INTERNATIONAL AVERAGE PRICES AND COMPARISONS OF NATIONAL AGGREGATE PRODUCTION OF AGRICULTURE

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"The whole question of making inter-spatial comparisons between countries is a most complicated and hazardous business" (Mr. Campion); international comparisons of a particular value aggregate between countries present a difficult problem connected with the conversion of national value aggregates into a comparable magnitude. This paper presents an alternative approach in that an internationally comparable value aggregate for each country is prepared by the international average prices of commodities which are determined simultaneously with the partial exchange rates of national currencies to a standard currency. The calculated partial exchange rates are so defined as to reflect the purchasing power of national currencies in respect of the group of commodities selected. Consequently, the resulting value aggregate for international comparison has a quantity dimension, eliminating the effect due to the different purchasing power of national currencies in which original prices are quoted. The other methods of international comparison so far being used by other research workers, such as C. Clerk and M. Gilbert and his associates, are examined in the light of the properties of the present method and the crucial differences are delineated. Using the method proposed, an international comparison is made of the aggregate value of agricultural products for 11 selected countries in the world, with sub-divisions into two regions.

1. INTRODUCTION

Some fifteen years ago Mr. C. Clark of Oxford University used a so-called "international unit" for the purpose of aggregating agricultural products of a country for international comparison.[1] He defined the international unit to be "a quantity of goods exchangeable for $1 in the United States over the average of the years 1929–1934." He also used a so-called "oriental unit" to serve the same purpose but applicable to the countries of Asia and the Far East where the commodity composition and its relative value is different to those for the other part of the world. This oriental unit is defined as "the quantity of goods exchangeable for an Indian Rupee in the year 1948/49".

In commenting on Mr. Clark's work, Mr. Campion[1] stated that "the whole question of making inter-spatial comparisons between countries is a most complicated and hazardous business and those who have to do it for necessity have to be careful not to fall so much in love with the arithmetic that they cannot pull themselves up in time to realize that some comparisons are not possible."

A few crucial questions were raised by Mr. Campion on the adequacy of Mr. Clark's method. Two of the questions in which we are particularly interested in

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[1]C. Clark: "World Supply and Requirements of Farm Products," *Journal of the Royal Statistical Society*, Series "A", Volume 117, Part III, 1954.

this paper are: "(a) whether exchange rates are really in equilibrium, and (b) what is the relation between internal prices and exchange rates."

In this paper a set of international average prices for agricultural products are used for aggregating the agricultural products for international comparison. Such average prices are calculated by using a set of specially calculated exchange rates on the bases of the purchasing power of the respective national currencies in respect of the group of agricultural products. Thus, the resulting comparison made here attempts to satisfy the two queries raised above in relation to Mr. C. Clark's method of obtaining internationally comparable value aggregates for countries. Although the present paper deals with the comparison of aggregate agricultural production for countries, the procedure adopted here seems to have much wider implications in the field of international comparison of the value aggregates in general. For example, a well-known work on international comparison of national products and purchasing power of currencies made by M. Gilbert and I. B. Kravis[2] adopted a method of paired (binary) comparison between the U.S.A. and one of the European countries. Gilbert and Kravis' investigations dealt with the international comparison of national income yet it recognized that "international comparisons of price or income levels derived by converting national currency values at official exchange rates are of doubtful value because of the inadequacy of exchange rates as indicators of relative purchasing powers". In their study, a number of reasons for inadequacy of using ordinary exchange rates in converting national currency values into a common currency unit are presented, all of the reasons would also be applicable in the comparison of partial value aggregate such as agricultural production. Furthermore, agricultural production in many countries is subject to special agricultural policies, and many of the agricultural products are not traded freely in the international market, consequently the domestic price levels of agricultural products reflect considerable artificial elements. Such price levels therefore deviate considerably from the domestic equilibrium prices. Application of official exchange rates in converting national currency value aggregates of agricultural products, therefore, would yield only superficially comparable magnitudes of very restricted meaning.

