calculated by deflating the value mutations. Of course, the different outcomes of the price indices are also reflected in the volume movements. Deflating with a Paasche price index gives a volume movement according to the Laspeyres formula, while the Laspeyres deflator yields a volume development in accordance with the Paasche formula. The Vartia I and Fisher deflators result in volume mutations according to the same formula.

The results of the yearly Fisher, Törnqvist and Vartia I price indices hardly diverge, cf. section 2.2. For that reason, the volume mutations based on the two last mentioned formulae have not been calculated. The direct indices in according with the formulae of Laspeyres, Paasche, Fisher, Törnqvist and Vartia I have been used as deflator as well.

An important macro-economic variable is GDP. Indices of GDP have been computed using the methods described in this study. Table A2 in the appendix presents yearly volume mutations based on the price indices according to the formulae of Laspeyres, Paasche and Fisher. The differences are small, they vary from 0.1 to 0.5 index point, only in 1922 the difference is somewhat higher, viz. 0.9 index point (0.9%). Here, the strong price movements between 1921 and 1922 play a role.

Table A3 in the appendix shows volume movements on the basis of direct price indices. Surely, the differences between volume indices based upon direct price indices are much larger than in the case of the annual mutations. For 1939, the Laspeyres deflator with 1921 weights gives a volume index of 158.8. The Paasche deflator (1939 weights) gives a volume index of 169.9, some 7% higher. These deflators yield similar differences in the volume movements for other years as well. The maximum difference is 9.4% in 1937. The volume developments based upon Laspeyres deflators with 1921, 1930 and 1939 weights, reveal substantial discrepancies. The difference in 1922 is already 3.5%, and in the succeeding years the discrepancies become larger and larger. The maximum difference is 10.2% in 1934 and in 1939 it has decreased again to 7%. In the 1920s, the 1930 and 1939 weights give about the same results but in the 1930s the 1930 weight gives lower indices: on average 1.7% less with a maximum of 2% in 1934 and 2.1% in 1938.

The annual mutations can be linked to chain indices, see table A3 in the appendix. The differences between the chain indices based on Laspeyres and Paasche formulae are between 0.6% (1924) and 2.1% (1934). The average for the whole period is 1.8%.

From table A3 in the appendix it appears that the results of the period indices are quite dissimilar to those of the chain indices. Examples are the chain volume indices based on Laspeyres price indices and the direct volume indices based on the Laspeyres price indices with 1921 weights. In the first half of the interwar period the differences are very small, in the 1930s they are 2.2% on average. In two years, 1932 and 1935, they are more than 3%. For 1939, the Paasche chain price index results in a volume index of 161.0 and the volume index calculated on the basis of the Paasche price index t/1921 gives 169.9, that is 5.5% higher. For 1939 too, the use of the Laspeyres deflator with weights 1921 gives a volume index of 158.8 or 1.4% lower than the volume index based on the Paasche chain price index.

4. Conclusions

4.1. The results with regard to the price indices

In this study, the impact of the use of different index number formulae and weigts on volume movements has been analysed. The calculations have been carried out for the main macro-economic variables and concern the years 1921-1939. These interwar figures are very useful for our purpose, since this period is characterized by large variations in economic growth rates and price movements. After a discussion of deflation problems in (historical) national accounts, the results with respect to the price indices and the volume indices have been examined

The price indices have been calculated on the basis of the formulae of Laspeyres, Paasche, Fisher, Törnqvist and Vartia I. They were applied to yearly mutations and as well to several years at once. In doing so, different weights and reference years have been utilized. The yearly mutations have been linked to series of chain indices too.

In line with our expectations, for two successive years the results do not deviate much when another index number formula is used. However, the series of chain indices based on those annual mutations sometimes yield large differences. For instance, viewed over the whole period, in the case of private consumption the outcome of the Laspeyres formula is almost 7% higher than the outcome of the Paasche formula.

The use of different weighting schemes in calculating direct indices based on the Laspeyres formula can also yield large differences in outcomes. For 1939, the 1921 weight gives a 5% higher outcome than that of 1939. In using the Paasche formula, the choice of the reference year plays an important role as well. The differences can mount up to more than 10%.

