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NOTE ON

EXTERNAL TRADE INDEX CONSTRUCTION IN

AFRICAN COUNTRIES

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NOTE ON EXTERNAL TRADE INDEX CONSTRUCTION IN
IN AFRICAN COUNTRIES

1. This note was drawn up at the request of the Economic Commission for Africa, following a recommendation made by the Seminar on External Trade Statistics which met at Addis Ababa from 29 November to 7 December 1961.

Statements made by several participants in that meeting showed that the classical fixed base formulae are generally used. However, the end-use categories and the geographical areas which the partial indices refer to as well as the periodicity of index construction and the basis adopted both for purposes of calculation and publication differ considerably between countries. Moreover, it was noted that the traditional methodology is not suitable for countries where the composition, the value and the volume of external trade are changing considerably in the short run.

The Seminar therefore stressed that it was necessary to show great caution in interpreting these indices. It recommended that the Secretariat should carry out a detailed study of the methods actually employed in the various African countries and arrange for the convening of a small Working Group of Experts to examine this question in connexion with the Third Conference of African Statisticians.

2. Before reviewing the methodology at present applied by the various countries, it may be convenient to make a few general remarks on certain aspects of the problem of constructing index numbers of external trade in Africa.

2-1. It is characteristic of the external trade of the African countries that imports cover a far wider range of products than exports. Moreover, the kind of goods imported varies very much according to the needs of the countries and imports develop very rapidly with industrial progress and competition. On the other hand, only a narrow range of goods are exported and additional commodities are added only slowly in spite of growing industrialization in many countries.

It follows that the methodological questions are particularly serious with regard to the calculation of index numbers for imports, although there are also difficulties met when calculating index numbers for exports.

2-2. The quality of the indices depends to a great extent on the quality of the basic customs statistics. Problems may arise, particularly with regard to the customs classifications, the quantities and values allowed by the customs and the work of computation carried out by the central statistical office. Priority must therefore be given to the improvement of customs statistics in accordance with the recommendations of the Seminar on External Trade Statistics. The problems of valuation and classification of commodities in external trade are obviously fundamental.

If the definition of value adopted by the customs authorities does not agree with the value concept defined by the Seminar delicate and difficult questions of adjustment, liable to give rise to mistakes, will arise when it is attempted to give the indices a proper economic meaning.

2-3. Since import trade covers a very large number of commodities, there can be no question of following the price movement of each of these commodities. For one thing, the volume of work employed would be out of proportion to the gain of accuracy which one could obtain and the very nature of many products entails permanent and inextricable problems of substitution. Also, even the most detailed nomenclatures imply some grouping of commodities.

This paragraph will deal with the construction of the unit value index of imports, the assumption being made that the volume index may be found from the following ratio:

$$\frac{\text{Total value index}}{\text{Unit value index}}$$

The method of classifying products which are more or less homogeneous in nature in the same group is generally adopted and it is very often considered sufficient to follow the development of the average price for each of these groups of products.

Sometimes the procedure is to measure the price movement of certain groups of products by the observed price movement for a certain number of selected products within the group (sometimes direct weighting is applied, sometimes representative weighting). This procedure presents considerable difficulties because most of the statistical offices have little direct contact with the persons who make out the customs declarations and it is an initial condition for following exactly the price movement of the selected import commodities that information from the customs declarations is obtained.

When average price by commodity group is used, certain groupings of products sometimes in themselves give rise to distortions which are unacceptable. This is for instance the case for many categories of manufactured goods, like machinery, transport equipment, electrical equipment, etc. Some manufactured products are imported with an annual frequency which is less than a unit. As a result the range of imported products within a specific category may vary considerably from one period to another and the unit values are, therefore, not strictly comparable. Moreover, the quality and the quantity of certain goods are subject to wide variations from one period to another because of the development of methods of manufacturing and changes in the sources of supply.

Thus, Paasche's index

$$\frac{\sum p_1^i q_1^i}{\sum p_0^i q_0^i}$$

where p_0^i , p_1^i represent the average price of imported goods in the category i in the period 0 and 1 respectively shows the combined effect on the average price of changes in the composition of goods in the category, of the quantity of the products and of the movement in the real price level.