The advantages of the method adopted in the present study in comparison to that adopted by C. Clark and Messrs. Gilbert and Kravis may be found in the following: The international average prices of agricultural commodities are determined simultaneously with the exchange rates of the national currencies in such a manner that the calculated exchange rates equalize the purchasing power of national currencies in respect of the defined groups of commodities. Consequently, though the average prices are expressed in a national currency unit, the value aggregates obtained with such average prices indicate a magnitude of quantity dimension which is comparable among countries. Secondly, the method is of a general nature and applicable to any number of countries and avoids the difficulties inherent to paired (binary) comparison where uniqueness and commutativity are not fulfilled.

[2]M. Gilbert and Associates: "Comparative National Products and Price Levels," O.E.E.C. Paris, 1958. M. Gilbert and I. B. Kravis: "An International Comparison of National Products and the Purchasing Power of Currencies," O.E.E.C. Paris, 1954.

2. Structure of International Average Prices and Partial Exchange Rates

In search of a common weighting coefficient for index numbers of agricultural production for countries to facilitate international comparison and for aggregation of these to yield regional and world index numbers. Mr. Geary suggested a model which gives "true" rate of exchange for national currencies and "international prices of commodities".[3] Later on S. H. Khamis has shown the existence of a unique solution of the model.

The model can be written in a system of simultaneous linear equations consisting of the two types of definitional equations. The first type defines the international average prices $\bar{P}_i$ of ith commodity in the following manner:

$$\bar{P}_i = \sum_{j=1}^{m} q_{ij} p_{ij} r_j \Big/ \sum_{j=1}^{m} q_{ij} \tag{1}$$

$$i = 1, 2, \ldots n \quad \text{and} \quad j = 1, 2, \ldots m$$

where $\bar{P}_i$ denotes the average price of ith commodity and q_{ij} and p_{ij} respectively for quantity and price (in national currency) of the ith commodity in jth country, and where r_j denotes a partial exchange rate of jth country's currency into a standard currency in which terms the average prices are expressed.

Equation (1) simply defines an international average price $\bar{P}_i$ for a commodity i. The numerator is the sum of value of that commodity for all the countries concerned. In order to sum up the value of the commodity expressed in each national currency, the value is converted to a standard currency unit conveniently chosen by using an exchange rate r_j. The denominator is the total quantity of that commodity in all the countries.

The question arises what exchange rate r_j should be used here for conversion of the national currency. One may use the ordinary exchange rate and obtain an international average price in, say, U.S.$. In this case, the resulting average prices would show an artificial level, as mentioned in the previous section, since ordinary exchange rates do not necessarily reflect the ratios of the purchasing power of national currencies in respect of the group of commodities chosen for a comparison. It is therefore necessary to find an exchange rate which reflects the purchasing power of national currencies for the group of commodities. Such exchange rates are defined by the following type of equations:

$$r_j = \sum_{i=1}^{n} q_{ij} \bar{P}_i \Big/ \sum_{i=1}^{n} q_{ij} p_{ij}. \tag{2}$$

[3] *Note on National and International Indices of Agricultural Output.* (A mimeographed paper reproduced as Appendix II of FAO document CL. 17/4 of the 17th Session of the Council of FAO, Rome, June 1953). Also, R. C. Geary: "A note on comparison of exchange rate and purchasing power between countries," Journal of Roy. Sat. Soc., 1958, Part 1, Vol. 121, pp 97–99, London.

[4] S. H. Khamis: "Properties and Conditions for the Existence of a New Type of Index Numbers" (mimeographed, not published), FAO, Rome, 1969.

This r_j is called here the partial exchange rate since it refers to only a group of commodities, i.e. agricultural products. Equation (2) defines the partial exchange rate as the ratio of the total value of a country's commodity group valued at the international average prices to the total value of the same group of commodities expressed in the national currency. In other words, a factor which converts the national currency value aggregate to the corresponding value aggregate in terms of the international average prices which are expressed in a standard currency unit is defined as the partial exchange rate of that national currency.

Taking equations (1) and (2) together, we have n equations of type (1), i.e. as many equations as the number of commodities, and m equations of type (2) i.e. as many number of equations as the number of countries. There are $m + n$ unknowns, m of r_j and n of $\bar{P}_i$ in the system of $m + n$ homogeneous linear equations.

