THE ECONOMIC JOURNAL

JUNE 1978

The Economic Journal, **88** (*June* 1978), 215–242
Printed in Great Britain

REAL GDP *PER CAPITA* FOR MORE THAN ONE HUNDRED COUNTRIES*

INTRODUCTION

The purpose of this paper is to fill, in an approximate way, a gap in the world statistical system arising from the absence of comparative data on "real" GDP *per capita* (i.e. gross domestic product *per capita* adjusted for differences in the purchasing power of currencies). The figures we present for 16 of more than 100 countries are based on careful comparisons of purchasing power. The others are derived from a short-cut method which extrapolates the relationship found for the 16 countries between real GDP *per capita* and certain independent variables.

The estimates of real GDP *per capita* derived by extrapolations from one set of countries to another must be regarded as approximations pending the further accretion of detailed purchasing power comparisons. Unfortunately, it will be quite some time before the more exact comparisons will be available for a large number of countries. The estimates offered here are subject to large margins of error, but are almost surely substantially closer to the true figures than the most commonly used comparisons of "nominal" GDP *per capita* (i.e. GDP *per capita* derived by using exchange rates to convert each country's GDP *per capita* to dollars).

THE PROBLEM AND ALTERNATIVE APPROACHES TO ITS SOLUTION

It is widely appreciated that the exchange-rate conversions of the Gross Domestic Products (GDPs) of different countries to a common currency such as the United States dollar do not yield a reliable basis for international comparisons. Detailed studies measuring the purchasing power parities (PPPs) of different currencies show clearly that the purchasing power over GDP of the currencies of low-income countries is systematically greater than their exchange rates as compared to the purchasing power/exchange rate relationship for high-income countries. Correspondingly, the real *per capita* GDP of low-income countries relative to that of high-income countries is greater than

* The authors wish to acknowledge helpful comments received from D. Crawford, W. Ethier, K. V. Henderson, L. R. Klein, A. Kundu, A. Maddison, W. Murray, C. Otto, A. Schwartz, L. H. Summers, and G. Szilagyi, some of them in connection with an earlier version of this paper. None of these persons necessarily endorses the methods or the results. The paper is the responsibility solely of the authors. The statistical work was performed by Sharon Bond and Chad Leechor.

Table 1

Indexes of Real and Nominal GDP per capita, *Indexes of Price Levels, and Measures of Exposure to World Prices, 1970*

(U.S. = 100)

	Indexes of GDP *per capita*		Exchange rate deviation index	Indexes of Price Levels			Indexes of Exposure	
	Real GDP 100*r* (1)	Nominal GDP 100*n* (2)	*r/n* (3)	GDP P_G (4)	Traded goods P_T (5)	Non-traded goods P_{NT} (6)	Openness *OP* (7)	Price isolation *PI* (8)
Kenya	6·33	2·99	2·12	47·3	63·7	31·7	542·0	793·0
India	6·92	2·07	3·34	30·0	49·6	13·4	91·8	5,936·0
Philippines	12·0	3·86	3·11	32·2	50·2	15·4	326·4	3,582·0
Korea, Rep. of	12·1	5·39	2·24	44·5	62·7	27·8	424·5	4,343·0
Colombia	18·1	7·24	2·50	39·9	58·8	24·8	253·6	5,121·0
Malaysia	19·1	8·10	2·36	42·2	59·2	26·6	753·6	1,139·0
Iran	20·3	8·37	2·42	41·2	60·5	24·8	365·5	911·0
Hungary	42·7	21·6	1·98	50·7	72·3	31·7	409·1	61,685·0
Italy	49·2	36·0	1·37	73·0	92·6	53·4	339·1	22·0
Japan	59·2	39·8	1·49	67·3	82·5	51·5	183·6	286·0
United Kingdom	63·5	45·7	1·39	72·1	85·7	57·9	393·6	1,211·0
Netherlands	68·7	50·8	1·35	73·8	91·2	56·0	835·5	499·0
Belgium	72·0	55·1	1·31	76·5	96·2	56·5	741·8	57·0
France	73·2	58·2	1·26	79·6	92·7	65·2	284·5	394·0
Germany, F.R.	78·2	64·1	1·22	82·0	100·1	63·2	373·6	349·0
United States	100·0	100·0	1·00	100·0	100·0	100·0	100·0	100·0

Sources:

(1) Real GDP = GDP *per capita* converted to dollars at purchasing power parity, expressed as *r* when taken as a ratio of U.S. GDP *per capita*. Kravis *et al.* (1978). Base value (for United States) = $4,790.

(2) Nominal GDP = GDP *per capita* converted to dollars at exchange rates, expressed as *n* when taken as ratio of U.S. GDP *per capita*. Kravis *et al.* (1978). Base value = $4,790.

(3) Column (1) ÷ column (2).

(4) Indexes of price levels = purchasing-power parity (foreign currency per dollar) divided by exchange rate (foreign currency per dollar) times 100. Kravis *et al.* (1978).

(7) Openness: *World Bank Tables, 1976* (Washington, D.C.: International Bank for Reconstruction and Development, 1976). Base value = 0·11.

(8) Price Isolation: See footnote on pp. 221–2. Base value = 3·22.

is indicated by comparisons based on exchange rate conversions of GDPs to a common currency.

This latter relationship shows up clearly in columns (1)–(3) of Table 1, which draws on the main results of the United Nations International Comparison Project (ICP), Kravis, Heston, Summers (1978). The ICP figures on real GDP *per capita*, obtained basically by making price comparisons for about 150 detailed subdivisions of final expenditures on GDP, are multilateral in the sense that they are transitive (yielding a unique cardinal scaling of the countries) and base-country invariant.

The exchange-rate deviation index, the ratio of real to nominal (exchange rate converted) income, tends to decline towards unity as one moves down the table from low- to high-income countries. A similar pattern is evident in other detailed studies of purchasing power parities (Gilbert and Kravis, 1954; Gilbert and associates, 1958).

