THE MEASUREMENT OF TERMS OF TRADE EFFECTS

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The change in goods and services available in a national economy brought about by the shifting of external price relationships is referred to as the terms of trade effects. This paper reviews the various methods which have been devised since the war to define and quantify such effects on the Gross National Product. The statistical annex shows that, as far as OECD countries are concerned, the differences between the various measures are not significant. Whereas the effects from terms of trade represented, on average, less than one half of one percent of the GNP of OECD countries during the 1960's the percentage has increased substantially since 1973, due most importantly to the increase in the oil price; by 1977 (on a 1970 price basis), it had reached 5 percent of GNP in Japan and up to 6 percent in Italy. On the other hand, the extreme case of Saudi Arabia where various formulas generate effects amounting to between one half and the whole of GNP, indicates that the measurement of terms of trade effects by various methods may give different results.

INTRODUCTION AND SUMMARY

Since the 1973 oil crisis, economists have been increasingly concerned with the effects of the deterioration of the terms of trade on the available resources of oil importing countries. Changes in relative external prices, particularly in 1974–75 and again in 1979–80, have been sufficiently large to have important effects on these economies. Yet it is possible that in assessing the immediate post-oil crisis situation, the effect of terms of trade changes have not been sufficiently integrated into short-term economic analysis. This may be partly due to the lack of a valid and internationally-accepted statistical measure of terms of trade effects. This article investigates such effects, discusses alternative definitions, and provides evidence on the importance of such differences.

This conceptual problem is not new. In fact, for almost a quarter of a century, economists have tried to define and quantify the effects of changes in the terms of trade[1] on the amount of resources which an economy has at its disposal to satisfy its needs. Over the years, there have been three approaches to this problem:

1. attributing part of the changes in the balance of trade specifically to the change in the relative prices of imports and exports;

2. defining a measure of "real national income" (real GDP measured in terms of purchasing power), in a different way from the normal measure of real GDP, and attributing the difference to the "terms of trade effect;"

3. integrating these measures (real national income, real GDP, effects of terms of trade) into a consistent system of national accounts in real terms. This third approach has been further extended in an attempt to take into account all

[1]Defined as the changes of the ratio of export prices to import prices between some base year and a current year.

the effects of relative price changes, and not only the effects of changes in the terms of trade.

It should be noted that these different approaches did not take place sequentially and that, in the past as well as in the present, efforts in the same three directions are still going on.

It will be shown that all the measures resulting from these approaches, although conceptually different, can be represented in a single fundamental formula:

$$T = \text{effects of terms of trade} = x\left(\frac{px}{p} - 1\right) + m\left(1 - \frac{pm}{p}\right)$$

where x is the export proceeds deflated by their own price deflator (px); m is the import proceeds deflated by their own price deflator (pm); and p is some other general deflator.

The statistical annex will show that all these different concepts generate data which are not significantly different from each other for the OECD Member countries but which may be different for a country such as Saudi Arabia whose GNP and trade are dominated by the output of a single commodity. Even though the alternative measures of T are very similar for OECD countries, the size of T itself is not insignificant so that its measurement on a regular basis should provide useful information for short-term economic analysis and forecasting.

The First Approach

Since export and import flows are directly connected with the prices of exports and imports, one of the first problems tackled was to quantify the change in the terms of trade on the current external balance.

Let, for instance, the balance of trade amount to a surplus in one year and a greater surplus in the next. If prices of exports and imports have not changed between the two periods, the whole change is attributable to a volume change. On the other hand, if the volumes have not changed the whole change can be entirely attributed to price movements (either moving in sympathy or moving differently). If, in this case, the price movement is related only to say, exports, then the change may be said to be due to changes in the terms of trade. In fact, all these movements occur at the same time, quantities and prices moving in all possible directions. Therefore, it has been thought useful to attempt to break up the total changes into components, one of which is attributable to the changes in terms of trade.

In 1956 [1] and 1958 [2], Stuvel tried to solve this problem by showing, in the first place, a way in which the current value V_1 of any commodity flow would be related to its base value V_0 in a multiplicative fashion:

$$\frac{V_1}{V_0} = qnpm$$

where

q = the general level of activity index (usually the GDP volume index)
n = the ratio of the volume index of the flow to the level of activity index; Stuvel called n the pattern of activity index
p = the general price level index (usually the implicit GDP deflator)
m = the ratio of the price index of the flow to the general price level; Stuvel called m the price structure index.

In the case of the export or the import flows, the price structure index was a ratio of either export price or import price to a general price index; it was an attempt to introduce, in the value index, an element due to relative prices. Stuvel tried to go from a multiplicative to an additive analysis, in order to provide the answer to the question of what share each of the components of change had in the total value of the product flow concerned. No unique and valid solution was found but in the approximations built up by Stuvel that part of the trade balance which was called the price structure effect was attributed by him to two factors, one relating export prices to some general price index and another relating import prices to that same general price index. Stuvel called the combination of these two factors the effects of the terms of trade on the trade balance. However, the formulae were extremely complicated and could, according to the author himself, be considered only as some sort of a "compromise solution." Following this method, Stuvel analysed the change in the GDP and expenditure data for the U.K. between 1948 and 1951. Among other things, he found that during that period the changes in the value of imports and exports were due at least as much to pattern or structure changes as to changes in levels. This kind of exercise was apparently not accepted and had no follow up except in Schimmler's [3] recent work.