The system of homogeneous equations mentioned above has a unique solution for $(m + n - 1)$ unknowns in terms of any one of unknowns. It has been proved that the $(m + n - 1)$ independent equations in the system exist with a mild condition which is in fact always satisfied in practically all cases in meaningful analyses[4]. For the present purpose it is convenient to choose the U.S.A. exchange rate, i.e. $r_s = 1$, and solve other unknowns in the terms of it.

3. Meaning of the International Average Prices

It may be intuitively clear from the equations (1) and (2) above that when the partial exchange rates are applied to national prices to yield the prices in standard currency, then the resulting price levels for the group of commodities are equalized in all countries. In other words, when the calculated average prices are used in valuing products in the countries and compared, one simply gets a kind of quantum index. Thus:

$$Q_{hk} = \frac{\sum_i q_{ih}\bar{P}_i}{\sum_i q_{ik}\bar{P}_i} \tag{3}$$

for h country as compared to country k. On the other hand, when value aggregates expressed in national currencies are compared among countries by using the calculated partial exchange rates, the following kind of value index will result:

$$V_{hk} = \frac{r_h \sum_i q_{ih}p_{ih}}{r_k \sum_i q_{ik}p_{ik}} \tag{4}$$

for countries h to the base of country k.

By dividing the value index (4) with the quantum index (3) one obtains a kind of price index.

$$P_{hk} = \frac{V_{hk}}{Q_{hk}} = 1 \tag{5}$$

It is easy to see by substitution that this price index is always unity.[5] That is to say, there is no difference in price levels of the group of commodities involved

[5]This property of the calculated exchange rates and the international average prices seems superior to the property of so-called "average European prices" adopted by Messrs. Gilbert and associates. Equation (5) can be written in full as follows:

$$P_{hk} = \frac{V_{hk}}{Q_{hk}} = \frac{r_h \sum_i q_{ih}p_{ih}}{r_k \sum_i q_{ik}p_{ik}} \Bigg/ \frac{\sum_i q_{ih}\bar{P}_i}{\sum_i q_{ik}\bar{P}_i}$$

by substituting r, we get:

$$P_{hk} = \frac{\dfrac{\sum_i q_{ih}\bar{P}_i}{\sum q_{ih}p_{ih}} \sum_i q_{ih}p_{ih}}{\dfrac{\sum_i q_{ik}\bar{P}_i}{\sum_i q_{ik}p_{ik}} \sum_i q_{ik}p_{ik}} \Bigg/ \frac{\sum_i q_{ih}\bar{P}_i}{\sum_i q_{ik}\bar{P}_i}$$

$$= \frac{\sum_i q_{ih}\bar{P}_i}{\sum_i q_{ik}\bar{P}_i} \Bigg/ \frac{\sum_i q_{ih}\bar{P}_i}{\sum_i q_{ik}\bar{P}_i} = 1.$$

Contrary to the above property of the proposed system, Messrs. Gilbert and his associates' formulation does not result in unitary price index between countries, because of the special relation between their average European price and their exchange rate. By using their definitions we can get the following corresponding indexes:

$$Q_{mn} = \frac{\sum_i q_{im}\bar{p}_i}{\sum_i q_{in}\bar{p}_i} \text{ quantity index}$$

$$V_{mn} = \frac{r_m \sum_i q_{im}p_{im}}{r_n \sum_i q_{in}p_{in}} \text{ value index.}$$

Where $\bar{p}_i$ = the average European price of commodity i.
In value index above the inverse of the purchasing power equivalent is used for dimensional consistency.

$$P_{mn} = \frac{r_m \sum_i q_{im}p_{im}}{r_n \sum_i q_{in}p_{in}} \Bigg/ \frac{\sum_i q_{im}\bar{p}_i}{\sum_i q_{in}\bar{p}_i} \text{ price index}$$

by substituting r, the exchange rate or inverse of the purchasing power equivalent for the gross national product of country m with the U.S.A. o quantity as weight which is defined by the following:

$$r_m = \left(\frac{\sum_i p_{im}q_{io}}{\sum_i p_{io}q_{io}}\right) = \frac{\sum_i p_{io}q_{io}}{\sum_i p_{im}q_{io}}.$$