In view of the obviously unsatisfactory character of exchange rate converted comparisons and the high cost of purchasing-power parity investigations, attempts have been made to employ "short cut" methods.[1] One approach has been to try to exploit structural relationships between real GDP (or sometimes consumption) *per capita* and economic variables, measures of which are readily available for many countries (e.g. *per capita* steel production, number of telephones in use, motor-vehicle stocks). These structural relationships usually are based upon patterns of domestic absorption of particular goods or services either for Engel-type reasons or because of production modes.[2]

Alternatively, the relationship between the exchange-rate deviation index and real income as depicted by the numbers in columns (1) and (3) in Table 1 has invited efforts to establish an empirical tie between real (r) and nominal (n) GDP *per capita* that could be used to estimate r for countries where it is unknown.[3] The work described below, which is the basis for the comparative income estimates reported in Table 4, is an extension of this latter approach.

A major difficulty in judging the comparisons produced by different versions of both of these approaches is that there has been no adequate standard against which their results could be assessed. The availability of the ICP Phase II comparisons for the 16 countries in Table 1 represents an improvement over the data base of earlier studies. The 16 countries include a wider variety of comparable observations than have previously been available: all the major continents are represented and the span of *per capita* GDP – from Kenya's to the United States' – approximates the range that exists in the world. The comparisons for a much larger number of countries, now contemplated in U.N. Statistical Office plans, will eventually make it possible to discriminate

[1] Another path to the desired comparisons is to attempt to produce them with less data than used in the full scale ICP studies. These "reduced information" methods are touched upon on p. 227.

[2] See Beckerman (1966), Beckerman and Bacon (1966) and Heston (1973).

[3] Early suggestions for this method may be found in Hagen (1957), p. 385; and in Delahaut and Kirschen (1961). B. Balassa and P. A. David have been prominently involved in this work. See David (1972). For the references to this literature and for a critical assessment, see Hulsman-Vejsova (1975). Some ICP work along these lines was reported upon by Summers and Ahmad (1974). This and other work by Sultan Ahmad helped to provide a basis for the present effort.

with greater precision among different approaches, and, within a given approach, among different variables. For now the results offered below must be regarded as state-of-the-art estimates which will surely require eventual revision.

Previous studies focusing on *n* have generally concentrated on an estimating equation in which real GDP *per capita* (*r*) has been related to nominal GDP *per capita* (*n*) alone.[1] This has had the practical advantage that *n* is a predictive variable that is readily available for almost all countries of the world. It would not help much in the task of getting estimates of *r* for countries not included in Table 1 to know for the 16 countries that relative prices of services, for example, played a large role in determining *r*, because the relative price of services is a very difficult variable to obtain on a comparable basis for many countries of the world. In the present study independent variables are employed which meet the essential criterion of wide availability and which add to the explanation of *r*.[2] The variables are based on the notion that the relationship between PPPs and exchange rates, or what is the mirror image of this relationship, the ratio of *r* to *n*, is affected by the connections between the price level of each country and world prices. For two countries at the same level of income, for example, internal prices may differ from world prices more for the country which is the more isolated from the world economy; if so, its ratio of *r* to *n* would also deviate from unity by a greater amount.

We begin in the next section with a theoretical discussion of the relationship between *r* and *n*, and then proceed to the empirical work. We focus initially on the relationships existing under the fixed exchange rate system which prevailed in 1970.

FACTORS INFLUENCING INTERNATIONAL PRICE RELATIONSHIPS

Though in this paper the object is to estimate real *per capita* GDPs, the discussion will concentrate on PPPs, which are monotonically related to real *per capita* GDPs. To say that there is a difference between PPPs and exchange rates is to assert that prices differ among the countries when they are all converted to a common currency via exchange rates. What is called for then is an analysis of the factors that determine international price relationships.

There are two broad sets of opposing forces affecting relationships among prices in different countries, one leading to integration of markets and driving prices towards equality and the other leading to the separation of markets and leaving room for or even producing international price differences.

The forces driving prices together are the pressures of international competition operating through world trade. Under certain conditions, these forces would indeed establish equal prices everywhere. If all the nations of the world were integrated in a single market, if perfect competition prevailed, and if

[1] Clague and Tanzi (1972) have investigated the determinants of the (*r*, *n*) relationship using other variables. However, they included the additional variables not primarily to enhance the relationship's ability to predict *r* for countries outside their sample but rather to throw light on the structure.

[2] Of course, the inclusion of more than one independent variable frees the ranking of countries by *r* from a necessarily monotonic relationship to their ranking by *n*.

there were no transport costs, there could be no differences in prices. Some writers in describing the real world have held the view that these conditions are sufficiently approximated so that, at least in the case of the industrialised countries, the "law of one price" generally governs international price relationships. For traded goods, world trade is held to guarantee the application of the law of one price. The same is claimed to be true for nontraded goods, but a more subtle argument is required: substitutions between nontraded and traded goods in consumption, and substitutions in factor use between the two types of goods are sufficiently great to ensure a clear tendency towards a law of one price for these goods as well.[1]

In fact, in the real world there is a problem with each of the necessary conditions for the operation of the law of one price in the world economy. Transport costs are not zero, but the advocates of the operation in the law of one price do, of course, take account of the fact. Perfect competition does not prevail and it has been shown (Kravis and Lipsey, 1977) that this can lead to systematic departures from the law of one price even for traded goods originating from a single source. However, neither of these considerations is likely to be related to any economic characteristic of different countries in a way that would lead to systematic differences in overall price levels.

The existence of systematic differences between price levels and a version of *per capita* income was suggested in a rudimentary form by Ricardo (1911) in his famous chapter on foreign trade in *Political Economy and Taxation* (p. 87): "the prices of home commodities, and those of great bulk, though of comparatively small value, are independently of other causes higher in those countries where manufactures flourish". Viner (1937), p. 315, in reviewing this and other passages, interpreted Ricardo as saying that non-tradables would be higher in price in high productivity countries because the effectiveness of labour in export industries would establish high wage levels for such countries. The nature of the relationship between price levels and *per capita* income has been discussed by a series of writers including Taussig (1928, ch. 5), Ohlin (1935, ch. 14), Harrod (1939, ch. 4), Usher (1963), Balassa (1964), and Samuelson (1964). What may be called a "productivity differential" model, most clearly set out by Harrod and Balassa, that is useful in the present context runs as follows. (1) International trade tends to equalise the prices of traded goods. (2) Given equal prices, wages will be high in high productivity countries. (3) Internal factor mobility will lead to high wages also in nontraded goods industries in high productivity countries. (4) Because international differences in productivity are smaller in non-traded goods industries (largely personal services) than in traded goods industries (largely commodities), the prices of non-traded goods will be higher in high productivity (high income) countries. (5) These high prices of non-traded goods have little if any impact on the exchange rate and thus make possible a difference between the overall purchasing power of the currency and the exchange rate. (Needless to say, these