The Second Approach

Meanwhile, Bowley [4], Geary [5] and even Stuvel [6] himself were arguing in a slightly different fashion; they were asking about the proper way of deflating national accounts aggregates. In the 1930s the emphasis was on the calculation of real national income by deflating the current value series by a general price index (the cost of living index or the wholesale price index, or a combination of both); when national accounts were developed a number of statisticians thought that the same price index should be applied to all items in the accounts in order to adjust for price changes. These adjustments were looked upon as corrections for changes in the purchasing power of money. After the war, however, the majority of national accounts statisticians held another view—they claimed that each product flow should be deflated by its own price index. For the gross domestic product itself (computed as a residual item), as no price index could be obtained by direct measurement, the so-called Geary method was used. This consisted (and still does) of deriving the GDP price index by dividing the total current year value of GDP at current prices by the total deflated current year values of its different components, and of deriving the GDP volume index by dividing the total of the deflated current values of the components of the GDP

by their base year current value at base year prices. The Geary method is consistent with the classical double deflation of value-added by industrial origin, which consists of subtracting intermediate consumption from gross output, each deflated by its own price index. It should be noted that the double deflation method is strictly conventional and may sometimes lead to ambiguous results (a positive value-added in nominal price versus a negative real value-added).

The protagonists of the old school (the purchasing power concept) practically lost their case; for national accounts purposes there was agreement on the use of the so-called Geary method of deflating each component by its own price index. But, and this is the main point, the protagonists' earlier concept was not completely abandoned. It was decided at that time by a number of statisticians that there should still be two categories of main aggregates at constant prices; one would be the now conventional measure of real domestic product at constant prices, showing the extent to which the domestic economy has been expanding, and the other would be a measure of real national income, embodying a purchasing power concept. Both aggregates were computed by deflating each component by its own price index, with the exception of exports which, in the case of real national income, were deflated by the price of imports on the grounds that the purpose of export proceeds is to purchase imports. This difference between real national income and the GDP at constant prices was called the effects of terms of trade on real national income:

Effects from terms of trade = real national income minus real GDP

$$= \frac{X-M}{pm} - (x-m) = \frac{X}{pm} - \frac{X}{px} = T$$

where

X = current exports
M = current imports
x = current exports deflated by its own price index px
m = current imports deflated by its own price index pm.

This formula was accepted internationally and Stuvel, at the OEEC, computed and published in the *National Accounts Year Book* of the time a gross national income at constant prices and a gross national product at constant market prices, together with the difference between them which was called the "effects from terms of trade" [6].

At about the same time Nicholson [7] used a similar formula to define effects from terms of trade. He reasoned more or less as follows: real national income is a measure of the total goods and services which become available for consumption and investment as a result of domestic economic effort and of owning property abroad: thus real national income is more or less synonymous with the purchasing power of nominal national income. The purchasing power of the current export proceeds (income from abroad), in terms of imports, is measured by $x(px/pm)$. The gain in income between the current period and the base period (if $px > pm$) is:

$$T = x\frac{px}{pm} - x$$

i.e. the difference between what the current volume of exports would have purchased (in terms of volume of imports) in the current year as compared to what it would have purchased in the base year. To the objection that his method generated effects of terms of trade on national incomes which were not additive, Nicholson replied that "it is wrong to assume that the adjustments to income in the two-country case should be equal and opposite." He brought in the idea that the effect of changes in the terms of trade on the income of one country had as a counterpart effects on the product of the other country. He added:

> "the other possible adjustment to terms of trade, symmetrical to the one just described, would consist in replacing imports by the value of exports at base year prices, needed to finance the actual level of imports. The result would indicate the level of domestic product needed to meet the current level of national expenditure,
>
> $$\text{i.e.} \quad T = m - m\frac{pm}{px}.$$
>
> It makes sense as economics. For the same goods and services which form part of the domestic and national product of one country form the imports and hence are part of the real income of the other country. These are simply two sides of the same coin."

However, the idea of measuring the "effects from terms of trade" as such was put aside, partly because in 1956 Stone [8] showed that, although for a closed economy one might define real income as equal to real product (as in this particular case what could be done with this income might be assumed to be the same as what had been done to earn it), when the economy is opened, this procedure did not provide a complete solution. This was because:

First, it may be assumed that there is a certain amount of net factor income (and current transfers) from abroad and these non-commodity transactions are not directly decomposable into a quantity element and a price element. If then one deflates this net factor income from abroad by means of an index of import prices, on the grounds that from a national point of view the purpose of such income is to finance a certain amount of imports, then two objections may be raised:

(a) index numbers of import prices refer only to commercial trade; and
(b) net income from abroad could equally well be used to either reduce exports or obtain financial claims on other countries.

Second, apart from the question of the real value of income from investment abroad, there remained the most important question of the real value of imports and exports (commercial trade). Again, it may be said that exports are useful because they finance the purchase of imports. There again one would be inclined to deflate the value of exports by means of the import price index. However, again Stone pointed out that "there is no obvious justification for making this assumption since:

(a) the export surplus is not in fact used to purchase imports at the time at which it arises; and
(b) in the future, it may be used to purchase home-produced goods by means of a reduction in future exports."

Then Stone went on to say "while it seems reasonable to adjust for the terms of trade as above if the value of imports and exports are always in balance and there are no other elements in the balance of payments, it does not appear that this procedure is equally satisfactory in the general case."