A comparison with other studies shows that in other countries different index number formulae trend to give strongly divergent results too. The differences vary from country to country, even when the periods considered are about the same.

4.2. The results with regard to the volume indices

Since the volume developments were calculated by deflating current value changes, the results with regard to the various price indices are mirrored in the volume indices. The volume index of GDP is calculated as a residual and like the other macro-economic aggregates this index is sensitive to the deflation methods selected. For example, the use of a Laspeyres deflator with 1921 weights yields a nearly 9.5% lower volume growth in 1937 than when a Paasche deflator (1939 weights) is applied. The growth rates based on Laspeyres indices with differing weights diverge strongly as well, the maximum difference being more than 10%. From what has been said above it follows that yearly mutations calculated from direct indices with different weights may also yield (strongly) diverging outcomes. These outcomes may as well differ substantially from the yearly mutations calculated by an annual application of the index formulae. Although the yearly mutations based upon various formulae do not deviate very much, their chaining can result in rather big differences. For instance, the Laspeyres and Paasche formula yield a deviation of more than 2% in 1934.

The great differences in GDP growth rates as a result of the use of different formulae and weights are important in two respects. In the first place, a country's estimated GDP growth appears to depend as well on the choosen calculation method. It goes without saying that one should always employ the same formula when making long time series. That is why in the compilation of historical national accounts for the Netherlands, we use the same deflation methods as are utilized at present. In the second place, comparisons of growth rates among countries are presently obscured by the use of different deflation methods. Therefore, to facilitate comparisons across countries, there exist an urgent need for standardization of the deflation methods at the international level.

Appendix

In the tables of this appendix the notation used is:

t = reporting year
t/t-1 = index number formula based on reporting year and previous year
t/1921 = index number formula based on reporting year and 1921
t/1930 = index number formula based on reporting year and 1930
t/1939 = index number formula based on reporting year and 1939

Table A1. Price indices private consumption, previous year is 100

	1922	1923	1924	1925	1926	1927	1928	1929	1930	1931	1932	1933	1934	1935	1936	1937	1938	1939	ave
Laspeyres t/t-1, weight t-1	90.7	95.9	100.5	100.9	95.4	99.0	100.6	99.7	95.9	93.8	91.9	96.5	98.5	96.7	96.6	104.9	102.3	100.9	
Paasche t/t-1, weight t	89.8	95.7	100.2	100.5	95.1	98.8	100.5	99.4	95.3	93.3	91.4	96.0	98.4	96.6	95.9	104.5	101.9	100.7	
Fisher t/t-1, weight t, t-1	90.3	95.8	100.3	100.7	95.3	98.9	100.5	99.6	95.6	93.5	91.6	96.2	98.4	96.6	96.2	104.7	102.1	100.8	
Törnqvist t/t-1, weight t, t-1	90.3	95.8	100.3	100.7	95.3	98.9	100.5	99.6	95.6	93.6	91.6	96.2	98.4	96.6	96.2	104.7	102.1	100.8	
Vartia I t/t-1, weight t, t-1	90.3	95.8	100.3	100.7	95.3	98.9	100.5	99.6	95.6	93.6	91.7	96.2	98.4	96.6	96.2	104.7	102.1	100.8	
Maximum deviation in index points	0.82	0.20	0.31	0.35	0.32	0.16	0.15	0.25	0.58	0.50	0.44	0.45	0.11	0.13	0.65	0.35	0.43	0.18	0.35
Maxumum deviation in % of the lowest value	0.91	0.21	0.31	0.35	0.33	0.16	0.15	0.25	0.61	0.53	0.48	0.47	0.12	0.14	0.68	0.34	0.42	0.18	0.37
Fisher-Törnqvist	-0.01	0.00	-0.00	-0.00	-0.00	-0.00	-0.00	0.00	-0.00	-0.02	0.00	-0.00	-0.00	0.00	-0.01	0.00	0.01	0.01	0.00
Vartia-Törnqvist	0.02	0.00	0.00	-0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.00	-0.00	-0.00	0.00	-0.00	-0.00	0.00	0.00
Laspeyres-Törnqvist	0.40	0.10	0.15	0.17	0.16	0.08	0.07	0.13	0.29	0.23	0.22	0.23	0.06	0.07	0.32	0.18	0.22	0.09	0.18
Paasche-Törnqvist	-0.42	-0.10	-0.15	-0.18	-0.16	-0.08	-0.08	-0.13	-0.29	-0.27	-0.22	-0.23	-0.06	-0.07	-0.33	-0.17	-0.20	-0.08	-0.18
Laspeyres-Paasche	0.82	0.20	0.31	0.35	0.32	0.16	0.15	0.25	0.58	0.50	0.44	0.45	0.11	0.13	0.65	0.35	0.43	0.18	0.35