[1] A broad applicability of the law of one price has recently found strong support among writers advocating the monetary approach to the balance of payments. See Frenkel and Johnson (1976), especially the chapter by D. N. McCloskey and J. R. Zecher.

various propositions are subject to independent check. Here they are used only as a basis for guiding the empirical work.)[1]

Let $r_j = R_j/R_b$ and $n_j = N_j/N_b$, where R is real (adjusted for purchasing power) GDP *per capita* and N is nominal or exchange-rate-converted GDP *per capita*. The subscripts j and b refer to the country being compared and the base country which for convenience is selected as the highest-income country. Further, let P_T denote the price of traded goods and P_{NT} denote the price of non-traded goods, each expressed as an index with the highest income country as the base. Then the ratio n/r for each country will be a weighted average of the price indexes for traded and non-traded goods,

$$n/r = \beta P_T + (1-\beta) P_{NT}, \tag{1}$$

where β and $1-\beta$ are the country's proportions of expenditure on traded and non-traded goods.[2]

Since, according to the argument set out above, $P_T = 1$, if β and P_{NT} were known for each country, n/r could easily be calculated and the occasion for writing this paper would not have arisen. All these values are known for the 16 countries in the ICP set but only n is known for other countries.

If $P_T = 1$ and P_{NT} is a function of *per capita* income,[3] the simple relationship of (2) can be derived from (1):

$$r_j = f(n_j). \tag{2}$$

The productivity differential model set out above would lead us to expect that (i) $r_j > n_j$ except for the base country, where $r_j = n_j$; and (ii)

$$d(r_j/n_j)/dr_j < 0.$$

The latter condition means that the ratio of real to nominal income – the index of exchange-rate deviation – falls with rising real *per capita* income.

In summary, if traded goods prices are pressed towards equality by international trade, but non-traded goods prices vary with the level of income, the overall price level for GDP will also vary directly with real *per capita* income. The prices of a low-income country will be low relative to those of a high-income country when both are converted to a common currency at prevailing exchange rates. The real *per capita* GDP (r) of the low income country consequently will be higher relative to that of the high-income country than is indicated by a comparison of their nominal GDPs *per capita* (n).

These theoretical expectations give no guidance about the precise empirical form of the relationship. r is expressed as a function of n in equation (1), because n is what is known and r is what is wanted. This is done even though, in causality terms, it is more appropriate to think of n as the dependent variable.[4]

[1] Note the similarity of this model with what is often referred to as the Scandinavian model of the transmission of inflation (see Aukrust, 1970).

[2] In the empirical work reported on below, the quantities are valued at international prices. For an explanation of this concept as used in the ICP, see *ibid.*, chapter 3.

[3] The relationship described holds and indeed is strengthened if $P_T \neq 1$ and both P_T and β are correlated with *per capita* income. See p. 224.

[4] It is easy to show that, when the direction of causality is from r to n, bias is introduced if r is placed on the left. However, the bias becomes small if R^2 is close to unity, which Table 2 shows to be the case.

Equation (2) may be put either in linear or log-linear form. Equation (3) represents the latter case, the one found more appropriate empirically:

$$\ln r_j = a + b \ln n_j. \tag{3}$$

The remarks about (2) translate into conditions about a and b: it is to be expected that $0 < b < 1$; and since $r_j = 1$ when $n_j = 1$ (i.e. for the base country), a should equal 0.[1]

To anticipate what follows, it may be remarked that it is quite possible that the real world relationship may not be linear in the logarithms so that a squared term which improves the fit may produce better estimates.

Per capita real income is surely not the only variable at work.[2] Equations (2) and (3) assert that for any pair of countries with the same nominal income *per capita*, real income *per capita* will be identical. This is almost equivalent to the assertion that the price levels – both the P_T's and P_{NT}'s – of such a pair of countries, when converted to a common currency via exchange rates, will also be identical.[3] However, the price level of each country is likely to be affected also by the degree of exposure to foreign price influences. One should not expect that the impact of such influences will be the same for two different countries with the same nominal (or real) *per capita* GDP's.

Consider two low-income countries with the same *per capita* income. The one more exposed to the world economy is likely to have its non-traded goods prices pulled up closer to the level of corresponding goods of high-income countries than the same prices in the country which is less exposed. In the more exposed economy, a larger proportion of the commodities that enter final expenditures are traded, and commodity prices are thus pulled closer to world levels. This raises factor prices in the commodity-producing (traded goods) sector. As a result of the tendency towards factor price equalisation within the economy, it also increases factor prices in the non-traded goods sector (service and construction industries), and thus raises the final prices of such products. In addition, higher commodity prices mean higher prices for the non-traded goods sector to the extent that commodity inputs are important in their final prices (e.g. as in construction). Thus the exchange-rate-converted GDP *per capita* for an open economy should be closer to its real *per capita* GDP than would be the case for an isolated economy with the same income; or in other terms, its exchange-rate deviation index (the ratio of r to n) should be smaller.

The extent of openness or isolation depends upon a wide variety of factors like geography, size, history and public policy.[4] Compare India and Kenya,

[1] In the empirical work described below, the constant term in fact is not suppressed for reasons discussed on p. 225.

[2] See Clague and Tanzi (1972) for example.

[3] "Almost" because relative prices might differ from one country to the other even though the average level of prices was in some sense similar.

[4] In this context the impact of public policies, particularly those which protect domestic industries against foreign competition, may appear to work in the opposite direction. That is, high levels of protection may produce both a more isolated economy and higher prices for the protected goods. The outcome for the GDP price level as a whole is not so clear, but the effects on relative prices seem predictable. In developing countries, for example, high levels of protection and the differential taxation of various industries, raise the internal price levels of those goods earmarked for development support, relative to the world price levels for the same goods. The direct impact is to

which have about the same *per capita* income. India, a huge populous subcontinent, is on the basis of size alone likely to be much less exposed to world price influences than a small country like Kenya.

The logic of these remarks is that equations (2) and (3) should be modified to include a measure of the degree to which each country's price level is influenced by foreign prices. Two different empirical approaches to such a measure have been examined.