Moreover, at the same time, Stone had also shown that it is apparently impossible to find a unique set of deflated values of the non-commodity flows in an accounting system such that the accounts continue to balance in real terms. He indicated that it is possible only in simplified cases to find appropriate deflators for non-commodity flows by combining the deflators of commodity flows with the requirement that each account balances when the entries are expressed in real terms. And, even in these simplified cases, the results may have only arbitrary significance.[2] The results might also be of doubtful significance when, for instance, it might lead to the deflation of net lending abroad by the difference between export and import prices weighted respectively by the value of exports and imports in the base period.

The Third Aproach

In 1967, Geary and Burge [9] and Stuvel [10] found ways which, in their opinion, seemed to meet Stone's objection that "it is impossible to find a unique set of deflated values of the non-commodity transactions in the accounting system such that the accounts continue to balance in real terms." This was achieved mainly by a high degree of consolidation, by ignoring certain items, and by accepting particular definitions of those items, like savings, which are not uniquely deflatable.

Geary and Burge argued as follows. Let a highly consolidated system of five accounts in current prices be:

Production account:

$$Y = P = C + K + X - M$$

Income and outlay accounts:

$$S = Y - C = K + X - M$$

Accumulation account:

$$S = K + N$$

External account:

$$X - M = N$$

where Y is income, P is output, C consumption, K investment, S saving, X and M exports and imports respectively and, for simplicity, net transfers and factor income from abroad have been ignored.

[2]For example, the deflator for saving would be equal to the deflator for capital formation, so that saving at constant prices would be defined in terms of the capital goods it will buy rather than, say, the consumption goods foregone to make this saving possible or the benefits expected to accrue from saving in terms of future consumption.

Arguing that "if the constant price series is conceivable, it should bear a close formal resemblance to the current price series, if only because in the base year the current and constant price systems must be identical," they came up with the following constant price system:

$$p = c + k + x - m$$

$$y = p + T$$

$$x - m + T = n$$

$$c + s = y$$

$$k + n = s.$$

The small letters signify the constant price values of the current price system, $c = C/pc$, $k = K/pk$, etc., where the denominators are the appropriate price indices. Here the constant price system of five equations really consists of four only since any one is redundant. Geary and Burge argued that it did not make economic sense to generate, say, an external deficit at constant prices starting from an external surplus at current prices (or vice versa) purely through differential import and export price trends. Accordingly they did not accept the constant price account, $x - m = n$, because it could involve a negative price deflator $p_n = N/n$ for, say, a surplus N. The view taken was that N should be deflated separately and that T, the "trading gain" should be introduced as a balancing item in the external account:

$$x - m + T = n$$

$$T = n - x + m = \frac{X - M}{p} - \frac{X}{px} + \frac{M}{pm}$$

$$= x\left(\frac{px}{p} - 1\right) + m\left(1 - \frac{pm}{p}\right).$$

Now, having five known variables (c, k, x, m, n) the remaining four unknown variables (p, y, T, s) could be regarded as defined by the four equations. The remaining problem was how to choose a proper deflator. Geary and Burge chose the latter according to the following considerations:

—if $N > 0$, then they argued that N is part of exports, that is, it represents a fraction of exports not utilized to pay for imports; in this case the deflator p should be px;

—if $N < 0$, N is part of imports and the deflator should be pm.

On the other hand Stuvel's argument ran as follows. Let the accounting system be symbolized in nominal terms as:

Production account:

$$Y + M = C + K + X$$

Income and outlay account:

$$C + S = Y + W$$

Accumulation account:

$$S = K + U$$

External account:

$$X + W = M + U$$

where,

Y = factor income
C = consumption
K = capital formation
X = exports
W = net transfers from abroad
S = net saving
U = net lending to abroad
M = imports.

In order to deflate the accounts Stuvel proceeded by:

(a) deflating the production account in the classical way; that is each commodity flow was deflated by its own price index, e.g. $c = C/pc$ where pc denotes the price index of consumption, the units of measurement of the indices being such that their base period values were equal to unity ($p_0^c = 1$); y is determined by the Geary method ($y = c + k + x - m$), so that its price index can be defined as

$$p_y = Y/y.$$

(b) To the extent that all the other items were non-commodity flows Stuvel decided that since such flows have no price indexes of their own, the problem of deflation might be solved by introducing the convention that those non-commodity flows in real terms would reflect changes in their purchasing power. Stuvel thought of various possibilities such as price indices of total expenditure ($C + K$), total output ($C + K + X$) and total product ($C + K + X - M$). He finally chose the latter, that is p_y.

(c) By deflating all items of the national accounts in nominal terms by such a common deflator, a system of accounts reflecting the purchasing power of the flows was generated:

Production account:

$$y' + m' = c' + k' + x'$$

Income and outlay account:

$$c' + s' = y' - w'$$

Accumulation account:

$$s' = k' + u'$$

External account:

$$x' + w' = m' + u'$$

where all the primed symbols denote the current value deflated by a common deflator p_y for all items.

The difference between the two production accounts in real terms:

$$y+m=c+k+x \quad \text{and} \quad y'+m'=c'+k'+x'$$

is due to the difference in deflating procedures. On the one hand, when a common deflator is used for all commodity flows, their current year values are corrected only for changes in the purchasing power of money between the base year and the current year. In the other case when each commodity flow is deflated by its own price index, the current year value of the commodity flow is also corrected for the change in its relative price. Accordingly, Stuvel said that "one might describe the differences between the corresponding entries on the two accounts in real terms as price structure effects." In other words, these price structure effects measure, according to Stuvel, the "real income gains" that result from the change in the relative prices of the commodities purchased. Stuvel thus denoted the so-called price structure effects by double-primed symbols: $y''=y-y'$; $m''=m-m'$; $x''=x-x'$; $c''=c-c'$ and $k''=k-k'$.

