MEASURING INTERNATIONAL AND INTER-SECTORAL TERMS OF TRADE: SOME METHODOLOGICAL ISSUES

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The view is expressed that the well-known formulae for measuring changes in terms of trade cannot be used to conclude whether a country is better off or not. Other variables which reflect the impact upon production, employment, and the competitive position should also be taken into account.

Similarly, changes in terms of trade between the industrial sectors of an economy cannot be used to conclude whether one sector is better off than others. Other factors which play a role include increases in productivity per man-hour. These may help to explain why in some sectors prices increase less than in others. An attempt is made to illustrate this point using some statistics for the Netherlands.

1. THE CONCEPT OF "GAINS FROM CHANGES IN TERMS OF TRADE"

The concept of "terms of trade" has played an important role in the classical and neo-classical theory of international trade. Authors such as Marshall, Taussig, Pigou, and Haberler have used numerical examples, which, however, relate to trade among the developed countries. Only recently has interest been broadened to include also the problems of the developing countries. These countries have been encouraged to compute index numbers of prices of exports and imports, and of changes in their terms of trade. Improvements in the terms of trade have been termed "favourable", a deterioration as "unfavourable". Various formulae have been proposed and used which enable countries to calculate "gains from changes in the terms of trade".

The following formula has been in the centre of the discussion:

$$G_t = E_t\left(\frac{1}{p_{It}} - \frac{1}{p_{Et}}\right) \tag{1}$$

where:

G_t = estimated gain from terms of trade in year t compared to the base year ("0").

p_{It}, p_{Et} = price index of imports, respectively of exports, in year t. In the base year these indexes are 1.00.

E_t = exports of goods and services.

According to (1) the proceeds of exports of goods and services (E_t) are deflated by an index of import prices on the grounds that the proceeds from exports are used or could be used to finance imports. "From this point of view the quantity of exports is irrelevant to real income. What is important is the quantity of imports that can be bought with the proceeds of the exports" (Stone, pp. 94–95).

Stone has several reservations with respect to this viewpoint. "There is no obvious justification for making this assumption since the export surplus is not in fact used to purchase imports at the time at which it arises. In the future it may be used to purchase home-produced goods by means of a reduction in future exports". Or it may be used to obtain financial claims on other countries, to redeem foreign debts, or to obtain fixed assets abroad.

Despite these reservations the adjustment for gains (losses) due to changes in terms of trade is frequently applied.

Expression (1) should not be regarded as an adjustment in the account of gross national product and expenditure, because by definition these two aggregates are identical. After cancellation of all domestic intermediate deliveries the gross national product equals all final outputs, including exports minus inputs from abroad, i.e. all imports. Therefore, if on both sides of the gross national product and expenditure account at constant prices exports have been deflated by the price index of exports, this account must necessarily balance, and no adjustment is required.

Introduction of expression (1) into the account of GNP and GNE could be justified if a more meaningful measure of "real national income" would be obtained in this way. The quotation from Stone's publication has shown that doubts can be expressed with respect to the plausibility of the proposal to deflate exports by the price index of imports. We share these doubts, and, therefore, would not be in favour of introducing expression (1) as an adjustment on both sides of the accounts of GNP and GNE at constant prices. The procedure does not necessarily lead to a more meaningful concept of "real income".

Formula (1) may also be considered as a separate statistical statement. The question then arises: is it a meaningful concept when studying the effects of changes in the terms of trade upon a country's economy? Could an increase in the terms of trade be interpreted as "favourable", a decrease as "unfavourable"?

A number of authors have drawn attention to the fundamental weakness of this approach. It is not generally true that countries experiencing a decline in their terms of trade are worse off than before, or that changes which have led to a decline in the terms of trade have affected the economy adversely.

Changes in terms of trade may have been caused by changes in productivity, by no means an unfavourable factor. Transport costs may have decreased, import duties and export taxes may have been changed. Whether a relative price decline of a country's exports has a favourable or an unfavourable effect on its economy depends on price and income elasticities on markets abroad. A relative price decline accompanied by an increased volume of exports may have favourable effects, for example, if combined with profitable investments in new domestic industries.

