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PROBLEMS OF ADAPTING EXTERNAL TRADE STATISTICS
FOR SPECIAL TYPES OF ECONOMIC ANALYSIS

(Memorandum by the Secretary-General)

1.   It is the purpose of this paper to enquire how external trade statistics
can be adapted to the requirements of modern economic analysis. The useful-
ness of international trade statistics for economic analysis is at present
limited by the fact that value data are universally presented in gross terms.
They do not therefore provide information that is correlative with aggregates
based on the concept of value added such as the gross national product or the
national income; nor do they reveal the economic sector of origin or destina-
tion of flows of trade between countries. The latter aspect has become
increasingly significant with the development of proposals for customs unions
and preferential trade agreements for which information is invariably required
as to the economic origin and destination of goods traded. For such purposes
the traditional practice of attributing the total value of imported commo-
dities to the last country in which they were transformed or sold is inadequate.
The same may be said of the practice of attributing exports to the last indus-
try in which they were processed. The paper contains, _inter alia_, the mate-
rial whose preparation was suggested by the Commission at its ninth session
on the question of adapting national index numbers of quantum and unit value
to the needs of economic analysis (E/2876, para. 41). All but one of the
adaptations here envisaged require no change from present methods of compiling
basic external trade statistics, and the remaining adaptation is designed to
take advantage of the additional information which will, in any case, have
to be collected by the customs authorities in the administration of a customs
union or free market.

I. ADAPTATION OF DATA ON CURRENT VALUE

2.   Traditional methods of classification in international trade are not
capable of yielding the type of information on the national origin of imports
required to study the effects of bilateral and multilateral trade agreements

or of yielding the information on industrial use of imports and industrial origin of exports required by recent developments in economic analysis. The analysis of aggregate import and export values has traditionally been based on a scheme such as the Standard International Trade Classification (SITC) which assigns to each article entering external trade a place according to its kind rather than according to the countries or economic sectors which contributed to its value. Thus it has been possible, by adding the values of all the articles classified as "food", to determine the total value of the food exports of a given country in a given period but it has not been possible to say how much of the value of exports is attributable to domestic production and how much to imported value or, in the value contributed by domestic production, to distinguish the shares of agriculture, mining, manufacturing, transportation or distribution. Nor is it possible to distinguish, by means of commodity classification, the part of import value obtained through third countries or to divide import value into the part destined to be consumed directly by households from the part destined for capital formation. Demand for sector analyses of external trade is growing; in the industrialised countries they are necessary inter alia for a proper understanding of the effects on the economy of the trade balance; there is reason to suppose that primary-producing countries can most usefully begin the statistical study of their economies through a sector analysis of their external trade which is the main area for which data are available. For instance imports may contribute to: (a) consumption, (b) capital formation or (c) exports and, in (a) or (c), may (i) be directly consumed or exported, or may (ii) contribute value to home produced goods destined for consumption or for export. The various uses of imports play such different roles in an economy that an importing country which wishes to improve its balance of payments by restricting imports would be materially helped in its planning by the ability to distinguish the sectors of destination in its aggregate imports. Demands for analytic tools of this sort have impinged on the Statistical Office in the form of persistent requests for subsidiary classifications of the SITC embodying the analyses desired and it is hoped that the detailed suggestions made below may contribute to the satisfaction of these needs. [1]

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[1] It will be explained that the methods suggested provide not only analyses of value at current prices but also of value at constant prices and of the effects of changes in the terms of trade.

3.   This paper takes the position that subsidiary classifications of commodity nomenclatures (e.g. the SITC) are not a suitable basis for sector analyses of external trade because:

    (a)   the value of most individual articles of commerce includes substantial contributions from each of a number of sectors of the economy of the exporting country;

    (b)   many important articles of commerce are used after importation in a number of economic sectors (e.g. flour is used in households as a consumer good, in commercial bakeries as a producer's good).