One approach is based directly on a measure of exposure to world markets – the ratio of exports plus imports to GDP. As used here, "openness", OP_i, is measured by the average ratio of exports plus imports to GDP for the years 1965 to 1973.[1]

However, this way of measuring the sensitivity of a country's price level to international influences assumes that all the factors linking a given degree of trade exposure to price levels operate identically in different countries with the same *per capita* income level. In fact there may be differences from one country to another. Factor markets may work less perfectly in some countries than in others; even in two countries with the same *per capita* income and ratio of trade to GDP, the extent of the equalisation of wages in traded and non-traded industries may not be the same. Commodity prices may be pulled closer to world levels in countries with variegated exports and imports than in countries with exports and imports concentrated in a few products. A similar trade ratio does not assure that the public policies of two countries with equal real incomes will have the same effects on internal price relationships.

The alternative approach involves a measure based not on the opportunity for exposure which OP_i attempts to capture, but on the end result in terms of actual price impacts. This alternative turns on the assumption that the in-

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depress further the relative position of other goods in the internal price structure, and this is probably still the net effect after all the repercussions, some of which lead to price increases for the other goods, work themselves out. For the most part, it is traded goods that are singled out for encouragement (as is implied by the prominence of "import substitution" and "export promotion" in development strategies). It seems likely that the impact of development policies is generally to lower nontraded goods prices relative to the prices of traded goods. Thus, to the extent development policies push up the internal prices of traded goods relative to world prices, they lead to an exaggeration of nominal GDP relative to real GDP but to the extent that they depress the prices of non-traded goods they have the opposite effect. In some instances development policies may push up some traded goods prices (e.g. machinery) and depress others (e.g. food). Which of these opposing consequences of development policies will predominate depends on the particular pattern of state intervention and on macroeconomic policies. As Table 1 shows, low-income countries end up with very low internal prices both in traded and non-traded categories but particularly for the latter group. For a discussion of the effects of protection in developing countries see Little *et al.* (1970).

[1] These years were used because the openness measure could then be taken directly from the *World Bank Tables, 1976* (Washington, D.C.: International Bank for Reconstruction and Development, 1976). Exports and imports include services other than those rewarded by factor payments. Other dates and also other formulations might have been used. For example, incremental versions such as the ratio of the increase in exports of manufactured goods to the increase in manufacturing output are also discussed in the literature. See Kravis (1970) and Morrison (1976). In the present work versions of openness based on the imports/GDP and exports/GDP ratios were experimented with. They gave similar results to *OP* with the import ratio producing marginally larger *t*-ratios and the export ratio marginally smaller ones than *OP*. *OP* was regarded as superior to the import ratio because for the whole world of countries it was regarded as preferable to allow both imports and exports to serve as channels through which domestic prices could be influenced.

fluence of external factors on a country's price level at a particular moment in time can be inferred from how closely its time to time movements over some preceding period have been correlated with time to time movements of "world" prices. Specifically we have designed a price isolation variable to capture this covariation: *PI* is the mean squared difference for the years 1963–70 between the country's GDP implicit deflator and a "world" average GDP implicit deflator.[1]

If the openness variable, OP_i, is introduced into equation (3), it is not entirely clear what sign its coefficient will have. The more open an economy is, the higher will be its prices for non-traded goods and therefore the smaller the difference between n and r. This hypothesis, making the expected sign of the coefficient negative, was the basis for our introduction of the variable. On the other hand, the possibility that a lack of openness due to protective commercial policies could lead to higher prices for traded goods must be recognised.

A similar ambiguity of sign pertains to the coefficient of price isolation, *PI*. The positive sign argument (paralleling the negative sign argument for *OP*) is that the greater the price isolation the less a country's non-traded goods prices will be pulled up to the level of the high income country's and the larger will be the real income (r) associated with a given nominal income (n). But again this could conceivably be counterbalanced by a particular combination of micro and macro economic policies.

Despite this ambiguity about the signs of the coefficients of *OP* and *PI*, our judgment is that the basic market forces affecting prices for all of GDP outweigh the possible counter effects of commercial policy on traded goods prices. In an effort to be conservative, however, two-tail tests have been performed in assessing the significance of the coefficients.

[1] The first step in constructing the *PI* index was to create a "world" price (implicit deflator) index for 1963–70, the period selected. The "world" consists of the countries in terms of whose currencies the IMF has defined the value of a unit of Special Drawing Rights (SDRs). The deflators of the SDR countries were placed on a common base, and were converted to dollars by division by an appropriate index of exchange rates. The world index was then constructed by aggregating the SDR country indexes using weights reflecting the importance assigned to each currency by the IMF in its initial calculation of the value of an SDR unit in mid 1974. (See IMF, *Finance and Development*, December 1974.) The second step was to adjust each individual country's implicit deflator to a common base period and to correct for exchange rate changes. (The exchange rate correction yields an index of the implicit deflator in dollar terms.) The final step was to compute the price isolation index, *PI*, from the formula:

$$PI = \sum_{t=1963}^{1970} (WD_t - CD_t)^2/8,$$

where *WD* is the world price index and *CD* is the country price index, both based on the average of the period 1963–70. Eight of the ICP countries were included in the set of countries the IMF used in its SDR calculation. In calculating *PI* for each of these countries, a special world index was computed excluding the given ICP country. Other formulations of the *PI* variable, including a longer time period and a different base year, yielded broadly similar results.

FORMULATING AN ESTIMATING EQUATION FOR A SHORT CUT METHOD

The measures of r, n, openness, and price isolation for the 16 Phase II countries of the ICP presented in Table 1 are the variables used in the empirical work. The table also shows price levels for traded goods and non-traded goods.[1]

The productivity differential model leads us to expect that the prices of non-traded goods will be positively correlated with *per capita* income but that P_T will be (essentially) independent of *per capita* income. But the figures in the table clearly show that traded goods prices also depend somewhat upon income. There must be powerful forces militating against price equalisation even for tradables. What can they be?