There are, of course, may countries where declines in the terms of trade are clearly unfavourable. In other cases improvements may without doubt be favourable. But in these cases formula (1) would not necessarily be a reliable tool of analysis. For instance, an increase in the price of exports may be accompanied by higher installation costs of new domestic investments, increased expenditures on infra-structure, and on services, etc.

Briefly, formula (1) is too simple to be useful in the analysis of what are essentially complicated relationships.

Therefore, we agree with Haberler's conclusion (Haberler, p. 30): "None of the various terms of trade is an index of the gains from trade and, unless a *ceteris paribus* assumption can be made, an "improvement" in any one of the various terms of trade does, by itself, not justify the conclusion that the country concerned is better off."

It follows that short-term fluctuations in the values of G_t cannot easily be interpreted as favourable or unfavourable depending on the algebraic sign of the change.

2. General Comments on Price Indexes of External Trade

It has frequently been pointed out that the concept of "terms of trade" may be meaningful for countries exporting one or two major products (or groups of products) only. In reality the situation is much more complicated. Usually, imports and exports of the developed countries comprise thousands of commodities. Even in developing countries, imports may consist of very large numbers of commodities. Moreover, the structure of external trade, and mainly of imports, tends to change rapidly, as industrial development gets underway and expands. Important shifts may occur in the classification by countries of origin. It follows that index numbers of prices of imports are usually weighted averages of hundreds, and perhaps thousands, of prices of individual goods. This applies particularly to the exports and imports of industrialized countries.

As an example, Table 1 shows indexes of prices of exports and imports of the Netherlands, separately for trade with countries of the European Community, and all other countries.

TABLE 1

Netherlands: Price Indexes of Foreign Trade, 1975 = 100

	1974	1975	1976	1977	1978
Trade with European Community					
Exports	95	100	107	111	109
Imports	94	100	105	108	110
Terms of Trade	101	100	103	103	100
Trade with all other Countries					
Exports	97	100	102	105	101
Imports	99	100	109	111	103
Terms of Trade	98	100	93	94	99
Total Trade					
Exports	95	100	106	109	107
Imports	96	100	106	109	107
Terms of Trade	99	100	100	100	100

Source: Pocket Yearbook, 1979, Netherlands Central Bureau of Statistics 1979, pp. 182–183.

The table reveals that the terms of trade of the Netherlands in the period shown have been favourable for her trade with the countries of the European Community, but unfavourable with the rest of the world, including all developing countries. A more detailed breakdown by countries of origin and destination is not available. But it is clear that the increase in price of crude oil has been a major factor in developments of recent years.

This is confirmed by tables (not reproduced here) which show indexes of prices of exports and imports by major groups of products, for imports, by raw

materials, consumers' goods, capital goods, etc., and for exports by major industries of origin: agriculture, food industries, textile and clothing, oil industry, metal and machinery industries, etc. (Statistical Pocket Year Book, 1978).

Indexes for broad economic categories, and for total exports and imports reflect average price fluctuations among large commodity groups. Obviously, a more thorough analysis would require more detailed information by smaller commodity groups and by countries of origin and destination because prices may vary with these countries.

3. Methods of Compiling Index Numbers of "Unit-Values"

The compilation of index numbers of prices of exports and imports raises serious problems. The method most widely used is based on "unit-values" derived from data on values and quantities of commodity groups that may be considered as homogeneous, at least approximately. In reality, this requirement is hard to fulfill, because nearly all items in external trade statistics represent commodities that vary a great deal in quality specifications, size, brand, accessories, etc. This difficulty is reflected in the terminology used: "unit-values" instead of prices. But this does not make us forget that what should be investigated are fluctuations in prices. This basic requirement eliminates a large number of items from the foreign trade statistics which are too heterogeneous, or too broad, to be used for computing average values per unit, or per ton, etc.