What is more, the distribution of value among sectors will vary between countries for the same article; this is particularly true of the distribution by sector of consumption. Therefore international recommendations cannot, in this area, go beyond the suggestion of methods by which each country can itself produce the analyses it requires. Paragraph 6 below shows that the methods which yield sector analyses will also solve the problem, which is of importance to members of customs unions and free market areas, of determining the value added to imports in intermediate countries.

4.   For each detailed commodity heading of its export statistics it will be possible for a country without too much difficulty to estimate the percentage of total f.o.b. value contributed on the average by each economic sector. For headings of minor importance, the allocation of percentages can be very rough; for headings of greater importance more research may be necessary. Industrial censuses which have been taken in the country and input-output tables where they exist will, of course, be of material assistance in making the estimates. Similarly for each commodity heading of the import statistics percentages of c.i.f. value consumed by the various economic sectors can be estimated. Once a system of allocations of value among economic sectors has been set up, it will have to be kept under surveillance by a qualified economic statistician who will, perhaps through sampling methods, determine whether the allocations remain valid over time and, where they do not, will adjust them.

5.   Annex I to this paper describes how an (n-1)-digit numerical code will then serve to estimate the distribution of value aggregates among n economic sectors. The result of each allocation described in paragraph 4 can in fact be expressed as a correspondence between the numerical code basic to the

external trade nomenclature and the (n-1)-digit code. Where trade statistics are compiled by means of punched cards this correspondence can be used to enter mechanically the (n-1)-digit code into the summary trade-by-commodity cards and, as explained in Annex I, it is then very easy to produce mechanically the sector analyses of the external trade statistics.

6.   In administering a customs union or free trade area it is often necessary for the customs authorities of a country in the union or area to be able to identify the national origin of articles declared for importation. In case value has been added to the article in more than one country it becomes administratively important to know what percentage of total value was added in the country from which the goods were first consigned to the importing country and this information is usually contained in a consular affidavit accompanying the import declaration. It is also important for policy-making in the importing country to know what part of import value is being received in this way through intermediary countries and to be able to analyse that part by commodities and countries. The general method here being described makes the provision of these data possible by means of an additional 1-digit code in the card punched for each import consignment whose national origin is not unique. The detailed procedure is outlined in Annex I.

7.   The studies of alternate transportation routes undertaken by governments and international agencies at the time of the closing of the Suez Canal and of certain oil pipe-lines threw into sharp relief the lack of readily available statistical data on the loading characteristics of the goods moving in international trade on various routes. External trade statistics contain essentially all the data required for a study of international transport. At present, however, they are not organised in a way that makes them accessible for the purpose. A 1-digit code would, however, suffice to provide a rather detailed analysis of goods according to their loading characteristics and this code can be associated with the commodity nomenclature used in external trade statistics. Whenever desired the new code can be inserted mechanically into the summary trade statistics cards, and tabulations useful for transport studies can then be based upon it. The tabulations will, inter alia, make possible the study of the utilisation of shipping tonnage, and, when taken together with data on current ocean freight rates, facilitate the estimation of the freight charges

on imports used by each sector of the economy of the importing country. The
suggestions are explained in more detail in paras. 7-9 of Annex I.

II. ADAPTATION OF INDEX NUMBERS

8.   The analyses by sectors of the current value imported or exported of each
commodity, when taken together with the corresponding quantity data, make
possible parallel analyses of value at constant prices. New index numbers of
economic interest can then be constructed analysing by sectors the traditional
quantum and unit value indices. Some examples are listed below and described
in more detail in Annex II.

    (a.) Quantum index for the share contributed by a given sector
         (e.g. agriculture) to the value of exports.

    (b) Index showing the average change in the value contributed
        by a given sector to a unit quantity of exports.

    (c) Unit value index for the share contributed by a given sector
        to the value of exports.

    (a') Quantum index for the share used by a given sector (e.g. transpor-
         tation) of the value of imports.

    (b') Index showing the average change in the value used by a given
         sector of a unit quantity of imports.

    (c') Unit value index for the share used by a given sector of
         the value of imports.

    (d) Index showing the average change in the value contributed
        by intermediate countries to a unit quantity of imports via
        intermediate countries.