The price index now becomes:

$$P_{mn} = \frac{\left(\dfrac{\sum_i p_{im}q_{io}}{\sum_i p_{io}q_{io}}\right)^{-1} \sum_i q_{im}p_{im}}{\left(\dfrac{\sum_i p_{in}q_{io}}{\sum_i p_{io}q_{io}}\right)^{-1} \sum_i p_{in}q_{in}} \Bigg/ \frac{\sum_i q_{im}\bar{p}_i}{\sum_i q_{in}\bar{p}_i}.$$

between the countries compared. This is one of the main reasons why we propose to use the average prices in aggregating commodities over countries for international comparison. Actually, what we are doing is to compare the quantum index which is equivalent to the value index obtained by equation (4) above.

$$V_{hk} = Q_{hk} \tag{6}$$

This is a desirable property for comparing real term aggregates, whether the comparison is made over time or cross-countrywise, and it applies that the international quantum index numbers can be constructed by using the calculated average prices as weighting coefficients.[6]

4. Data and Calculated International Average Prices

In testing the method for obtaining the average prices for weighting coefficients for FAO index numbers of agricultural production, we have selected eleven countries; three from Asia and the Far East, seven from Europe, and the United States. These countries are chosen partly on the basis of availability of suitable data on production and respective producer prices. Thirty-eight agricultural products are selected on similar grounds. Not all of the commodities selected are necessarily produced in all of the countries, and even where they are produced, proper data either on prices or on quantities are not available. However, in all cases the data on price and quantity of all commodities are

(Footnote 5 continued)

Or:

$$P_{mn} = \frac{\dfrac{\sum_i p_{im}q_{im}}{\sum_i p_{im}q_{io}}}{\dfrac{\sum_i p_{in}q_{in}}{\sum_i p_{in}q_{io}}} \Big/ \frac{\sum_i q_{im}\bar{p}_i}{\sum_i q_{in}\bar{p}_i}.$$

This type of price index would become unity for very special cases only. One such case would be $p_{in} = p_{im} = \bar{p}_i$ which is a trivial case.

[6]Since

$$r_k \sum_i p_{ik}q_{ik} = \frac{\sum_i q_{ik}\bar{P}_i}{\sum_i q_{ik}p_{ik}} \sum_i p_{ik}q_{ik} = \sum_i q_{ik}\bar{P}_i.$$

That is to say, aggregation of quantity with the international average prices yields the same result as the value aggregate converted through the partial exchange rate.

Contrary to the above result, Messrs. Gilbert and associates' method does not have this property, because of the structure of so called the average European price which is connected with the exchange rate in a special way. (Gilbert, op. cit. p.155(2)). Since:

$$r_m \sum_i q_{im}p_{im} = \left(\frac{\sum_i p_{im}q_{io}}{\sum_i p_{io}q_{io}}\right)^{-1} \sum_i q_{im}p_{im}$$

$$= \frac{\sum_i p_{io}q_{io}}{\sum_i p_{im}q_{io}} \sum_i p_{im}q_{im} = \frac{\sum_i p_{im}q_{im}}{\sum_i p_{im}q_{io}} \sum_i p_{io}q_{io}$$

TABLE 1.

INTERNATIONAL AVERAGE PRICES AT PRODUCERS' LEVEL (PER t IN $.U.S.)