(d) By rewriting the above described real terms accounts in terms of the y and y'', m and m'', etc., and by deconsolidating the production account into two separate accounts in real terms (a production account in real terms of the classical type, and what could be called a "price structure effects account"), Stuvel generated a fully articulated system of national accounts in real terms.

Production account:

$$y+m=c+k+x$$

Price structure account:

$$c''+k''=m''-x''$$

Income and outlay account:

$$c+s'=y+c''+t'$$

Accumulation account:

$$k+u'=s'+k''$$

External account:

$$x+w'+m''-x''=m+u'$$

Since y and y' are both deflated by the same price index, $y''=0$.

Let us consider $m''-x''$ and examine what it means more precisely. Consider the current export flow X at current prices; if $px>py$ (py = the general price index), the export growth would generate more money to the exporter if sold on the export market than if sold on the domestic market. The gain for the exporter, due to these relative prices, is

$$\frac{X}{py}-\frac{X}{px}=-(x-x')=-x''.$$

Consider now the current import flow M at current prices. Let $py>pm$. If the importer can purchase the volume of imports on the external market instead of

on the domestic market, the import volume will cost him less. In this case, the importer will have made a relative gain due to the relative prices, equal to

$$\frac{M}{pm} - \frac{M}{py} = m - m' = m''.$$

The combination (in the example above) shows why Stuvel argued that $m'' - x''$ corresponded to the gain in exports and on imports due to relative prices. The formula $m'' - x''$ may be rewritten as:

$$T = m'' - x'' = \frac{X}{py} - \frac{X}{px} + \frac{M}{pm} - \frac{M}{py}$$

$$= x\left(\frac{px}{py} - 1\right) + m\left(1 - \frac{pm}{py}\right).$$

It can readily be seen that, if one chose pm instead of py as the common deflator, one would get back to the old effects from terms of trade as defined in the OEEC National Accounts Yearbook of the early 1950s, namely

$$T = \frac{X}{pm} - \frac{X}{px}.$$

Stuvel finally argued that, with his system, he could clearly distinguish a concept of real product y, and a concept of real income defined as $y' + T$. This latter measure described how well-off the country is in the current year, taking into account the effects of terms of trade between base year and current year. Stuvel concluded "that while real product (y) would seem relevant to the study of production and productivity developments, the real income $y' + T$ would seem a more appropriate concept to use in the study of welfare."

Stuvel's accounts were not generally accepted, perhaps partly because Courbis argued that they generated the "misleading idea" that the gains from terms of trade, $m'' - x''$ were financing $c'' + k''$ (see price structure account above, that is, that they were a transfer of purchasing power from the rest of the world to the country). Courbis [11] proved that Stuvel's deflator, py, did not automatically generate such a result. He and later Kurabayashi [12] chose a deflator which, in their opinion, not only had such a characteristic but also had the advantage of being linked with the purchasing power of the national currency on the international market. This deflator, a linear combination of px and pm, was specifically defined as:

$$p = apx + (1 - a)pm = \frac{X + M}{x + m}$$

with

$$a = \frac{x}{x + m}.$$

The Courbis/Kurabayashi formula can be written as follows:

$$T = \frac{M}{X + M} \cdot x\left(\frac{px}{pm} - 1\right) - \frac{X}{X + M} \cdot m\left(\frac{pm}{px} - 1\right).$$

The effects from terms of trade can clearly be interpreted as a weighted arithmetic average (with exports and imports as weights) of the effects imputable to exports, $x[(px/pm)-1]$, plus the effects imputable to imports, $-m[(pm/px)-1]$. It should also be noted that in 1959, Geary [13], in trying to solve an objection to the external surplus deflation advocated by Burge and himself, had already proposed a deflator comparable to the Courbis deflator:

$$p = \tfrac{1}{2}(px + pm)$$

corresponding to $a = \frac{1}{2}$ in Courbis' formulation. The objection was that in the case of two countries trading with the rest of the world, but not with each other, the effects from the terms of trade (calculated by the Geary and Burge method) lead to a trading gain for the amalgamation of the two countries unequal to the sum of the trading gain for the two countries computed separately.

Present Proposals

The situation today is still ambiguous. For instance, whereas it seems that the Norwegian statistical authorities have chosen the old Stuvel deflator; Godley and Cripps [14] on the other hand proposed in 1974 a very similar one:

$$p = \frac{C+K+X-M}{c+k+x-m} \qquad \text{computed at factor cost.}$$

It may finally be of interest to examine what is the position of the SNA [15] in these matters.