    (e) Quantum index for imports via intermediate countries.

9.   Much interest has recently been shown in the adjustment of figures for
production at current value to a constant value basis taking into account
changes in the terms of trade. Emphasis has recently been given to determining
the particular index number formulas best suited to these purposes, but the
question of matching the coverage of the index used to the coverage of the aggre-
gate to be adjusted has been largely neglected even though the effect on the
final result of discrepancies in coverage is likely to be much more serious
than the effects of difference of formula. The adjustment for changes in terms
of trade sometimes used in order to balance national accounts at constant

prices is often merely a correction required by imperfect coverage of the deflators originally applied to data at current prices. One of the purposes of the sector analysis here described is to provide deflators whose coverage corresponds to that of the figures to be deflated.

10. On the basis of a paper then before it (E/CN.3/200) the Commission at its ninth session took note that in certain cases, particularly for the exports of primary-producing countries, the choice of the index number formula might seriously affect the result of using the index and asked the Secretary-General to present a further report on the matter (E/2876, para. 41). Since the ninth session of the Commission, the Secretariat has carried on the study of the method, which it had briefly described in document E/CN.3/200, for rapidly adjusting an index by one formula adequately to approximate that by another. The Secretariat has continued, with good results, to use its method, in connexion with its quarterly summary indices of quantum and unit value for exports of selected regions of the world, in examining the suitability of national indices calculated according to a variety of formulas for revaluing the exports of the country in question at prices of 1948 for the years 1937, 1938, 1949-1950 and at prices of 1953 for the period 1950 to date. Where investigation revealed that a national index was inadequate for these purposes the index was adjusted (using the quick method of E/CN.3/200) before being incorporated in the Statistical Office summary indices. On the basis of the additional experience thus acquired, the Secretariat has begun, as opportunity offered, to draw its method to the attention of governments and specialized agencies. The technique is, of course, applicable to the new indices described earlier in this paper, as well as to the traditional indices of quantum and unit value.

III. CONCLUSIONS

11. The Commission may wish to request the Secretary-General to draw to the attention of governments the suggestions contained in this paper for obtaining sector analyses of external trade and to report to the Commission the views of governments on the interest of the results to be obtained and the practicability of the methods suggested for obtaining them.

12. The Commission may further wish the Secretary-General to continue his efforts to interest individual governments and agencies in the short methods,

originally described to it at its ninth session, for adjusting index numbers of external trade for changes in formula and to keep the Commission informed as progress in the matter is made.

ANNEX I

ANALYSIS BY INDUSTRIAL SECTORS AND BY TRANSPORT CLASSES OF THE VALUE
REPRESENTED BY IMPORTS AND EXPORTS USING PUNCHED CARD MACHINES

1.   Part I of the paper to which this Annex is attached suggested basing a
sector analysis of external trade upon the estimation, for each of the most
detailed headings of the export statistics, of the proportion of the f.o.b.
value of the heading contributed by each sector of the economy of the exporting
country and, for each heading of the import statistics, the estimation of the
division of the commodity in question between types of use in the importing
country.

2.   It was suggested that these estimates be made for a recent year and then
kept up to date by adjustment as required for changes. Adjustment for tempo-
rary disturbances, such as sudden price changes affecting the sectors unevenly,
can, if desired, be made by machine to the summary data resulting from the
whole process of analysis.

3.   In deciding what limits of error can be tolerated in apportioning the
value of a commodity heading between sectors the aim should, perhaps, be at
first merely to make a distinct improvement upon the accuracy of the methods
currently used in estimating this sort of data and to benefit, as is described
below, from the convenience of punched card machine methods.

4.   A code of n-1 digits will be used to distribute the total value of a
detailed heading of the external trade statistics among n industrial sectors,
the value assignable to the nth sector being that remaining after the value
assigned to the first n-1 has been removed. The magnitude of each digit will
represent, in some convenient way (for instance that shown in Table 1 below),
the fraction of total value which is assignable to the sector corresponding to
the position (first, second, ..., (n-1)st) of the digit in question.