Average 1961–1965

		$\bar{P}_i$ All Countries	$\bar{P}_i$ Europe Group	$\bar{P}_i$ Asia Group
1.	Wheat	79.940	69.245	82.479
2.	Rye	64.028	63.041	39.579
3.	Barley	62.805	57.753	59.583
4.	Oats	49.203	48.825	43.215
5.	Maize	47.081	44.619	46.099
6.	Sorghum	39.566	39.582	39.486
7.	Rice, Paddy	96.705	102.788	98.710
8.	Sugar Cane	13.299	10.804	13.561
9.	Sugar Beets	13.769	13.590	15.578
10.	Potatoes	35.308	34.097	45.729
11.	Onions	53.781	58.744	54.892
12.	Tomatoes	80.604	80.079	103.138
13.	Cabbages	34.595	37.571	31.183
14.	Cauliflowers	71.954	70.756	166.151
15.	Green Beans	180.087	178.824	175.759
16.	Green Peas	136.371	135.788	165.389
17.	Dry Beans	165.116	164.258	164.488
18.	Dry Peas	94.384	94.080	91.692
19.	Apples	88.231	90.744	96.851
20.	Pears	96.217	98.767	91.819
21.	Plums and Prunes	114.636	12.309	144.023
22.	Grapes	93.805	91.828	61.888
23.	Oranges and Tangerines	82.157	78.905	81.506
24.	Lemons	71.727	70.921	69.151
25.	Figs	137.997	35.800	200.817
26.	Groundnuts	157.601	249,851	160.247
27.	Linseed	113.188	113.016	112.924
28.	Hops	1,395,225	1,378,730	1,032,852
29.	Tobacco	990.427	1,255,761	1,019,890
30.	Wine	101.869	99.621	49.852
31.	Cotton Lint	571.947	669.671	580.734
32.	Cattle liveweight	441.124	439.870	433.597
33.	Sheep liveweight	425.387	419.294	411.647
34.	Pigs liveweight	401.201	398.473	366.250
35.	Poultry liveweight	388.666	386.483	334.537
36.	Milk	80.257	80.106	92.685
37.	Hens Eggs	474.617	497.003	445.594
38.	Wool Greasy	1,029,740	1,019,713	1,051,613

available for at least more than two countries. This is, incidentally, the required rank condition for unique rational solution of the system of homogeneous equations of the order $(m + n - 1)$.

All the data on quantity produced and corresponding producer prices are averaged for the five years 1961–1965 in order to normalize any special conditions associated with a single year. Calculations are made using equations (1) and (2) with the partial exchange rate for the U.S.A., i.e. r_s being taken as unity. Consequently, the international average prices are expressed in terms of U.S.$. and the partial exchange rates for countries are expressed in U.S.$. per national currency unit adopted for measuring domestic prices.

In order to examine the sensibility of the solution, the countries are grouped into three sets. The first group of countries consists of all eleven countries with

the U.S.A. as standard; the second group of eight countries of the European group, again with the U.S.A., and the third group consists of four countries of Asia with the U.S.A. as standard. The resulting international average prices are presented in Table 1.

5. Calculated Partial Exchange Rates

Table 2 presents the calculated partial exchange rates of national currencies for these countries. The first row (1) presents r_j the partial exchange rates calculated according to the formula but the U.S.A. is not presented here since its exchange rate is taken to be unity. The second row (2) presents the inverse of the first row, expressing national currency units per one U.S.$. for ease of comparison with ordinary exchange rates which are presented in row (3). These are taken from actual transaction rates when they differ from the per value established with IMF, and five year averages are made.

By comparing rows (2) and (3) of the Table 2 one can see the differences between ordinary exchange rates and the calculated partial exchange rates. The partial exchange rates are lower than the ordinary exchange rates for India and Yugoslavia, but higher for the other countries. In cases where the partial exchange rates are higher than the ordinary exchange rates, one can infer that the general price level of the agricultural products in these countries is higher than that of other products which are considered important in international trade and therefore relate closely to the ordinary exchange rates.

Row (4) of Table 2 presents an indication of the relative price level of agricultural products as compared to that of other commodities. These indicative relative price levels have a limited meaning, since they compare the average price levels of selected agricultural products with the ordinary exchange rates which are in fact only applicable in international currency exchange in these countries. In an equilibrium situation, the relative price levels of all the commodities should be proportional to the ordinary exchange rate, but in fact it never is since comparative advantages in producing certain commodities do exist in certain countries and this is a reason for the existence of international trade in competitive commodities.

The purchasing power interpretation of the partial exchange rates as compared to the ordinary exchange rates is just another side of the coin. In those countries where the partial exchange rates exceed the ordinary exchange rates, the purchasing power of the national currencies for the agricultural products is lesser than for other goods and services. Column (5) of Table 2 indicates the relative purchasing powers of national currencies for agricultural products as compared to those for other commodities. It is interesting to see that in most countries selected here, with the exception of two, the relative purchasing power of national currencies is lower for agricultural products. There may be many reasons for this and an important one seems to be the national policy in supporting agriculture by keeping prices relatively higher through various policy measures.