In order to isolate the real price movement, it would be necessary to replace p_0^i by p_0^{ii} , representing the average price at the price level of period 0 of imports in category i during period 1. In practice, such a substitution could only be carried out if one disposed of data on the price

movement for a very wide range of products. The procedure of grouping similar commodities together has been adopted precisely to avoid the need for such detailed information. Moreover, because of the substitution of products, assumptions would in many cases have to be made which would be difficult to check and in addition would involve lengthy calculations.

However, in practice, it is true for a fairly large number of groups that the level of the average price is hardly affected by the change in the structure of the group from one period to another and it may, therefore, be considered that the recorded price movement represents the general movement of the prices of commodities included in the group. The method of direct or representative weighting may also be used and it would then be sufficient to follow the prices of products that are considered representative.

The situation is quite different as regards a limited number of commodity groups which cover a considerable part of general imports. Particularly does this refer to equipment goods. The information supplied about the trade of the countries concerned generally is not sufficient to isolate the price movement of these industrial products. The range of products for which it would be possible to follow the price movement is too restricted and their representative character would be lost too quickly.

It is therefore, preferable to turn to the price indices established by the statistical offices of the industrial countries. Although this is of necessity an approximate solution, it should be satisfactory in most cases if one takes the precaution of weighting the foreign indices on the basis of the classification of imports by country of origin.

Let us use the following symbols:

$P_2^I(0,1)$, the unit value index according to Paasche's formula for the total of the groups of imported commodities for which the average unit value is only affected by the movement of the price level.

$V_{(0)}^I$, the total value of these commodities for period 0, at current prices.

$V_{(0)}^{II}$, the total value of commodities in period 0 in groups for which it is not possible to say that the average unit value is only affected by the movement of the price level.

$V_{(0)}^{II ij}$, the total value in period 0 at current prices of this period of imports in group i originating from country j.

$J_{(0,1)}^{II ij}$, the index of unit value for group i in the supplier country j.

The unit value index for the total of imported commodities may be calculated by means of the formula:

$$P(0,1) = \frac{V_{(0)}^I P_2^I(0,1) + \sum_i \sum_j V_{(0,1)}^{II ij} \cdot J_{(0,1)}^{II ij}}{V_{(0,1)}^I + V_{(0)}^{II}}$$

This method does not imply any restriction if it is used in estimating a chain index.

2-4. The relative importance of the various commodity groups changes considerably over time, both for imports and for exports. With regard to imports, the effect of investment programmes and the increase in the volume of raw materials imported for local industries gradually extend the range and alter the pattern of imported commodities. The high elasticity of demand for raw materials which constitute the largest part of exported goods has a marked effect on the volume and value composition of the goods exported. In some countries also the range of exported goods has considerably widened during the last two decades. These circumstances endanger the representativeness of indices with a fixed base. On the other hand, chain indices with moving weights and also Fisher's fixed crossed weight index limit the distortive effects caused by constant fluctuations in composition.

As may be seen from Table III annexed, only a small proportion of the African countries do actually use chain indices. This phenomena is not peculiar to Africa as may be seen from the statistics given below on formulae utilized in forty-seven countries, mainly non-African, for calculating unit value indices of external trade.

	<u>Number of countries</u>	<u>Percent</u>
Laspeyres	7	15
Paasche	27	57
Mixed	5	11
Chain	8	17
	<u>47</u>	<u>100</u>

Fixed base formulae represent 72 percent of the total. That so few other indices are used reflect the inadequacy of the theory of index numbers and the ignorance about the uses to which these other indices may be put.

2-5. For some countries, the problem of valuation of the products comes in addition to the difficulties resulting from the change in composition of foreign trade. The values recorded in customs statistics are sometimes conventional values which may differ markedly from commercial values. The selling price of some major commodities (particularly export commodities) is not known at the time when the merchandise crosses the frontier and in order to facilitate the calculation of customs duties the valuation is sometimes made on the basis of official fixed prices (mercuriales) which are adjusted periodically.

When calculating index numbers of unit value and of total value, it is therefore desirable to take into account as far as possible the extent of possible disparity between the real prices and the conventional prices derived from official fixed prices (mercuriales).

The following technique is used by one African country to calculate the unit value index of exported commodities.