Table 1. Use of Digits 0-9 to Indicate Fractions of Value

Digit	Fractions of Value	Digit	Fractions of Value
0	None	5	0.50 to 0.64
1	0.01 to 0.05	6	0.65 to 0.79
2	0.06 to 0.20	7	0.80 to 0.94
3	0.21 to 0.35	8	0.95 to 0.99
4	0.36 to 0.49	9	All

As Table 1 makes clear, the distribution, among digits, of the "fractions of value" need not be uniform; it can be adapted to the characteristics of the trade which is being analysed.

5.   On the basis of Table 1, the heading "woollen fabrics" of the export statistics of a country might, for example, be assigned the code number "315" which would indicate that the value of that heading should be divided approximately as follows among sectors:

imports	27.5%
agriculture (domestic)	4 %
mining and manufacturing	57.5%
commerce and transport	11 %

On the import side, "flour" might be assigned the code number "60" indicating, on the basis of Table 1, that about 72% of flour imported was expected to be for further processing by commercial bakers, etc., none for capital formation and the rest, about 28%, for consumption by households or government agencies.

6.   Upon first using a method such as the one described here, it would probably be wise to keep to a minimum the number of sectors among which value was to be distinguished in detail.   In the case of imports, a two-digit code can, as indicated by the example, distinguish the fractions of value absorbed by the sectors: production, capital formation and direct consumption, and this degree of detail is, perhaps, reasonably adequate.   In the case of exports, there are five sectors of the International Standard Industrial Classification[1]/ (ISIC) which may contribute to export value: agriculture, mining, manufacturing, commerce and transportation.   Importation is omitted from the list because the value added by imports in each of the five industrial sectors can be determined by analysing the import statistics in the same way as the export statistics. To avoid having to divide the value of each commodity heading into five parts, it may be possible to combine commerce and transportation under a single rubric "distribution" distinguished from agriculture, mining and manufacturing by the fact that value added in distribution does not affect the intrinsic properties of the goods whereas value added by the other three does do so. Value added by distribution could then either be specified in detail for each heading of the export statistics, in which case a three-digit code would be required for exports, or it could be removed as an overall percentage of value,

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1/   Statistical Papers, Series M, No. 4.

in which case a two-digit code would suffice.

7.   In paragraph 7 of the paper to which this annex is attached, the application of the methods of the paper to economic and technical problems in the field of international transport was briefly discussed. Three circumstances have, up to the present, prevented the full use of external trade statistics to study transport questions.

(i)   In national statistics the trade in an important proportion of commodity headings may be recorded by value only, no quantity data being shown. Where quantity data are available for a heading they may be in a unit like "number" or "length" not readily combined with data in units of weight.

(ii)   The weight of a commodity is not always the only property which has an important influence on the method and cost of transporting it. It is also important to distinguish liquids in bulk and goods like lumber and this may not always be possible by means of the commodity classification alone.

(iii)   The cost of transporting goods may also depend on the form of transport used and on the type of contract within the form of transport. Thus trainload lots move more cheaply than small individual shipments and transport by tramp steamer may be cheaper than shipment by liner at Conference rates.

8.   Methods are here suggested for circumventing the difficulties listed above. They do not require any changes in the compilation of the trade statistics themselves but depend, as do the methods of sector analyses, on adding new codes to the summary cards after their preparation for use in trade statistics.

9.   A study of world external trade in 1956 leads to the suggestion of Table 2 for a 1-digit code to distinguish goods according to their loading characteristics. Such a code can be keyed in each country to the code of the commodity nomenclature and will make possible the estimation of tonnage from the value figures appearing in external trade statistics.