In Chapter IV, which deals with "the system as a basis for quantity and price comparisons," the SNA, while never specifically mentioning "effects of terms of trade" reasons as follows:

> "... in principle, though the practical difficulties are in some cases formidable, all flows in the commodity accounts and most, if not all, flows in the activity accounts can be decomposed into a price component and a quantity component ... but elsewhere, in the system this is not the case. Consider, for example, the net disposable income of households which is either spent on consumption goods and services or is saved. In the first place, a significant part of this income is likely to be received in the form of transfers from government and this part can hardly be decomposed into a price and a quantity component. In the second place, while some other forms of household income, such as wages, could be decomposed into an average rate of earnings and an amount of labour supplied, this would not be what is needed because the concept of income at constant prices, or real income as it is usually called, relates to what can be done with income rather than with what has been done to earn it. Difficulties similar to those just described are encountered with other elements of the disposable income of households and so the idea of decomposition into price and quantity components is not relevant in this case. Instead, it is necessary to consider how the purchasing

TABLE 1

THE VARIOUS DEFLATORS (p) CHOSEN BY DIFFERENT AUTHORS

	Surplus	Deficit
Geary 1, Nicholson, Stuvel (OEEC), and SNA 1	pm	pm
Geary and Burge	px	pm
Geary 2	$\frac{1}{2}(px+pm)$	$\frac{1}{2}(px+pm)$
Stuvel, Norway	$ps=\frac{C+K+X-M}{c+k+x-m}$ at market prices	
SNA 2	$pn=\frac{C+K}{c+k}$	
Courbis and Kurabayashi	$pc=\frac{X+M}{x+m}$	
Godley and Cripps	$pg=\frac{C+I+X-M}{c+k+x-m}$ at factor cost	

power of disposable income has changed over some well-defined collection of items on which it might be spent. This question admits of as many answers as there are collections of items which are deemed relevant. For most purposes it is generally agreed that the collection of goods and services which enter into household consumption expenditures provides a suitable unit in which to measure changes in real disposable income. These two approaches, decomposition into price and quantity components and selection of a relevant collection of items in terms of which purchasing power can be measured, are radically different and should not be confused with one another. In a sense, both approaches are dependent on the first; it is possible to define various units of purchasing power only because it is possible to decompose certain value totals into price and quantity components."

The SNA then shows, as Stone had done before, that the two approaches cannot be united by defining a unique set of units in terms of which to express the purchasing power of every value total that cannot be decomposed:

"... In spite of this it is generally considered important to give numerical expression to such aggregates as the gross national product at constant prices. There are two solutions to this problem in common use. The first is based on the assumption that the purpose of exports and net distributed factor income from abroad is to buy imports, and so these items are deflated by the price index number for imports. As a consequence, the price deflator for the gross national product is obtained by deflating the components of final expenditure in the domestic market by price index numbers of private and public consumption expenditures and of gross capital formation and by deflating the excess of exports and distributed factor income from abroad

over imports by the price index number of imports. This is a clear assumption despite the fact that a balance of payments surplus is not used to buy imports at the time when it arises and may not be so used in the future; instead, it may be used either to reduce exports or to accumulate claims on the rest of the world and so increase factor income. The second solution is to deflate the gross national product by a price index number of current and capital final expenditure in the domestic market. The two methods will give different results only if the balance of payments is different from zero and then only if the price index number for imports differs from the price index numbers of final purchases in the domestic market."

It follows that the SNA proposes two measures of the gross national product at constant prices (computed according to a purchasing power concept):

$$y = c + k + \left(\frac{X - M}{p}\right) \quad \text{where } p = pm$$

$$y = c + k + \left(\frac{X - M}{p}\right) \quad \text{where } p = \frac{C + K}{c + k}.$$

If one defines the "effects from terms of trade" as the difference between the above formulae for real income and the classical formula for the real product: $P = c + k + x - m$, one obtains again the previous formula for T, namely

$$T = x\left(\frac{px}{p} - 1\right) + m\left(1 - \frac{pm}{p}\right).$$

Thus, the difference between real income and real product, the effects from terms of trade, may be interpreted as the gain (loss) of a country's real income

TABLE 2

TERMS OF TRADE EFFECTS GENERATED BY VARIOUS DEFLATORS

$$T = x\left(\frac{px}{p} - 1\right) + m\left(1 - \frac{pm}{p}\right)$$

Geary 1, Nicholson, Stuvel (OEEC), and SNA 1	$x\left(\frac{px}{pm} - 1\right)$
Geary and Burge	$m\left(\frac{px}{pm} - 1\right)$ for a surplus, $x\left(1 - \frac{pm}{px}\right)$ for a deficit
Geary 2	$x\left(\frac{px - pm}{px + pm}\right) + m\left(\frac{px - pm}{px + pm}\right)$
Courbis/Kurabayashi	$\frac{Mx}{X + M}\left[\frac{px}{pm} - 1\right] - \frac{Xm}{X + M}\left[\frac{pm}{px} - 1\right]$
Stuvel, Godley and Cripps, SNA 2	$x\left(\frac{px}{p^*} - 1\right) + m\left(1 - \frac{pm}{p^*}\right)$

*The respective chosen deflators (see Table 1).

due to an increase (decrease) of the relative price of its external resources (exports) plus the gain (loss) of that country's real income due to the decrease (increase) of the relative price of its external expenditure (imports).

Can One Make a Proper Choice?

In the present state of the art, which formula might be recommended? It seems clear from the discussion above that is difficult to put an end to the 25-year-old debate on this matter. It also seems clear that both measures of real national income and measures of the effects of terms of trade on real national income can only be conventional.

In these circumstances, one solution is to make a choice using more practical criteria. The following criteria have been proposed:

(a) the effects should be nil when export and import prices are equal;
(b) the effects should be symmetrical in the two-country case: if one considers two countries trading exclusively with each other, the effects from changes in terms of trade of country one vis-à-vis country two should be the opposite of the effects from changes in the terms of trade of country two vis-à-vis country one;
(c) the measure should be capable of meaningful economic interpretation;
(d) the measure should be based on statistics which are presently available in a standardized form for most countries.

The various measures have been classified in Table 3 according to the above criteria.