For one thing, the prices paid by final purchasers for most commodities – which we have classified entirely as traded goods – contain large service elements attributable to trade and transport margins.[2] For the United States, for example, over a third of prices paid by final purchasers of commodities was accounted for by services.[3]

Furthermore, not all kinds of commodities are subject to the same degree of exposure to foreign prices, and the degree of exposure for a given category varies from one country to another. It is possible, for example, that in many countries most fruits and vegetables are consumed out of domestic production and are only marginally affected by international price competition. International price links for final expenditures on bread and cereals are also weakened, despite a substantial volume of international trade, by government actions directed at determining domestic price levels for foods. Governments in low-income countries often opt for low food prices partly or mainly with the needs of consumers in mind while governments in high-income countries are inclined to favour high food prices in order to support agricultural incomes and production. Not all public interventions, of course, work to reinforce the tendencies towards low prices in low-income countries and high prices in high-income countries, but food prices have large weights in GDP, particularly in low-income countries.

These factors that weaken the links between commodity prices at home and abroad are very pervasive in their impact. One finds very few of the more than 30 final expenditure categories in the basic ICP report for which prices do not move from very low levels in low-income countries to high levels in high-

[1] Traded goods have been defined to include all commodity components of final expenditures, except construction. Construction along with services has been classified as the non-traded component. See Kravis *et al.* (1978), chapter 4. Traded goods as defined here range from about 50 % of final expenditures on GDP in the highest-income country (the United States) to an average of more than two-thirds in the four lowest-income countries.

[2] See Usher (1968), pp. 77 and 158 f., for an argument that transport and distribution tend to be cheap in low-income countries.

[3] Trade, transport and insurance margins accounted for 40 % of purchasers' prices for commodities in personal consumption expenditures in the 1967 U.S. input–output table. For consumption commodities and gross private fixed capital formation combined, the margins made up 36 % of purchasers' prices. *Survey of Current Business*, February 1974, pp. 28, 32.

income countries very much in the manner that the figures in Table 1 indicate. Indeed, the only category for which prices are nearly the same, at least in 1970, in all 16 countries, is producers' durable goods. These are in a sense traded goods *par excellence*. A substantial fraction of their production enters international trade and buyers in many countries are in contact with sellers from many countries. For these goods even sales and services tend to carry international price tags.

The extent to which the prices of traded and non-traded goods approximate world levels in a country gives us the degree to which n equals r. A full statement of our model would have the prices of traded and non-traded goods each taken as a function of levels of income, openness and price isolation in a country. The reduced form equation of the system is derived when the relations explaining the prices of traded and non-traded goods are substituted into an expression for r_j, involving the prices of traded and non-traded goods on the right. The reduced form is given in (4*a*) below, with alternatives implied by uncertainties about the relative strengths of *PI* and *OP*.

$$\ln r_j = \gamma_1 \ln n + \gamma_2 \ln \left(\frac{OP_j}{OP_{US}}\right) + \gamma_3 \ln \left(\frac{PI_j}{PI_{US}}\right) + \gamma_4, \qquad (4a)$$

$$\ln r_j = \alpha_1 \ln n + \alpha_2 \ln \left(\frac{OP_j}{OP_{US}}\right) + \alpha_3, \qquad (4b)$$

$$\ln r_j = \beta_1 \ln n + \beta_2 \ln \left(\frac{PI_j}{PI_{US}}\right) + \beta_3. \qquad (4c)$$

Note that the constant has not been suppressed in these equations or in the regressions that follow. It might appear that the constant should be omitted because r should equal 1 when n and the *OP* and *PI* ratios equal 1. However, the omission of the constant would destroy the base invariance property that the estimates for the 16 ICP countries possess and which we wish to carry over into the extrapolations to non-ICP countries.[1] Retaining the constant and using the double logarithmic form means that the use of any other country as the numeraire in lieu of the United States would produce exactly the same *relative per capita* GDP estimates.

Equations (4*a*)–(4*c*) have been used as the basis for regressions with the addition, in each case, of a $(\ln n)^2$ term. This quadratic term was included because it was observed empirically that there was curvature in the double logarithmic relationship. The results using 1970 data are represented in Table 2 by equations B, C, and D.[2] In addition, the table contains equation A which omits *OP* and *PI*.

[1] Requiring the regression relationship to go through the base country point would clearly lead to a different estimated relationship if the base country were changed. This would mean that individual country predictions would depend upon which country was chosen as the base. Officer (1976), in his thoughtful article, p. 552, states that the numeraire country should be excluded. This procedure, like omitting the constant, would make the results dependent on the choice of the numeraire country.

[2] Hungary has been included in all the regressions that follow even though the case for applying this short-cut method to centrally planned economies may be weak. Perhaps it is a result of chance but the Hungarian residuals in the equations tend to be small. Consequently, excluding Hungary did not change the regression results materially.

Both *PI* and *OP* have slight explanatory power over and above that of *n*. *PI* does a little better than *OP* (compare equations C and B).[1] This means that the standard errors of estimate are smaller in both C and B than in A, which in turn indicates that errors of forecast are likely to be smaller. If we had to choose between equation B and equation C we would pick the latter. However, bearing in mind that the regressions are based on only 16 observations and that a clear picture cannot therefore be formed of the connections between world prices and domestic price levels, it seems the better part of valour to

Table 2

Estimating Equations Relating Real per capita *GDP to Nominal* per capita *GDP, Openness and Price Isolation*

Equation number*	$\ln n_i$	$(\ln n_i)^2$	$\ln \frac{PI_i}{PI_{US}}$	$\ln \frac{OP_i}{OP_{US}}$	$\ln \left(\frac{PI_i/PI_{US}}{OP_i/OP_{US}}\right)$	Constant	$\bar{R}^2$ (S.E.E.)
A_{70}	0·5542 (0·0995)	−0·0468 (0·0253)	—	—	—	0·0018 (0·0718)	0·986 (0·1091)
B_{70}	0·4560 (0·1121)	−0·0704 (0·0289)	— —	−0·0752 (0·0506)	— —	0·0471 (0·0751)	0·987 (0·1044)
C_{70}	0·6172 (0·0996)	−0·0351 (0·0241)	0·0308 (0·0167)	—	—	0·0094 (0·0661)	0·988 (0·1002)
D_{70}	0·5379 (0·1176)	−0·0552 (0·0289)	0·0266 (0·0168)	−0·0591 (0·0487)	—	0·0439 (0·0708)	0·989 (0·0983)
E_{70}	0·5819 (0·0889)	−0·0446 (0·0222)	—	—	0·0315 (0·0142)	0·0285 (0·0641)	0·989 (0·0957)
D_{73}	0·4046 (0·0773)	−0·0807 (0·0211)	0·0404 (0·0207)	−0·1061 (0·0408)	—	−0·0110 (0·0604)	0·991 (0·0888)
I_{70}	0·6566† (0·0910)	−0·0438† (0·0248)	0·0213 (0·0130)	−0·0706 (0·0388)	—	0·0270 (0·0530)	0·993 (0·0757)