At this point a comment on the sensitivity of the method in relation to different country and commodity groupings may be appropriate. As limited

TABLE 2

PARTIAL EXCHANGE RATES OF AGRICULTURAL PRODUCTS

Average 1961–1965

Country		Japan	Taiwan	India	Yugoslavia	Germany	U.K.	Italy	Netherlands	Spain	France
National Currency Unit =		1,000 yen	1 NT$	1 Rupiah	1 Dinar	1 DM	1 Pound	1,000 lt	1 guilder	1 peseta	1 Fr.
All Countries (11 countries)											
r_j Partial exchange rate											
U.S.$/national currency	(1)	1.443	0.021	0.292	0.126	0.182	0.121	1.144	0.238	0.015	0.162
$1/r_j$ national currency/U.S.$	(2)	0.693	47.62	3.42	793.7	5.495	0.4132	0.87413	4.202	66.667	6.173
(Ordinary Exchange Rate)	(3)	(0.360)	(40.10)	(4.78)	(850)	(3.99)	(0.357)	(0.622)	(3.60)	(59.97)	(4.90)
(3)/(2)	(4)	0.52	0.84	1.40	1.07	0.73	0.86	0.71	0.85	0.90	0.79
(2)/(3)	(5)	1.92	1.19	0.71	0.93	1.37	1.16	1.40	1.17	1.11	1.26
Asia Group											
(4 countries)	(1)	1.471	0.021	0.298							
	(2)	0.680	47.62	3.36							
European Group											
(8 countries)	(1)				0.121	0.179	0.118	1.220	0.236	0.015	0.158
	(2)				826.4	5.586	0.4237	0.893	4.237	66.67	6.329

experiments so far performed have shown, different country groupings do not result in much different partial exchange rates for countries. This aspect may be observed for the Asian Group and the European Group which are presented in Table 2, whereas the international average prices change rather noticeably, as may be seen in Table 1. This may suggest that in a country the price policy for agriculture seems to be rather uniform to all commodities, resulting in similar partial exchange rates for different country groups. On the other hand, the international average prices differ according to different country groupings because the relative quantity of certain products from certain countries contributes to the total of the group of countries in different degrees. Because of the nature of the model, the resulting international average prices and the partial exchange rates differ greatly when different commodities are chosen. Limited experimental results, however, on this effect are not reported here.

Another point to be mentioned here is that the European Group of countries show unanimously relatively higher price levels for agricultural products. Major EEC agricultural producing countries such as Germany, France and Italy, show that the terms of trade between agriculture and the rest are in favour of agriculture by about 10–20 per cent in comparison to that of U.S.A. Again, whether or not these indications observable from the computed partial exchange rates relate to the relative productivity difference between agriculture and the rest of the sector in an economy, as compared to those of U.S.A. requires further investigation. This field seems to be of extreme interest from the economics point of view vis-a-vis the theory of general equilibrium[7] but we cannot go into this field in the present paper.

6. Comparisons of Aggregate Production

Due to many theoretical as well as practical difficulties involved in aggregating total agricultural production of countries in a manner comparable among countries, FAO, for example, has been adopting wheat based relative prices as weighting coefficients in the past. An alternative to this method is to use cereal prices as the base for obtaining relative prices and this also has been explored.[8]

The method proposed in this paper is in effect to take all the commodities' prices into consideration. In addition to this, this method will yield the absolute level of U.S. dollar aggregates which are useful in many studies. The result of the total aggregate value expressed in U.S. dollars is presented in Table 3. The aggregate values of countries in Europe and the U.S.A. are obtained by using the average prices for European Group, while those for Asian countries are obtained by the average prices for Asian Group presented in Table 1.

The problem we face here is to answer the question asking how good are

[7]A. Wald: "On Some Systems of Equations of Mathematical Economics," *Econometrica*, XIX, October 1951. P. A. Samuelson: "International Trade and Equalization of Factor Press," *Economic Journal*, 58, June 1948. P. A. Samuelson: "International Factor Price Equalization Once Again," *Economic Journal*, 59, June 1949.

[8]*Recommendations for the Revision of FAO Index Numbers of Food and Agricultural Production:* Report by E. L. Snowdon, FAO Consultant, FAO, Rome, 1967. Colin Clark: "Future Sources of Food Supply: Economic Problems," *Journal of the Royal Statistical Society*, Series A, Volume 125, Part III, 1962.