Table 3
Assessment of Formulae on Different Criteria

	(a)	(b)	(c)	(d)
Geary 1, Nicholson	**		*	**
Geary and Burge	**	*	*	**
Stuvel			*	**
Godley and Cripps			*	**
Geary 2	**	*	*	**
Courbis, Kurabayashi	**	*	*	**
SNA 2	**		*	**

** Verified criteria.
* Approximately verified criteria.
See text for details of the four criteria.

Criterion (a) eliminates all formulae not based on *px* and/or *pm*. When countries have systematically regular net imports (for instance) the Stuvel and Godley/Cripps methods have a justification because for these countries it is a real gain when external prices increase more slowly than internal prices, even if there is no difference between the export price and the import price indices. On the other hand as there are more countries where the sign of the balance of trade is incidental, when one considers Table 3, only three acceptable methods

emerge: Geary and Burge, Geary 2 and Courbis/Kurabayashi. Looking first at the Geary and Burge formula, one notes that, besides the terms of trade themselves, the formula relies uniquely on either the volume of exports or the volume of imports (according to the sign of the trade balance); it thus ignores the supplementary gains that may be realised by exporting more (if there was already an external trade surplus) or by importing less (if there was already an external trade deficit). The Geary 2 and the Courbis/Kurabayashi formulae both use a weighted average of export and import prices as their general price deflator. However, the Courbis/Kurabayashi formula is conceptually more interesting since it explicitly takes into account the relative importance of exports and imports for measuring the change in the international purchasing power of the national currency:

$$p = \frac{X+M}{x+m} = \frac{x}{x+m}px + \frac{m}{x+m}pm.$$

The Geary 2 formula makes no such distinction. In practice, as long as px/pm is relatively close to unity, the Geary 2 formula is a good enough approximation of the Courbis formula and may be recommended, if only for its simplicity. But the Courbis/Kurabayashi formula is preferable, not only because of its richer economic significance but because, as both authors have shown, it can be transposed to the analysis of the implicit transfers that take place between any two groups of economic units (including within the domestic economy) because of price distortion over time.

Finally, it must be emphasized that the terms of trade effects are calculated with respect to a specific base year. The levels as well as the signs of the effects would differ if another base year were used. Also, as Richardson has indicated [16], different external trade price concepts (Laspeyres, Paasche) as well as different measures (unit value, price) may generate very different price indices. And as Angermann has shown [17], different categories of price indices for exports and imports (Paasche, Laspeyres, unit values) may produce greater differences on the effects from terms of trade than the alternative general deflators. This means that the economic interpretation of the effects from terms of trade has to be done with caution.

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Statistical Annex

The statistical annex reports the size of terms of trade effects for a variety of countries using a selection of the different formulae described in the main text. Table 1 of the annex shows that, as far as the OECD countries are concerned, the differences between the various measures are not significant. For such a group of countries one might therefore also consider the Geary 1–Nicholson method, which is simple, has a clear—although questionable—economic interpretation, and is the only one to have actually been used at the international level. Table 2, using the Geary 1 method, shows the effects of the terms of trade when net factor incomes and transfers from abroad are included; these results can be compared directly with those shown in line 1 of the first table. Table 3 indicates that, whereas the effects from terms of trade represented, on average, less than one half of one percent of the GDP of OECD countries during the 1960s, this percentage has increased substantially since 1973, due most importantly to the increase in the oil price, and by 1977 had reached 5 percent of GNP in Japan and up to 6 percent in Italy (on a 1970 price basis).

On the other hand, Table 4 indicates that for a country like Saudi Arabia, the choice of formula does make a difference. Whereas the Geary 1 formula generates, as from 1974, a gain from the terms of trade larger than the whole of GDP, the Geary 2 formula produces a gain only about half the size. Saudi Arabia is thus the extreme case which proves that the measurement of terms of trade effects by various methods can give significantly different results.

In order to find out which countries are responsible for the gains (or losses) of terms of trade, Angermann [17] attempted to disaggregate the effects by groups of countries, for Germany. Table 5 indicates that the large losses which began to occur from 1974 onwards were practically entirely due to the large rise in oil producing countries' prices.

It is also a fact that large changes in relative prices, say between imports and the domestic economy, may generate strange results with the classical macro-economic measures. For instance, it must be stressed that an increase in the GDP implicit price deflator is not an adequate indicator of inflation, to the extent that it can differ widely from the rise in the domestic price level, just

because of a relatively big rise in import prices. Again, the change in the classical measure of GDP in constant prices would not be a good measure of the change in the real national income. For example, Table 6 indicates that in 1974 the GDP implicit price deflator grossly underestimated the domestic rate of inflation (represented by the implicit price of final sales) in a selection of OECD countries. Finally, Table 7 indicates the extent to which changes in real GDP do not always move in sympathy with changes in real income.