Using the symbol :

p_n^i for the estimated average unit price (based on quotations for essential commodities on the world markets) of the commodity i, for the year n

p_0^i for the estimated average unit price (based on quotations for essential commodities on the world markets) of the commodity i, for the base year

pc_o^i for the conventional average unit price of the commodity i , for the base year

q_{n-1}^i for the quantity of the commodity i exported during the year $n-1$

The formula used is written as follows :

$$P(o,n) = 100 \sum_i \frac{pc_o^i q_{n-1}^i \frac{p_n^i}{p_o^i}}{\sum_i pc_o^i q_{n-1}^i}$$

The index of total value is expressed by the product of the volume index and the unit value index.

2-6. For those countries which have administrative facilities for calculating monthly or quarterly indices, it would appear that indices relating to the cumulative figures from the beginning of the year are of more interest for economic analysis than those relating to the given periods. Non-cumulative monthly figures, in particular, are practically meaningless, as they are affected by accidental causes having no connexion with the general trend of trade; and in addition the groups covered usually include a reduced number of commodities.

2-7. When the index calculation involves a very large number of articles or groups of articles, it is obviously desirable to make use of mechanical methods for the actual computation.

Annex IV describes the essential stages of the organization chart concerning the calculation of the volume and unit value indices (partial and overall) for the import trade of the Republic of the Congo (Leopoldville).

The average unit prices and the quantities are related to all the items (about 1,000) of the Brussels Tariff Nomenclature and the indices calculated cover 20 groups, condensed in turn into 3 major categories: consumer goods (4 groups), supply goods and raw materials (10), and capital goods (6).

3. In the three annexed tables will be found the replies given by the different countries to the questionnaire sent to them by the secretariat concerning their methodology. Some of the replies require further clarification so that the tables can be made more precise.

The tables cover the following topics:

Table I (a) Types of indices calculated, for total external trade and for certain groups of commodities, with an indication of the frequency of calculation and the definition of external trade.

(b) Description of the commodity groups covered by partial indices.

Table II The base year for calculation and for publication

Table III Formulae used

	MONTHLY 4/	
		P
General imports	Rh ^{esia}	Rhodesia
	Gh.	
	Ni.	
	Al	
Retained imports	Et	
	Ea	
Special imports	Co	
	Ca	
	EC	
General exports	Gh	
	Al	
Exports of national products	Rh ^{esia}	Rhodesia
	Co	
	Ni	
	Et	
	E.	
Special exports	Ca	
	EC	
Imports 3/	S. Africa	S. Africa

TABLE I (b)

DESCRIPTION OF THE END-USE GROUPS COVERED
BY PARTIAL INDICES

COUNTRY	IMPORTS	EXPORTS
East Africa Kenya Uganda Tanganyika	SITC - Sections (0 to 8)	SITC - Sections (0 to 8)
South Africa	SITC - Sections (0 to 8)	SITC - Sections (0 to 8)
Cameroon	9 indices concerning (1) Food (2) Beverages (3) Tobacco (4) Raw materials (5) Energy (6) Lubricants (7) Semi-finished products (8) Capital goods (9) Manufactured consumer goods 3 indices summarizing sub- groups - (1) + (2) + (3) - (5) + (6) - (7) + (8) + (9)	9 indices concerning (1) Food (2) Beverages (3) Tobacco (4) Raw materials (5) Energy (6) Lubricants (7) Semi-finished products (8) Capital goods (9) Manufactured consumer goods 3 indices summarizing sub- groups - (1) + (2) + (3) - (5) + (6) - (7) + (8) + (9)
Congo (Leopoldville)	Items of the Brussels nomenclature, divided into 20 sub-groups and further grouped into 3 sections. Human consumption goods (4 sub-groups) Raw material supply goods (10 sub-groups) Capital goods (6 sub-groups)	2 sub-groups: 1. Vegetable products 2. Mineral products
Ethiopia	1. Food - Beverages - Tobacco 2. Raw materials and mineral fuels 3. Manufactured goods	1. Coffee 2. Leather, hides and skins 3. Cereals 4. Other products

COUNTRY	IMPORTS	EXPORTS
Ghana	SITC - Sections (0 to 8)	1. Food and live animals 2. Raw materials, with the exception of mineral oils 3. Manufactured goods, mainly classified according to the base material 4. Transactions in gold, currency and bills
Madagascar	-----	-----
Morocco	6 sub-groups Food - Beverages - Tobacco Energy and lubricants Raw materials Semi-finished products final capital goods Final consumer goods	3 sub-groups Food - Tobacco Raw materials Manufactured products
Nigeria	SITC - Sections (0 to 8)	No sub-groups
Rhodesia	SITC - Sections (0 to 8)	SITC - Sections (0 to 8)
Sudan	-----	-----
Tunisia	4 sub-groups Energy Raw materials and semi-finished products Capital goods Consumer goods	2 sub-groups Raw materials and semi-finished products Consumer goods