Table A2. Volume indices Gross Domestic Product at market prices, previous year is 100

	1922	1923	1924	1925	1926	1927	1928	1929	1930	1931	1932	1933	1934	1935	1936	1937	1938	1939
Based on Laspeyres price index, t/t-1, weight t-1	105.6	101.9	107.5	103.1	106.6	104.5	104.8	102.3	98.9	95.6	98.7	100.3	98.6	103.2	105.2	105.9	97.3	108.6
Based on Paasche price index, t/t-1, weight t	106.5	102.1	107.2	103.6	106.8	104.6	104.9	102.4	98.8	95.4	99.1	100.4	98.9	102.7	105.5	105.7	96.8	108.1
Based on Fisher price index, t/t-1, weight t, t-1	106.1	102.0	107.3	103.3	106.7	104.6	104.8	102.3	98.9	95.5	98.9	100.4	98.7	103.0	105.3	105.8	97.1	108.3

Table A3. Volume indices Gross Domestic Product at market prices: chain indices and direct indices, 1921=100

	1922	1923	1924	1925	1926	1927	1928	1929	1930	1931	1932	1933	1934	1935	1936	1937	1938	1939
Based on Laspeyres price index, 21=100, chain index	105.6	107.7	115.8	119.3	127.3	132.9	139.3	142.5	141.0	134.8	133.1	133.5	131.6	135.9	142.9	151.3	147.2	159.8
Based on Laspeyres price index t/1921, weight 1921	105.6	107.4	115.8	119.4	126.6	131.9	138.1	142.1	139.7	132.1	129.1	129.9	128.0	131.7	139.1	148.9	144.6	158.8
Based on Laspeyres price index weight 1939, t/1939	109.3	112.8	121.1	125.4	133.7	139.6	145.9	149.4	148.0	142.2	141.5	142.7	141.1	144.8	152.5	162.1	157.1	169.9
Based on Laspeyres price index weight 1930, t/1930	108.8	112.1	121.2	125.3	133.3	139.1	145.4	148.7	147.0	140.5	139.0	140.1	138.3	142.4	149.7	159.5	153.9	167.4
Based on Paasche price index 21=100, chain index	106.5	108.7	116.5	120.7	128.9	134.9	141.4	144.8	143.1	136.5	135.3	135.9	134.3	138.0	145.6	153.8	148.9	161.0
Based on Paasche price index t/1921, weight t	106.5	109.4	118.3	122.9	132.1	138.8	146.1	149.4	147.0	139.0	137.3	137.0	136.7	142.7	151.9	162.9	155.7	169.9
Based on Paasche price index weight t, t/1939	105.4	107.4	116.1	117.9	125.4	130.2	136.6	140.3	139.5	133.0	131.4	131.3	129.8	135.0	142.5	150.6	146.3	158.8
Based on Paasche price index weight t, t/1930	105.1	107.4	114.8	118.3	126.1	131.9	138.5	141.2	139.7	133.2	132.1	131.8	131.2	136.4	144.5	153.1	148.2	160.3
Based on Fisher price index t/1921, weight t, 1921	106.1	108.4	117.1	121.1	129.3	135.3	142.1	145.7	143.3	135.5	133.1	133.4	132.3	137.1	145.4	155.7	150.1	164.3
Based on Fisher price index t/t-1, weight t,t-1	106.1	108.2	116.2	120.0	128.1	133.9	140.4	143.7	142.1	135.7	134.2	134.6	133.0	136.9	144.2	152.5	148.1	160.4

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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.