Table 2. Use of 1-digit code to indicate loading characteristics

(values in US cents)

		Digit
Goods with f.o.b. value not greater than 2¢ per kilo		
Liquid in bulk	value not more than 1¢ per kilo	0
" " "	value between 1¢ and 2¢ per kilo	1
Wood in bulk	value not more than 1¢ per kilo	2
" " "	value between 1¢ and 2¢ per kilo	3
Other cargo	value not more than 2¢ per kilo	4
Goods with f.o.b. value greater than 2¢ per kilo		
	value between 2¢ and 6¢ per kilo	5
	value between 6¢ and 18¢ per kilo	6
	value between 18¢ and 54¢ per kilo	7
	value between 54¢ and 162¢ per kilo	8
	value more than 162¢ per kilo	9

The data provided via the new code would make possible study of the utilisation of shipping tonnage on various routes or, when taken together with current freight rates, would facilitate the estimation of the freight charges on external trade.

10. It will often be possible to distinguish the form of transport[2] by which goods enter or leave a country by noting the country of provenance or destination and the customs district through which the goods cleared, and the analyses suggested in Table 2 will then give a great deal of information on the freight rates applicable to the goods. But where even more precise information is needed, a detailed study for a recent period will make it possible to associate with each commodity heading a 1-digit code providing analyses by form of transport. Table 3 illustrates such a code.

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[2] It is assumed that data on the movement of goods by air will be obtained from official air transport statistics. The magnitudes involved are seldom large enough to affect the figures for the other forms of transport.

Table 3. Use of a 1-digit code to indicate Freight Rate Classes

Digit	Meaning
0	Shipment by rail: trainload lots
1	: carload lots
2	: less than carload lots
3	Shipment by road transport
4	Shipment by inland waterway: full load
5	: part load
6	Shipment by sea: at trip charter rates
7	: at "Conference" rates
8	: in vessel on time charter
9	: in vessel owned by owner of goods

11. Each of the methods of the preceding paragraphs associates with each commodity heading of the trade statistics a special code number. These associations can give rise to "master decks" of punched cards, each card being prepared to contain:

(a) the code number of the commodity heading in the national export or import classification.

(b) the special code number or numbers associated with that heading.

Then when analysis is to be made on the basis of the special code, the summary cards showing the trade data in terms of the basic commodity headings (either in total or analysed by countries of provenance and destination, as desired) can, by means of the master deck, be effected with the information at (b). Sorting the cards on one of the codes (b), multiplying the data by the fractions appropriate to each code and adding the results then produces the analysis to which the code refers.

ANNEX II

SECTOR ANALYSIS OF EXTERNAL TRADE AT CONSTANT PRICES:
SECTOR INDICES OF QUANTUM AND UNIT VALUE
(see paragraph 8 of the main text)

1. It will be assumed that q, v and p refer as usual to the quantity, value and unit value of a given commodity exported or imported in the period o or n indicated by the subscript. Furthermore, s will refer to the share of the value of the commodity attributable to a given sector. Thus $s_n v_n$ is the value of the given commodity attributable in period n to the given sector. The symbol Σ will indicate summation over all commodities but $\underline{not}$ over sectors; $\Sigma s_n v_n$ is then the value of total exports or imports attributable in period n to the given sector.

2. Since it is obtained by substituting base period for current period prices in $\Sigma s_n p_n q_n$, the expression $\Sigma s_n p_o q_n$ represents the value at constant prices attributable in period n to the given sector. Comparing this to $\Sigma s_o p_o q_o$ gives the $\underline{\text{Laspeyres quantum index}}$

(a)
$$\Sigma s_n p_o q_n / \Sigma s_o p_o q_o$$

for the given sector. The traditional Laspeyres quantum index for total exports or imports is the arithmetic average of all sector indices (a), each weighted by the share of its sector in the total exports or imports of period o.

3. The expression $s_n p_n$ represents the share of the given sector in the value of a unit of the given commodity in period n. The ratio $s_n p_n / s_o p_o$ measures the change in that share between periods o and n. An average, over all commodities, of the ratios gives an index measuring $\underline{\text{the average change in value}}$ $\underline{\text{contributed by a given sector to a unit quantity of exports or imports}}$. If the basic ratios are averaged by the Paasche formula, the algebraic expression for the index is

(b)
$$\Sigma s_n p_n q_n / \Sigma s_o p_o q_n .$$

The traditional Paasche unit value index is the harmonic average of all sector indices (b), each weighted by the share of its sector in the total exports or imports in period n.