1. ----- Information not supplied.
2. Most countries calculate partial indices by end-use groups. Notwithstanding the differences between the base nomenclatures being used, a certain uniformity among the major end-use groups adopted is apparent. Without neglecting efforts to standardize the base nomenclatures, it should be possible, pending such time as those efforts bear fruit, to achieve some homogeneity between countries with respect to the definition of the various end-use groups for which it would be desirable to calculate partial indices.
3. Very few countries calculate partial indices according to geographical areas.

TABLE II
BASE YEAR FOR CALCULATION AND PUBLICATION

COUNTRY	CALCULATION	PUBLICATION
East Africa Kenya Uganda Tanganyika	1954	1954
South Africa	----	1957
Algeria	1956	1956
Cameroon	----	1949 and 1953 simultaneously
Congo - Leopoldville	1949 and 1953 (imports) Exports: Chain index	1949 and 1953 simultaneously
Ethiopia	1945 - Volume index, exports & imports 1953 - Quarterly export volume index 1958 - Monthly unit value index (exports and imports)	The base year is the same, as that used for the calculation
Ghana	1948 and 1954	1954
Morocco	1949 to 1955 Base: 1949 } relates } 1956 Base: 1955 } only to } 1957 Base: 1956 } Southern } } Zone } 1958 Base: 1956 Whole of Morocco except Tangier	Bases 1949 and 1956 Splicing for general indices and groups of countries only Base 1956
NIGERIA	1948 - 1954	Base 1954, not officially spliced to the 1948-based index
Madagascar	----	1957
Tunisia	----	1949
Rhodesia	Not relevant (chain index)	1954
Sudan	1953	1953

NOTES

1. Information not yet supplied
2. There is a considerable disparity between the reference years, both for calculation and for publication.

It will be for the Working Group to make recommendations as to the reference year which it would be desirable to see adopted uniformly by all the countries.

It is obvious that the adoption of a distant year would involve major drawbacks especially for the basis of calculation. The new indices would be appreciably different from the old ones, which is scarcely desirable from a psychological point of view, and moreover their calculation would entail a good deal of extra work which some countries would be unable to cope with; the above-mentioned disadvantages would be lessened in so far as the year chosen was a fairly recent one.

Furthermore, it would be impossible to change the reference year, either for calculation or for publication, every time an alteration was made in the statistical coverage at a time subsequent to the reference year adopted.

Consequently the working group will doubtless have to direct its recommendations towards the adoption of a reference year close to 1963, at least with regard to the base year used for calculating fixed-base indices.

COUNTRY	COVERAGE IN PERCENT	VOLUME INDEX
		TECHNIQUE
RHODESIA	80 % in 1961	<p>Monthly chain index with moving crossed weights in index with moving crossed weights the 9 sections of the SITC</p> <p>n-1 indicates n indicates The observed price or to groups of (n) = $12 \left(\frac{V_n^s}{V_o^s} \right)$ The overall index $P_3^s(n-1, n)$</p> <p>index is supplied by the formula: $P(n-1, n) = \sqrt[12]{ \frac{\sum_{s=0}^8 V_n^s}{\sum_{s=0}^8 V_o^s} } P(n-1, n)$</p>
ETHIOPIA	75 % in 1960	<p>Fixed-base index when the total value index and the The commodity index.</p> <p>statistics produced most part imported articles: machinery, transport equipment, articles, soap</p>
GHANA	65 % in 1961	<p>Paasche's formula when the index of total value and either the average unit value for each major constituting group, and also for the total of specific commodities</p>
CONGO (LEO)		<p>Total value index formula based on average prices (1955) and the quantities of 1953. weights estimated at the level of the items of the Brussels Tariff Schedule.</p>
NIGERIA		