Dependent variable: r = real (purchasing power adjusted) GDP *per capita* as ratio of U.S.
Independent variables: n = nominal (exchange-rate converted) GDP *per capita* as ratio of U.S. PI = price isolation (mean squared deviation of implicit deflator from "world" implicit deflator, 1963–70). OP = openness (ratio of exports plus imports to GNP, 1965–73).
N.B. If equation D_{70} is rewritten with the dependent variable taken as $\ln(r_i/n_i)$, $\bar{R}^2 = 0{\cdot}930$.
All variables taken as ratios of U.S. values and expressed in natural logarithms; figures in parentheses are standard errors.
* Subscripts refer to 1970 and 1973.
† In Equation I_{70}, n has been replaced by n/P^{REX} where P^{REX} is the U.N. place-to-place retail price index (excluding housing) with New York City = 100. See text, p. 227.

use some sort of average of the two sets of estimates – that is, the one based on n, n^2 and *PI* and the other based on n, n^2 and *OP*. Equation D which includes n, n^2 and both *PI* and *OP* is a way of obtaining such an average, allowing the data to establish the relative weights of *OP* and *PI*. Perhaps the availability of data for more countries at the end of Phase III of the ICP will make the choice between these variables clearer. Meanwhile, we consider equation D the best among A–D.

For those concerned about the low *t*-ratios of the coefficients of *PI* and *OP*

[1] Two-tail tests are used because of the uncertainties about the correct sign. See p. 223 above.

(1·58 and −1·21, respectively), it must be said that an F test of the null hypothesis that both coefficients are zero (essentially a two-tail test) had to be accepted at the 0·05 level. However, in equation E where PI and OP are combined in the ratio form, the coefficient of the ratio is significant at the 0·05 % level (two-tail test). PI and OP are nevertheless retained as separate influences because of a reluctance to accept the implication of the ratio form that the two have equal coefficients that are equal in magnitude but opposite in sign.

The estimates of real *per capita* GDP for well over 100 countries produced by equation D, our (marginally) preferred equation, are compared with those of other equations in Table 4. Fortunately, the estimates produced by B and C are not very different from those of D. Only three B estimates are not within 10 % of the corresponding D estimate, and while 14 of the C estimates fall outside this range, none is beyond 15 %. Thus it affects the results for most countries very little if we choose OP or PI singly rather than both together as the additional independent variables to add to n and n^2.[1]

One can get an idea of the precision of the estimates of r for the 139 non-ICP countries listed in Table 3 from the variability in estimates produced by the different plausible estimating equations.[2] More useful probably is an indication of the standard error of forecast for the best regression equation. Of course, this standard error depends upon the values of the independent variables on the basis of which the "forecast" is to be made. Over a broad range of these values, the standard error for (the log-linear) equation D is 0·12, implying an error of about 13 %. This in turn implies, very loosely, a 0·95 confidence interval of about 28 % above the estimated value and 22 % below. ("Loosely" because a proper confidence interval interpretation requires repeated sampling, which does not apply in the present work.)

It might be added that in the search for plausible estimating equations we experimented also with a variant of n which was based in part upon retail price indexes covering the living expenses of U.N. officials regularly published for over 100 (mainly capital) cities of the world.[3] The most successful of the equations involving these data, equation I (see Table 2), compared favourably with our preferred equation D, particularly with respect to the standard error of estimate. However, the estimates of real *per capita* GDP derived from this and

[1] The main exception is Indonesia for which the C equation produces an estimate 32 % higher than that of the B equation.

[2] For comparisons of any two countries the "best" estimate of real *per capita* GDP should be used for each country. In order of our preference the "best" estimate is obtained from (i) the ICP actual, (ii) Equation D_{70}, (iii) Equation C_{70}, (iv) equation B_{70} and (v) equation A_{70}. This suggested rule is based upon the assumption that the residuals of the two countries obtained from any of the regressions are independent. If it is believed that the two countries have factors in common that would produce similar residuals (i.e. correlated), then they should be compared on the basis of estimates of real *per capita* GDP taken from the "best" estimate available to the two of them in common. For example, if Sweden, a non-ICP country, is to be compared with the Netherlands, an ICP country, and it is thought that the two countries are so similar that they would be likely to deviate from equation D_{70} in the same way, then a more appropriate Netherlands figure to use would be that produced by equation D_{70}. That is, Sweden's 86·6 should be compared with Netherland's 62·3 of column 5, not the ICP figure of 68·7 in Table 1. (In effect, this is equivalent to a comparison of the ICP figure from the Netherlands with Sweden's D_{70} figure modified by an amount equal to Netherlands' residual.)

[3] Currently published in the February and August issues of the U.N. *Monthly Bulletin of Statistics*. Note that the use of these data provide an illustration of a "reduced information" method referred to earlier.

other equations in which the post-adjustment data were included produced notably lower estimates for the African countries than the other equations. Our surmise was that, particularly for a Western basket of goods, the ratio of capital city prices to prices in the rest of the country tends to be much higher in many African countries than is the case elsewhere.

ESTIMATES FOR 1973 AND SUBSEQUENT YEARS

One way of deriving estimates of real GDP *per capita* for years later than 1970 is to extrapolate the 1970 estimates in Table 3 by the rate of growth in real *per capita* GDP in each country relative to the growth rate in the United States. The 1970 basis was taken as a starting point for the work described above rather than the similar ICP benchmark estimates for the same 16 countries for 1973 for both statistical and economic reasons. On the statistical side, the 1970 data have to be regarded as somewhat more reliable since for most countries they were based on more detailed information. From an economic standpoint it seemed possible that the variability of exchange rates during 1973 and the two preceding years might have been too large, too frequent, and/or too erratic to enable us to feel certain that the price levels of most of the ICP countries fell into a normal relationship to the average 1973 exchange rate.[1] On the other hand, the choice of 1970 is vulnerable to the criticism that the final disruption of the fixed exchange rate system in 1971 does not provide the basis for much confidence that the 1970 price-levels/exchange-rate relationship could be regarded as being any more normal.