ANNEX TABLE 1

TERMS OF TRADE EFFECTS

1970 prices

		1970	1971	1972	1973	1974	1975	1976	1977
Canada	Geary 1	—	−0.3	−0.1	1.2	3.4	2.3	3.0	1.9
bn Can $	Geary and Burge	—	−0.3	−0.1	1.1	3.4	2.3	3.0	1.9
	Geary 2	—	−0.3	−0.1	1.2	3.4	2.4	3.0	1.9
	Courbis	—	−0.3	−0.1	1.2	3.3	2.5	3.0	1.9
	Stuvel	—	−0.4	−0.2	1.2	3.3	2.3	3.0	1.9
	GDP	86.5	92.5	97.9	105.3	109.0	110.3	117.7	120.1
United States	Geary 1	—	−0.8	−3.4	−5.7	−16.4	−15.9	−15.3	−18.2
bn US $	Geary and Burge	—	−0.8	−3.4	−5.7	−16.4	−14.4	−15.3	−18.2
	Geary 2	—	−0.8	−3.5	−5.7	−16.7	−15.2	−15.6	−19.7
	Courbis	—	−0.8	−3.5	−5.7	−16.8	−15.1	−15.6	−19.8
	Stuvel	—	−0.8	−3.6	−5.6	−19.9	−12.8	−16.8	−24.7
	GDP	981	1,010	1,068	1,126	1,111	1,100	1,161	1,216
Japan	Geary 1	—	0.1	0.3	−0.6	−2.9	−3.8	−5.2	−5.8
(000) bn Yen	Geary and Burge	—	0.1	0.2	−0.6	−2.9	−3.8	−4.9	−5.1
	Geary 2	—	0.1	0.3	−0.6	−2.9	−3.8	−5.1	−5.5
	Courbis	—	0.1	0.3	−0.6	−2.9	−3.8	−5.0	−5.4
	Stuvel	—	—	—	−0.6	−3.0	−3.8	−5.1	−5.7
	GDP	73.7	77.4	84.7	93.1	92.8	94.0	100.1	105.5

France	Geary 1	—	1.5	5.7	7.4	−19.8	−11.1	−13.4	−15.3
bn Fr	Geary and Burge	—	1.4	5.4	7.2	−19.9	−10.7	−13.4	−15.3
	Geary 2	—	1.4	5.5	7.3	−20.4	−10.9	−13.8	−15.4
	Courbis	—	1.4	5.5	7.3	−20.4	−10.9	−13.8	−15.4
	Stuvel	—	1.3	4.8	6.8	−21.7	−11.0	−11.0	−15.4
	GDP	783	824	874	920	950	953	997	1,028
Germany	Geary 1	—	4.1	6.9	0.1	−10.6	−2.0	−6.0	−7.4
bn DM	Geary and Burge	—	3.7	6.2	0.1	−8.8	−1.8	−5.4	−6.7
	Geary 2	—	3.9	6.6	0.1	−9.7	−1.8	−5.7	−7.1
	Courbis	—	3.9	6.6	0.1	−9.6	−1.8	−5.7	−7.0
	Stuvel	—	3.2	5.1	−1.9	−9.1	−2.2	−6.0	−7.7
	GDP	679	701	726	762	766	750	788	814
Italy	Geary 1	—	−0.1	−0.3	−1.4	−3.4	−2.9	−5.8	−4.0
(000) bn Lire	Geary and Burge	—	−0.1	−0.3	−1.4	−3.4	−2.9	−3.8	−3.8
	Geary 2	—	−0.1	−0.3	−1.5	−3.7	−2.9	−4.0	−3.9
	Courbis	—	−0.1	−0.3	−1.5	−3.7	−2.9	−4.0	−3.9
	Stuvel	—	−0.1	−0.3	−1.6	−4.4	−2.9	−4.1	3.8
	GDP	57.9	58.8	60.7	64.9	67.7	65.3	69.1	70.2
United Kingdom	Geary 1	—	0.1	0.2	−1.0	−2.7	−2.0	−2.4	−2.4
bn £	Geary and Burge	—	0.1	0.2	−1.0	−2.7	−2.0	−2.4	−2.4
	Geary 2	—	0.1	0.2	−1.1	−2.9	−2.1	−2.4	−2.4
	Courbis	—	0.1	0.2	−1.1	−3.0	−2.1	−2.4	−2.4
	Stuvel	—	0.1	0.2	−1.1	−3.4	−2.1	−2.5	−2.3
	GDP	50.8	52.1	53.3	57.5	56.5	55.5	57.5	58.1

Source: *National Accounts of OECD countries*, 1977, Volume 1.

ANNEX TABLE 2

TERMS OF TRADE EFFECTS INCLUDING NET FACTOR INCOME AND TRANSFERS FROM ABROAD

	1970	1971	1972	1973	1974	1975	1976	1977
Canada (bn $ Can)	—	−0.3	−0.1	1.3	3.6	2.4	3.2	2.0
United States (bn $ US)	—	−0.9	−3.9	−6.7	−19.3	−18.1	−18.2	−21.4
Japan (000 bn Yen)	—	−0.1	−0.3	−0.7	−3.0	4.1	−5.5	−6.1
France (bn Fr)	—	1.7	6.6	8.6	−22.9	−13.0	−15.8	−17.8
Germany (bn DM)	—	4.5	7.6	0.1	−11.4	−2.1	−6.5	−8.1
Italy (000 bn Lire)	—	−0.1	−0.3	−1.7	−3.8	−3.2	−4.2	−4.3
United Kingdom (bn £)	—	0.1	0.2	−1.2	−3.9	−2.3	−2.7	−2.7

ANNEX TABLE 3

EFFECTS OF TERMS OF TRADE AS A PERCENTAGE OF GDP, USING GEARY 2 METHOD

	1960	1965	1971	1972	1973	1974	1975	1976	1977
Canada	0.2	—	−0.3	−0.1	1.2	3.1	2.1	2.6	1.6
United States	−0.2	−0.1	−0.1	−0.3	−0.5	−1.5	−1.4	−1.4	−1.6
Japan	−0.3	−0.2	0.1	0.3	−0.7	−3.2	−4.0	−5.1	−5.2
France	−0.2	0.2	0.2	0.6	0.8	−2.2	−1.1	−1.4	−1.5
Germany	−1.3	−0.9	0.6	0.9	—	−1.3	−0.2	−0.7	−0.8
Italy	−0.6	−0.3	−0.2	−0.4	−2.3	−5.4	−4.5	−5.7	−5.6
United Kingdom	−0.4	−0.2	0.4	0.4	−1.9	−5.2	−3.7	−4.3	−4.2

Note: A negative (positive) sign for the effect of changes in the terms of trade for years prior to 1970, the base year, indicates an improvement (deterioration) in the terms of trade between the year concerned and 1970, whereas a negative (positive) sign for years after 1970 indicates a deterioration (improvement).