TABLE 3

AGGREGATE PRODUCTION OF AGRICULTURE IN CONSTANT U.S. DOLLARS OF 1961–1965

(In thousand $)

	1963	1965	1967	1961–65
France	8,944,514	9,653,211	10,160,377	9,084,777
Germany	6,354,464	5,893,377	9,591,891	6,008,749
Italy	5,188,027	5,707,672	6,154,917	5,422,982
Netherlands	1,620,572	1,583,360	1,731,507	1,596,878
Spain	2,923,659	2,897,000	3,130,579	2,825,016
United Kingdom	4,279,693	4,538,992	4,562,802	4,307,454
Yugoslavia	1,829,557	1,772,531	2,065,752	1,764,111
U.S.A.	34,186,420	35,272,717	35,972,409	33,929,238
Taiwan	568,428	654,792	728,875	592,012
India	13,901,773	12,945,177	14,144,475	13,492,721
Japan	3,633,041	4,011,933	4,557,210	3,746,416

these estimates. Apart from theoretical advantages associated with the method of international average prices, the following empirical experiment has been performed in order to see the difference of comparable aggregates obtained in different methods; viz. comparisons of the different aggregates obtained by three alternative methods by means of quantum index numbers. Table 4 presents the resulting index numbers of agricultural production thus obtained by three sets of different weighting coefficients for the countries, regions and the world for selected years.

From Table 4, it is rather difficult to arrive at a definite conclusion; however, all three methods seem to show roughly similar results for most of the countries. In particular, the years within the broad base period do not show much difference and for the year away from the base period, i.e. 1967, there is no difference for the world total. Some difference is observed for Asia, and a large part of this is attributable to the relative weight for those commodities of importance, such as rice.

At this point I should conclude by saying that the method of international average prices has a definite advantage of calculating the aggregate in terms of one country's currency unit, and an extension of it is to enable the calculation of both current and constant price aggregates. The inverse operation would provide a general deflator for agricultural products.[9]

[9]Also; see J. van Yzeren: "Three Methods of Comparing the Purchasing Power of Currencies," *Statistical Studies*, No. 7, December 1956, The Netherlands Central Bureau of Statistics; and B. Balassa, "The Purchasing Power Parity Doctrine: A Reappraisal," *Journal of Political Economy*, Vol. LXXII, 1964.

TABLE 4

INDEX NUMBERS OF AGRICULTURAL PRODUCTION OBTAINED BY THREE ALTERNATIVE WEIGHTING SYSTEMS

1961–1965 = 100

Year	1963			1965			1967		
Type of weight	Wheat	All Cereals	Average prices	Wheat	All Cereals	Average prices	Wheat	All Cereals	Average prices
Country and Region With regional weights									
France	98.72	98.75	98.46	106.18	106.17	106.26	111.73	111.90	111.84
Germany, F.R.	105.65	105.57	105.75	98.22	98.35	98.08	110.59	110.68	110.54
Italy	96.00	96.15	95.67	105.10	105.08	105.25	113.51	113.48	113.50
Netherlands	101.49	101.57	101.48	99.27	99.26	99.15	108.63	108.56	108.43
Spain	103.75	103.53	103.49	102.51	102.52	102.55	111.65	11.181	110.82
United Kingdom	99.36	99.37	99.36	105.27	105.15	105.38	105.87	105.72	105.93
Yugoslavia	103.60	103.59	103.71	100.66	100.82	100.48	117.68	117.97	117.10
U.S.A.	100.87	100.92	100.76	103.96	104.01	103.96	105.95	105.95	106.02
Europe	101.22	101.22	101.13	102.46	102.48	102.45	111.38	111.45	111.17
India	102.92	102.64	103.03	96.58	97.26	95.94	104.84	104.50	104.83
Japan	96.91	96.90	96.97	109.16	109.66	107.09	124.14	124.69	121.64
Taiwan	96.88	96.61	96.02	109.78	110.12	110.60	126.60	127.00	123.12
Asia	98.90	98.71	98.67	105.17	105.68	104.54	118.53	118.73	116.53
World	100.56	100.51	100.43	103.34	103.49	103.16	112.84	112.93	112.16
With World Weight India	103.05	102.80	103.05	96.13	96.63	95.73	105.21	105.01	104.98