In the light of these uncertainties, we fitted equations (4*a*)–(4*c*) to 1973 data as a means of providing an alternative way of getting 1973 estimates of real *per capita* GDP for non-ICP countries. The best equation, even more clearly than in 1970, included both *PI* and *OP* among the independent variables. It is entered in Table 2 as equation D_{73}. While it is very similar to D_{70} with respect to signs and general magnitudes and significance of the coefficients, the coefficients for *PI* and *OP* are more significant and the standard error of estimate is lower. Despite these differences, the appropriate analysis of covariance test is consistent with the hypothesis that the coefficients in the two regressions are equal.[2] This finding is consistent with evidence from other work, not reported upon here,[3] indicating stability of the *n*/*r* relationship over a longer period of time. However, the small numbers of observations make it impossible to accept the hypothesis of temporal stability with great confidence.[4]

[1] For example, the number of German (F.R.) marks required to buy one U.S. dollar in 1973 declined by 26% between the end of January and the end of July and then rose by 14·9% by the end of December. In terms of annual averages the DM/dollar rate declined by 16% between 1972 and 1973 and by 27% between 1970 and 1973. (*International Financial Statistics*, Feb. 1974, Aug. 1974 and March 1977.)

[2] $F_{5,22} = 0{\cdot}75$. Since the critical value of $F_{5,22}$ at the 5% level is 2·66 we cannot reject the hypothesis that 1970 and 1973 are homogeneous.

[3] The work included the 1950 and 1955 estimates of the OEEC and some of it was reported upon in Summers and Ahmad (1974).

[4] When a slope dummy is added for openness for the 1973 observations, its coefficient is more than twice its standard error. Similar treatment for *PI* yielded a coefficient less than its standard error. As the analysis of covariance test mentioned in the text implies, when both dummies were added in the same equation, neither was significant.

Before comparing the results of using equation D_{73} to estimate 1973 real GDP *per capita* for non-ICP countries with the results obtained by extrapolating to 1973 the 1970 estimates produced by equation D_{70}, it is necessary to say a few words about the method of extrapolation. A suitable method of extrapolation is important in the long run if use is to be made of benchmark estimates to derive figures for other years. Here the selected method is used to obtain 1974 figures on GDP *per capita.*

The main problem is the need to ensure that the comparisons for non-benchmark years include the effects of changes in the terms of trade since the benchmark year. The series on GDP in constant prices appearing in standard sources are usually based on the valuation of both exports and imports in constant prices, thus precluding allowance for changes in the terms of trade. For some countries that are relatively dependent upon international trade, changes in the terms of trade can have a substantial impact upon real income. This is particularly true over a period like 1970–3 in which great changes in international price relationships, of which changes in oil prices were the most spectacular, took place.

In order to incorporate the impact on real income of changes in the terms of trade, the net foreign balance component of GDP has to be treated separately from "domestic absorption" (the rest of GDP). For domestic absorption, the *per capita* quantity change between the benchmark year and the year of extrapolation for each country is estimated by deflating consumption, capital formation and government by the implicit deflators covering these sectors. This yields the value of domestic absorption in the extrapolation year expressed in international dollars of the benchmark year. The net foreign balance is then valued in benchmark year international dollars[1] and added to the figure for domestic absorption to obtain GDP *per capita* in international dollars. Finally, this sum is compared to the corresponding U.S. total to form the extrapolation year index for real per capita GDP.

The present possibilities for evaluating the two methods of estimating real 1973 GDPs *per capita* – the one applying equation D_{73}, based on 1973 benchmark data for 16 countries to non-ICP countries and the other extrapolating 1970 *r*'s (from D_{70}) to 1973 – are quite limited. One of the few that is open is to compare their relative success in matching the 1973 ICP benchmark indexes. The test is, of course, biased in favour of the D_{73} equation since it is a least squares fit to the data, but it is of interest to see whether the extrapolations do as well, nearly as well, or much worse.

The actual indexes are set out in column (1) of Table 3, the ratios of the 1973 predicted values of equation D_{73} to the actual values are in column (2), and the ratios of the 1973 extrapolations of the 1970 values produced by equation

[1] As in other categories of GDP, a notional quantity is formed by dividing expenditures (the net foreign balance, in this case in local currency) by the PPP (in this category, the exchange rate). Since international prices are all relative (in the sense that the international price for GDP as a whole equals unity), it is necessary to correct for the change in price levels between the benchmark and extrapolation years. For technical reasons related to the way in which the ICP produces the multilateral results, this adjustment is based on implicit deflators for U.S. exports and imports. See Kravis *et al.* (1978, chapter 4).

Table 3

Comparison of Alternative Estimates for 1973

	Actual ICP 1973 (U.S. = 100) (1)	Ratio of predicted to actual: Equation D_{73} predicted values (2)	Ratio of predicted to actual: D_{70} results extrapolated to 1973 with internal growth rates (3)
Kenya	6·12	1·18	1·12
India	6·37	0·96	0·84
Philippines	12·2	0·93	0·79
Korea, Rep. of	14·6	0·97	1·03
Colombia	17·9	0·99	0·97
Malaysia	19·1	1·07	0·98
Iran	29·2	1·02	0·88
Hungary	45·1	0·96	0·97
Italy	47·0	1·04	0·99
Japan	64·0	1·16	0·98
U.K.	60·6	1·00	1·01
Netherlands	68·4	0·99	0·93
Belgium	75·3	0·89	0·87
France	76·1	0·98	0·98
Germany, F.R.	77·4	1·09	0·96

D_{70} to the actuals are in column. (3) As is to be expected, the predicted values of the 1973 equation are closer to the 1973 actuals than the estimates produced by either of the other methods. This is true whether the judgement is based on a count of the cases in which each method comes closer to the actual or on the mean deviations from the actuals. However, its margin of superiority over the extrapolations of the 1970 (D_{70}) estimates is quite narrow.

The estimates based on equation D_{73} have the advantages of greater currency and of wider country coverage. Still we come down in favour of those derived from D_{70} because we think there was more intrinsic stability in the 1970 r/n relationship than in the one for 1973. The explanatory power of equation D_{73} depends more on *PI* and *OP* than is the case for equation D_{70} and we are not confident that the number of observations is large enough to permit us to perceive the role of these variables accurately. The case for using more recent data for the estimating equation is likely to carry more weight in the future when more observations are available, particularly in a world that has more clearly adapted to a more variable exchange rate system, or, if that has not happened, ways may be found to capture the unsettling effects of varying exchange rates.