Any rigorous attempt to remove all heterogeneous items from the calculations may end up with a very small number of usable commodity groups. Thus, there are countries where the index of import prices covers not more than 10 percent of total imports. The resulting price index may show fluctuations which are far off the mark if applied to total trade.

Another problem affects the reliability of the calculations of unit-values. The composition of foreign trade, and particularly, of imports, may show changes in structure, caused by a rapid industrial expansion. This applies to many developing countries, but also to developed countries like the Netherlands, where as a consequence of changes in the industrial structure of the country and in demand, rapid changes occur in the composition of imports of raw materials, semi-finished goods, consumers' goods, machinery and equipment, etc.

These rapid changes in the industrial structure imply that indexes of prices of exports and imports cannot be constructed using the Laspeyres index formula with a fixed base period. The weights established for any base year would very quickly become obsolete. Instead of one base year with fixed weights, a chain index with weights varying from year to year must be used. A method which I have described elsewhere (Derksen, 5) and which agrees largely with the method used in the Netherlands, may be summarized as follows:

a. A large number of more or less homogeneous items are chosen from the annual statistics of foreign trade. With respect to their price movements the various commodities selected are considered to be representative of the groups to which they belong. Together these groups cover about 90 percent of total trade.

b. For the year $T+1$ a Laspeyres index is calculated using the year T as the base, with "weights" derived from the trade statistics for year T.

c. For year $T+1$ a Paasche index is calculated, using T as the base period, and "weights" derived from the statistics for year $T+1$. It follows that these computations can be carried out only after the statistics for the entire year $T+1$ have become available; in some countries with a considerable time lag.

d. A geometric average (Fisher's "ideal" formula) is accepted as the final index for the years $T+1$, with year T as the comparison base.

e. In the following year the calculations are carried out in the same way for years $T+2$ and $T+1$. The resulting index is "linked" to the previous one.

f. Problems arise because of changes in qualities, models, measures, weight per unit, and other product specifications, introduction of new products in year $T+1$ and $T+2$, etc. These problems can be solved only on the basis of simplifying assumptions, for instance, supposing that prices of new products, if available before, would have moved parallel to those observed.

Fisher's "ideal" index is too complicated to be used for the compilation of *monthly* indexes of prices of exports and imports. A simpler method is used, which is based on the Laspeyres index formula. Firstly, the number of commodities selected to compute "unit-values" for the monthly indexes is much smaller than for the annual indexes. Secondly, the "weights" are derived from the data of the preceding full calendar year. (The problem of seasonal products will not be considered here.)

After the twelve monthly indexes for year $T+1$ have been calculated and the complete annual statistics for that year have also become available, the new annual indexes for the year $T+1$ will be calculated. They will differ somewhat from the averages of twelve monthly index numbers for $T+1$. Any remaining discrepancy could be eliminated by adjusting the monthly index numbers for $T+1$ as follows:

January plus $\frac{1}{24}$ of the discrepancy

February plus $\frac{3}{24}$ of the discrepancy

etc.

Compared to Laspeyres' index, Fisher's "ideal" index has the disadvantage that it is not additive. There exists no simple relationship between the index for the total exports (or imports) and the Fisher indexes for separate commodity groups. In practice, Laspeyres and Paasche index numbers are computed at different levels of aggregation, and, thereupon, combined into Fisher indexes. It is not necessary to go into technical details, such as the amount of "blowing up" of the weights at different levels of aggregation. For a summary statement on the problems inherent in the construction of the price indexes based on "unit-values" reference is made to a United Nations report (6).

4. Direct Observations of Prices of Exports and Imports

The problems encountered in the compilation of index numbers of prices based on "unit-values" are almost unsurmountable. As in some other countries the Netherlands Central Bureau of Statistics started many years ago upon a programme for the collection of price statistics from firms engaged in exports of

their products, and in imports of raw materials, semi-finished goods and finished goods from abroad. This programme forms a part of a much broader one which also embraces prices of products sold in domestic markets.