CAMEL

COUNTRY	COVERAGE IN PERCENT	
EAST AFRICA (Kenya, Uganda, Tanganyika)	99.4 (1961)	Fisher's of unit value. Price of groups.
CAMEROON	100 %	Paasche'
CONGO (LEO)	Unit value Index 85.5 % 1957 <hr/> Volume index <u>100%</u>	Base 195 ed from customs values, P (o.n) <u>recursiales</u> - i p ₀ = i n = c n-1 = y i p ₀ } i i p _n } t
ETHIOPIA	95 % (1961)	Paasche'
GHANA	96 %	Paasche'
MOROCCO	100 %	Paasche'
NIGERIA	98 % (1954)	Laspeyre to 21 cc
RHODESIA	91 %	Monthly ts, for each of the 9 s

ORGANIZATION CHART OF THE MECHANICAL COMPUTATION
OF THE VOLUME INDEX AND THE UNIT VALUE INDEX
WHEN THE NUMBER OF ARTICLES COVERED IS VERY LARGE

In the Republic of the Congo (Leopoldville), imported goods are classified under a six-digit nomenclature, the first four digits of which are the items of the Brussels Tariff Nomenclature.

The average unit prices used in the calculation are established for each item. Laspeyres' formula is used to calculate the volume index, and the unit value index is derived from the ratio:

$$\frac{\text{Total value index}}{\text{Volume index}}$$

The base year is 1953 and the base prices are the average prices for the three-year period 1953, 1954, 1955.

The formula for the volume index is :

$$Q(o,n) = \frac{\sum \bar{p}_o^i \times q_o^i}{\sum \bar{p}_o^i \times q} \times 100$$

where \bar{p}_o^i is the average price for item i, relating to the three-year period 1953, 1954, 1955.

Partial indices are calculated for the following 20 groups and for the three main categories.

- (g) 11 - Foodstuffs
- 12 - Textiles, clothing, footwear
- 13 - Other non-durable consumer goods
- 14 - other durable consumer goods
- 1 - Total consumer goods

- 20 - Foodstuffs
- 21 - Products for agriculture and animal husbandry
- 22 - Leather and textiles
- 23 - Building materials

- 24 - Solid fuels
- 25 - Liquid fuels
- 26 - Chemical products
- 27 - Packaging
- 28 - Raw and semi-finished metal products
- 29 - Other supplies and raw materials
- 2 - Supplies and raw materials
- 31 - Agricultural machinery
- 32 - Road transport equipment
- 33 - Rail transport equipment
- 34 - Water transport equipment
- 35 - Sea transport equipment
- 36 - Other machinery and capital goods
- 3 - Capital goods

The monthly data are supplied by summary punched cards (code 01) compiled for six-digit items (sub-heading = col. 22 to 27; gross weight = col. 60 to 69; Value = col. 70 to 79).

The p_o^{-i} , $\bar{p}_o^{-i} \times q_o^i$, $p_o^i \times q_o^i$ and the code of the grouping g corresponding to i , are entered on master cards (code 03) identified by the number of the item i that they represent.

The mechanical processing chart provides for the following main phases: (the IBM equipment used includes a calculator (604) and a 421 accounting machine not connected).

1. Card sorting (01) by items (col. 22 to 25)
2. Compiling of summary cards (02) by items, with the data q_n^i and $q_n^i \times p_n^i$
3. Collating of summary cards (02), master cards (03) and a set of blank cards
4. Compilation, on the 604, of the summary card (04), by items, with the data
$$i - g - p_o^i \times q_o^i - \bar{p}_o^{-i} \times q_o^i - \bar{p}_o^{-i} \times q_n^i - p_n^i \times q_n^i - \bar{p}_i$$
5. Sorting of cards (04) according to the index g

6. Listing of cards (04) and compilation of summary cards (code 05) by groupings for the 3 categories (code 05^x).
7. Calculation, on the 604, by means of the cards (05) and (05^x), of cards (06) and (06^x). We get :

$$\text{Card (06)} \quad \frac{\sum \bar{p}_o^i \times q_n^i}{\sum \bar{p}_o^i \times q_o^i} \times 100 = Q(o,n)$$
$$100 \times \frac{V(o,n)}{Q(o,n)} = P(o,n)$$

$$\frac{\sum p_n^i \times q_n^i}{\sum p_o^i \times q_n^i} \times 100 = V(o,n)$$

For card (06)^x, same result as for card (06), in which the grouping g is replaced by the grouping category.

8. Listing of results.