ANNEX TABLE 4

SAUDI ARABIA[a]; GAINS FROM TERMS OF TRADE WITH RESPECT TO 1970

Millions of riyals of 1970

	1970	1971	1972	1973	1974	1975	1976
GDP[b]	17,399	19,907	22,963	24,163	31,543	32,561	35,297
T1[c]	—	667	1,581	3,044	18,136	18,989	23,263
T1/GDP	—	0.03	0.07	0.13	0.57	0.58	0.66
T2[d]	—	713	1,910	3,734	32,679	43,991	39,056
T2/GDP	—	0.04	0.08	0.15	1.04	1.35	1.11
T1 in million $	—	154	381	791	5,109	5,364	6,571

[a]Financial years beginning 1st July of preceding year.
[b]At market prices.
[c]Geary 2 formula.
[d]Geary 1 formula.

Note: Saudi Arabia's national accounts are published in current prices. Although total GDP at constant prices is available, none of its components are officially computed. To estimate the terms of trade, the Secretariat has used for *px* the Saudi Arabia export price indices for crude petroleum as they are published in *International Financial Statistics*; for *pm*, the Secretariat has used the unit value indices of OECD exports to OPEC (computed by the Balance of Payments Division of OECD) after having checked from OECD trade statistics (series B and C) that the structure of Saudi Arabia main imports by commodity is practically identical to the corresponding import structure of the OPEC countries taken as a whole.

ANNEX TABLE 5

TERMS OF TRADE EFFECTS OF THE FEDERAL REPUBLIC OF GERMANY BY GROUPS OF COUNTRIES[a]

1970 prices—Billion DM

Year	Total	EEC countries	Other OECD countries	Oil exporting countries	COMECON countries	Other countries
1971	3.0	1.5	1.5	−1.3	0.0	1.4
1972	6.5	2.5	2.8	−0.8	0.4	1.6
1973	1.1	0.7	1.9	−1.8	0.0	0.3
1974	−9.7	1.2	0.9	−11.5	−0.8	0.6
1975	−1.8	2.2	2.6	9.0	−0.5	3.0
1976	−6.6	0.4	2.8	−10.8	−1.0	2.0
1977	−6.1	0.9	3.5	−10.0	−1.0	0.3

[a]Calculation based on Paasche price indices and according to Geary 2 formula.
Source: O. Angermann [17].

ANNEX TABLE 6

ANNUAL PERCENTAGE CHANGE OF GDP IMPLICIT PRICE DEFLATOR MINUS YEAR-TO-YEAR PERCENTAGE CHANGE OF FINAL SALES IMPLICIT PRICE DEFLATOR DUE TO THE CHANGE IN THE TERMS OF TRADE

	1971	1972	1973	1974	1975	1976	1977
Canada	0.2	0.4	0.4	−0.8	−0.8	1.6	−1.0
United States	—	−0.2	−0.7	−2.3	0.3	−0.2	−0.4
Japan	0.4	0.8	−0.4	−3.7	0.3	0.3	1.1
France	0.3	1.2	0.3	−4.8	2.5	0.2	−0.4
Germany	1.1	0.8	−0.6	−2.4	1.2	−0.3	0.3
Italy	0.3	0.4	−2.4	−6.8	2.7	−1.7	0.3
United Kingdom	1.0	+1.0	−3.0	−5.9	3.5	−1.5	−0.3

ANNEX TABLE 7

REAL INCOME (Y) VERSUS REAL GDP (P)

1970 prices—Annual percentage changes

		1971	1972	1973	1974	1975	1976	1977
Canada	Y	6.6	6.0	8.9	5.6	0.3	6.3	1.8
	P	7.0	5.8	7.5	3.5	1.2	5.8	2.9
United States	Y	2.8	5.5	5.2	−2.3	−0.8	5.6	4.5
	P	2.9	5.8	5.4	−1.3	−1.0	5.5	4.8
Japan	Y	5.2	9.5	8.9	−2.9	0.4	5.3	5.2
	P	5.2	9.3	10.0	−0.3	1.4	6.5	5.4
France	Y	5.6	6.4	5.5	+0.2	1.4	4.4	3.0
	P	5.4	5.9	5.4	3.2	0.3	4.6	3.1
Germany	Y	3.8	4.0	4.0	−0.8	−1.1	5.0	2.6
	P	3.2	3.7	4.9	0.5	−2.1	5.6	2.8
Italy	Y	1.4	2.9	4.9	1.0	−2.5	4.4	1.8
	P	1.6	3.2	6.9	4.2	−3.5	5.7	1.7
United Kingdom	Y	2.8	2.4	5.5	−5.1	−0.3	3.0	1.3
	P	2.6	2.3	7.9	−1.8	−1.7	3.6	1.2

Note: Real income defined as real GDP plus terms of trade effect (Geary 2 method).