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 institu-tional 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 should contain 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 processing 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).
A set of macro-economic time series for the Netherlands 1921-1939 is presented. The new series differ considerably from the data that had been published before. They are also more comprehensive, more detailed, and conceptually consistent with the modern National Accounts. The macro-economic developments that are shown by the new series are discussed. It turns out that the traditional economic-historical view of the Dutch economy has to be reversed.

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, Adriaan M. (1989).
Units in legal-administrative reality are often not suitable as statistical units in describing economic processes. Some transformation of legal-administrative units into economic statistical units is needed. This paper examines this transformation and furnishes definitions of economic statistical units. Proper definitions are especially important because of the forthcoming revision of the SNA.

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**, Oudde-ken, 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).
In this paper, concepts of income are explicitly linked to the purposes of use and to actual circumstances. Main choices in defining income are presented in a general system. The National Accounts is a multi-purpose framework. It should therefore contain several concepts of income, e.g. differing with respect to the production boundary. Furthermore, concepts of national income 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. (1990).
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. It is argued that the way of recording the use of financial services in the present SNA should remain 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 (1990).
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 (1990, forthcoming).
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 demands and international guidelines are examined.

NA/37 **A proposal for a SAM which fits into the next System of National Accounts**, Keuning, Steven J. (1990).
This paper shows that all flow accounts which may become part of the next System of National Accounts can be embedded easily in a Social Accounting Matrix (SAM). In fact, for many purposes a SAM format may be preferred to the traditional T-accounts for the institutional sectors, since it allows for more flexibility in selecting relevant classifications and valuation principles.

NA/38 **Net versus gross National Income**, Bos, Frits (1990).
In practice, gross figures of Domestic Product, National Product and National Income are most often preferred to net figures. In this paper, this practice is challenged. Conceptual issues and the reliability of capital consumption estimates are discussed.

NA/39 **Concealed interest income of households in the Netherlands; 1977, 1979 and 1981**, Kazemier, Brugt (1990).
The major problem in estimating the size of hidden income is that total income, reported plus unreported, is unknown. However, this is not the case with total interest income of households in the Netherlands. This makes it possible to estimate at least the order of magnitude of this part of hidden income. In this paper it will be shown that in 1977, 1979 and 1981 almost 50% of total interest received by households was concealed.

NA/40 Who came off worst: Structural change of Dutch value added and employ-- ment during the interwar period, Den Bakker, Gert P. and Jan de Gijt (1990).
In this paper new data for the interwar period are presented. The distribution of value added over industries and a break-down of value added into components is given. Employment by industry is estimated as well. Moreover, structural changes during the interwar years and in the more recent past are juxtaposed.

NA/41 The supply of hidden labour in the Netherlands: a model, Kazemier, Brugt and Rob van Eck (1990).
This paper presents a model of the supply of hidden labour in the Netherlands. Model simulations show that the supply of hidden labour is not very sensitive to cyclical fluctuations. A tax exempt of 1500 guilders for second jobs and a higher probability of detection, however, may substantially decrease the magnitude of the hidden labour market.

NA/42 Benefits from productivity growth and the distribution of income, Keuning, Steven J. (1990).
This paper contains a discussion on the measurement of multifactor productivity and sketches a framework for analyzing the relation between productivity changes and changes in the average factor remuneration rate by industry. Subsequently, the effects on the average wage rate by labour category and the household primary income distribution are studied.

NA/43 Valuation principles in supply and use tables and in the sectoral accounts, Steven J. Keuning (1991).
In many instances, the valuation of transactions in goods and services in the national accounts poses a problem. The main reason is that the price paid by the purchaser deviates from the price received by the producers. The paper discusses these problems and demonstrates that different valuations should be used in the supply and use tables and in the sectoral accounts.

NA/44 The choice of index number formulae and weights in the National Accounts. A sensitivity analysis based on macro-economic data for the interwar period, Gert P. den Bakker (1991).
The sensitivity of growth estimates to variations in index number formulae and weighting procedures is discussed. The calculations concern the macro-economic variables for the interwar period in the Netherlands. It appears, that the use of different formulae and weights yields large differences in growth rates. Comparisons of Gross Domestic Product growth rates among countries are presently obscured by the use of different deflation methods. There exists an urgent need for standardization of deflation methods at the international level.

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