In principle, the method consists in the selection of representative commodities, and the preparation of detailed product specifications, in close consultation with experts from the industrial firms concerned, and importers. The ultimate aim of the project is to construct a system of price statistics and index numbers which can be used to deflate all items in the input–output table for the Netherlands (see de Boer and van Tuinen).

The programme covers a very long period, each year a number of industries being approached to solicit their cooperation in the project. Experience has shown that because of rapid changes in quality of products, introduction of new models and new products, at least once every two years the list of products and their specifications must be reviewed in consultation with the experts from the industries concerned.

The method has required the adoption of a uniform Standard Industrial Classification of all Economic Activities, which is closely related to the ISIC, 1968, of U.N., and the classification adopted by the Statistical Office of the European Community.

The commodity classifications must also be uniform. Results obtained so far have been compared with the index numbers of "unit-values". The discrepancies ascertained have been analysed taking into account also differences in the detail of commodity classifications used, in weights, etc. The explanations obtained so far give partial answers only.

5. Reconciliation of Gross National Product and Expenditure at Constant Prices

By definition gross national product equals gross national expenditure. In practice, discrepancies may arise, due to the fact that the statistical methods used to deflate components of GNP and GNE are not consistent in every detail. GNP is the sum of the "values added" of the various branches of economic activity, such as: agriculture, mining, textile and clothing industry, paper and paperware industry, etc. Different methods are used to express "value added" at constant prices: single indicator methods based on available index numbers of production, price indexes to deflate time series of output at current prices, etc. More precise are double indicator methods, which require that both output and input series are expressed at constant prices of a chosen base year. The difference between output and input at constant prices represents value added at constant prices.

In the gross national expenditure account the components of final expenditure, and exports minus imports, are deflated using suitable price indexes. In principle, each group of prices used to deflate an item of value added in the GNP should be identical to the price index of the corresponding commodity group in the GNE account.

In practice this close correspondence is often not realised. For example, value added of the food processing industry may be deflated using a particular method. In this calculation no distinction is made between domestic sales and exports. But

when studying GNE, domestic sales are part of private consumption expenditure, and exports of the food processing industry are part of total exports. Presumably, the first items will be deflated by components of the consumer price index. But exports will be deflated by a chain index based on Fisher's formula, and this differs from the price index implied in the estimate of value added at constant prices. Similarly, the method of deflation applied to inputs in the GNP account, which includes imports, will not be identical to the Fisher index with moving base year used to express imports at constant prices in the GNE account.

The statistical problems involved in expressing net changes in stocks at constant prices present another source of discrepancies between estimates of GNP and GNE at constant prices.

6. Intersectoral Terms of Trade

Bjerke (8 and 9) has published detailed calculations on gains and losses from changes in inter-sectoral terms of trade. His tables are derived from the national accounts of Denmark (1949–65), which show the breakdown of gross domestic product at factor cost by 28 branches of industry, at current and at constant prices. Gains (or losses) of income due to changes in terms of trade of a particular industry are defined as follows:

$$\text{Gain in income} = \frac{X_i}{P} - X_i' \tag{2}$$

where X_i = value added at current prices of industry "i"
X_i' = idem, at constant prices of the chosen base year
P = general price index of final demand, same base year

In our calculations P is a composite index of prices of private consumption expenditure, gross private and public fixed capital formation, and changes in stocks.

Our criticism of the concept of gains or losses from changes in international terms of trade applies equally to formula (2). A rapid increase (decrease) in relative prices is not necessarily favourable (unfavourable), because other factors, such as increases in productivity, growth of total sales and economies of scale, high wage costs per unit of output, technological progress, formation of larger units, also play a role. In the short run, phenomena such as the oil crisis, or a growing over-capacity, may seriously affect developments in a particular branch of economic activity. New discoveries, e.g. of deposits of natural gas, the closing of coal mines, growing competition from third-world countries, are factors which should be taken into account. These and other phenomena vary greatly, and the economic relationships are complex. Formula (2) and fluctuations therein cannot be interpreted simply as favourable or unfavourable, depending on the algebraic sign of the changes.