4.   It will be noticed that $(a)(b) \neq \sum s_n v_n / \sum s_o v_o$ and that (b) is not, in general, a unit value index for the sector. The Paasche unit value index for the sector is given by

(c) $$\sum s_n p_n q_n / \sum s_n p_o q_n \ .$$

The indices (c), as well as the indices (b), represent an analysis by sectors of the traditional Paasche unit value index. When $s_o = s_n$ for every commodity, then (b)=(c).

5.   This paragraph presents a simple numerical example. Assume for simplicity that the exports of a country consist of two commodities, A and B, and that only two sectors, agriculture and manufacturing, contribute to the value of exports. Let a_o and a_n be, for each commodity, the fractional shares contributed by agriculture in periods o and n. Then $1-a_o = m_o$ and $1-a_n = m_n$ are the fractional shares contributed by manufacturing. The following tables set forth the given data and the computation of the index numbers discussed in the preceding paragraphs.

TABLE I

	Period o			Period n			Cross products		
	A	B	Sum	A	B	Sum	A	B	Sum
					Given data				
q	10	8		12	10				
$v=pq$	20	16	36	18	30	48			
a	.9	.2		.8	.1				
m	.1	.8		.2	.9				
				Preliminary calculations					
p	2	2		1.5	3				
apq	18	3.2	21.2	14.4	3	17.4			
mpq	2	12.8	14.8	3.6	27	30.6			
$p_o q_n$							24	20	44
$a_o p_o q_n$							21.6	4	25.6
$m_o p_o q_n$							2.4	16	18.4
$a_n p_o q_n$							19.2	2	21.2
$m_n p_o q_n$							4.8	18	22.8

TABLE II

Final calculation of index numbers

Quantum	Unit value

Tot. $\quad \dfrac{\sum p_o q_n}{\sum p_o q_o} = \dfrac{44}{36} = 1.22 \qquad\qquad \dfrac{\sum p_n q_n}{\sum p_o q_n} = \dfrac{48}{44} = 1.09$

Quantum (a)	Value share (b)	Unit value (c)

Agr. $\quad \dfrac{\sum a_n p_o q_n}{\sum a_o p_o q_o} = \dfrac{21.2}{21.2} = 1.00 \qquad \dfrac{\sum a_n p_n q_n}{\sum a_o p_o q_n} = \dfrac{17.4}{25.6} = 0.68 \qquad \dfrac{\sum a_n p_n q_n}{\sum a_n p_o q_n} = \dfrac{17.4}{21.2} = 0.82$

Mfg. $\quad \dfrac{\sum m_n p_o q_n}{\sum m_o p_o q_o} = \dfrac{22.8}{14.8} = 1.54 \qquad \dfrac{\sum m_n p_n q_n}{\sum m_o p_o q_n} = \dfrac{30.6}{18.4} = 1.66 \qquad \dfrac{\sum m_n p_n q_n}{\sum m_n p_o q_n} = \dfrac{30.6}{22.8} = 1.34$

It is readily verified that the sector indices summed over all sectors with appropriate weights yield the corresponding total indices. Had the structural changes in a and m between periods o and n not taken place (e.g. if $a_o = a_n = 0.9$ for A and 0.2 for B) and if the other data were as before, the total indices would be unchanged but the sector indices would be:

for agriculture: (a)=1.21, (b)=(c)=0.87

for manufacturing: (a)=1.24, (b)=(c)=1.40

6. In the indices (d) and (e) of paragraph 8 dealing with imports via intermediate countries, q_o, q_n, v_o, v_n refer, for each commodity, to those import shipments to which value was added in more than one country prior to their importation. The change in value contributed by intermediate countries (index d) will result if s specifies the fraction of total value which was added in the country of first consignment. The change in volume of imports via intermediate countries (index e) can be obtained by setting s=1 throughout.

7. The variables which would result from the statistical techniques discussed in this paper can, of course, be combined in many other ways to give index numbers with different meanings from those here described.