As observed by Bjerke, "In the industries where there have been moderate price increases there has often been a considerable rise in productivity" (9, p. 343). We have tried to verify this statement using data from the Dutch national accounts and input–output tables. The publications show net value added at factor

cost, at current and at constant prices, employment expressed in man–years, etc. From the ratios of values added at current and at constant prices implicit price indexes can be derived for the various branches of industry.

These calculations should be handled somewhat critically, because an element of spurious correlation may be involved. This may originate in assumptions underlying the estimates of value added at constant prices, or the corresponding component of the index of industrial production. If in the construction of this index data on employment were used combined with an assumed increase in productivity per man–year, then the resulting price index of value added will also reflect this assumption. If this increase in productivity is underestimated, then the resulting implicit price index overestimates the true price index, and the result is not a new finding, but a reformulation of an assumption introduced at the start of the calculations.

A case in point is the general government sector, i.e. public administration and education. Frequently, it is assumed that the total employment in the government sector, excluding public enterprises, is a measure of total output. Hence, it is assumed that there is no increase in productivity, implying a very rapid rise in the implicit price index, which in this case is actually an index of changes in wage and salary scales. For this reason we have excluded the general government sector from Table 2. The same criticism applies to those countries where value added at constant prices in the service industries (wholesale and retail trade, banking and insurance, etc.) is measured using employment figures as indicators of total output.

The annual input–output tables for the Netherlands are based on a classification by 34 branches of economic activity. They are available at current prices since 1948. A programme has been developed to express all time series of inputs and outputs at constant prices. Statistics on the volume of output per man–year are available for a large number of industries since 1958. Because of minor changes in presentation, introduction of new products, and revisions in UN standard classifications the various series are not strictly comparable over time and in every detail. As a rule revisions in national accounts data are applied to the estimates for the two most recent years, which are labelled "provisional". Input–output tables can be compiled only after the detailed basic economic statistics have been compiled. This takes some time, and, therefore, the input–output tables are usually about two years behind. This explains why Table 2 relates to the year 1975.

Table 2, which is limited to the period 1967 (= 100) to 1975, provides some information for broad branches of industry. The general price index of final expenditure is defined as stated on page 347. It equals 178 in 1975 (with 1967 = 100). Table 2 shows that in agriculture and public utilities (electricity and gas) a very moderate price increase is accompanied by a rapid rise in output per man–year. This agrees with Bjerke's findings for Denmark. The figures for the food, beverages and tobacco industry fit in with this picture but this is not true for the other branches listed in the table. If follows that other factors, such as listed on page 347, must have been important.

The groups shown in Table 2 are very broad, and heterogeneous. A more precise presentation would require a breakdown by a large number of subgroups, for instance about 25 to 30 branches of industry.

TABLE 2

NETHERLANDS: INDEX-NUMBERS FOR 1975
Comparison base: 1967 = 100

	Value Added at current factor cost	Value Added at constant factor cost	Implicit price index	Output per person employed
	1	2	3	4
Agriculture and fishing	172	142	121	166
Manufacture of food, beverages and tobacco	211	141	149	150
Textiles, clothing and footwear	129	77	168	158
Manufacture of building materials	179	123	146	130
Paper and paper products	164	123	133	145
Metal products, machinery and equipment	248	147	169	143
Electricity and gas	256	235	109	248

Sources: Cols. 1 and 2: Computed from *National Accounts 1978*, Netherlands Central Bureau of Statistics, 1979, and earlier issues (in Dutch). Col. 4: Statistical Pocket Yearbook 1979, C.B.S., 1979, p. 161 and earlier volumes (in Dutch). Index based on value added at constant prices.

In a paper released by OECD in 1978 (10), the authors examine various formulae that have been developed to deal with the problem of how to measure changes in the terms of trade, and how to define and measure real national income as distinct from GDP at constant prices. They also study the possibility of integrating these measures into a consistent system of national accounts in real terms. To the extent that these formulae are used as devices to measure gains from changes in the terms of trade, they are subject to the same criticisms as raised above, viz. page 342.

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