The extrapolation of the 1970 estimates also has the advantage of ensuring intertemporal relationships that are more consistent with the time to time changes within countries. The use of one equation to estimate 1970 *per capita* GDPs for non-ICP countries and of another to estimate their 1973 *per capita*

GDPs would open the possibility that chance factors may affect the 1970 and 1973 indexes for a given country in opposite directions.[1]

Although we prefer the estimates obtained by extrapolating the D_{70} 1970 indexes, estimates based on Equation D_{73} are shown in Table 4 (column 8) so that they may be compared with extrapolated indexes (column 9). The ratio of the latter to the former falls within the range of 0·9–1·1 in over 60 % of the cases for which both are available. Further, the difference between the two estimates of real *per capita* GDP is almost always smaller than the difference between either and the nominal *per capita* income.

We also show in Table 4 the differences in the extrapolations of equation D_{70} to 1973 when as in column 9 changes in real income are used (i.e. allowance is made for changes in the terms of trade), and the extrapolations of D_{70} to 1973 when as in column 10 the changes in real production are used (i.e. the terms of trade are assumed to be constant).[2] The differences between the two sets of extrapolations depend upon changes in the terms of trade and upon the magnitudes of exports and imports.[3] The real growth in domestic absorption (consumption plus investment plus government) is, of course, the same under either method. If the country has a zero net foreign balance or if the prices in all sectors (domestic absorption, exports and imports) change by the same percentages, the real growth in income and production will be the same. But if exports and imports differ, then when export prices rise by more than import prices, the change in real income will be greater than the change in production. With the same physical outputs and the same physical exports and imports, the country's claim against the rest of the world will be greater than would be the case without the relative rise in export prices. A striking case is Kuwait where the estimate based on income is 130 % higher than that based on production. In Kuwait the implicit deflator for exports rose by 167·8 % while the import price deflator changed by only 7·8 %. Since the net foreign balance for Kuwait was 42 % and 63 % of GDP in 1970 and 1973, respectively, the rise in relative export prices produces a substantial difference between the two methods. A deterioration in the terms of trade, of course, produces the opposite effect.[4] In most cases, the terms of trade do not change so much or the relative importance of the net foreign balance is smaller. Therefore, the two extrapolations yield more similar answers. For over three quarters of the countries for which both figures are available, the difference is less than 5 %.

[1] This may have happened in the case of Sweden, for example: the D_{70} equation produces a 1970 *per capita* GDP index of 86·6 for Sweden (with 1970 U.S. GDP *per capita* = 100) and the D_{73} one of 77·1 for 1973 (1973 U.S. *per capita* GDP = 100). It seems implausible that a change this large occurred in the relative *per capita* GDPs of these two countries in this three year period. The extrapolation of the 1970 index of 86·6 produces a 1973 estimate of 83·0 if changes in the terms of trade are taken into account and 81·8 if they are assumed to be constant. In terms of each country's own accounts, there was a 5·6 % rise in real *per capita* GDP in Sweden between 1970 and 1973 compared with a 11·8 % rise in the United States.

[2] That is, when both exports and imports are valued at base year prices.

[3] It should be noted that extrapolators for real production are available sooner in conveniently assembled form than are the more complicated extrapolators for real income.

[4] For example, Zaïre, a country in which the extrapolation based on production yields a GDP estimate 7 % greater than that based on income, had an 8·7 % rise in its implicit deflator for exports and 37·2 % for its import deflator. Zaïre's net foreign balance accounted for 1·5 and 8·5 % respectively of GDP. (U.N. *Yearbook of National Accounts Statistics*, vol. II, 1975, p. 890.)

Table 4

Indexes of GDP per capita *1970, 1973 and 1974* (*U.S.* = 100)

	1970						1973				1974	
		Real, based on equation				Exchange rate deviation index			Extrapolated from 1970 with terms of trade			
	Nominal (1)	A_{70} (2)	B_{70} (3)	C_{70} (4)	D_{70} (5)	(6)	Nominal (7)	Equation D_{73} (8)	Changed (9)	Constant (10)	Nominal (11)	Real (12)
Bhutan	0·981	2·97	—	—	—	—	—	—	—	—	—	—
Mali	1·13	3·39	2·83	3·36	2·92	2·59	—	—	—	—	—	—
Upper Volta	1·23	3·69	3·24	3·72	3·35	2·72	—	—	—	—	—	—
Rwanda	1·25	3·75	3·30	3·76	3·39	2·71	1·16	3·06	2·90	2·92	1·10	3·00
Burundi	1·40	4·17	3·72	4·49	4·07	2·91	—	—	—	—	—	—
Bangladesh*	1·44	4·29	3·88	4·31	3·99	2·77	1·28	3·54	2·90	2·83	1·60	3·20
Lao PDR	1·44	4·29	—	4·18	—	—	—	—	—	—	—	—
Ethiopia†	1·50	4·46	4·03	4·27	3·96	2·64	1·45	3·80	3·72	3·74	1·48	3·80
Chad	1·55	4·58	3·87	4·39	3·87	2·50	—	—	—	—	—	—
Lesotho‡	1·55	4·58	3·81	4·33	3·78	2·44	2·05	4·85	3·94	3·81	1·34	4·59
Malawi	1·55	4·58	3·90	4·56	4·02	2·60	1·78	4·36	4·30	4·49	2·00	4·60
Yemen	1·59	4·69	—	—	—	—	—	—	—	—	—	—
Nepal§	1·61	4·75	—	4·83	—	—	—	—	—	—	—	—
Burma‖	1·63	4·81	4·46	4·63	4·38	2·69	1·31	3·69	3·81	3·88	1·52	4·08
Indonesia	1·65	4·86	4·34	5·72	5·12	3·10	2·05	5·51	5·40	5·20	3·00	6·40
Guinea	1·71	5·04	4·46	4·67	4·28	2·50	—	—	—	—	—	—
Benin	1·71	5·04	4·28	4·94	4·36	2·55	1·84	4·38	3·90	3·71	1·70	4·00
Afghanistan	1·84	5·38	4·91	5·25	4·90	2·67	—	—	—	—	—	—
Zaire	1·84	5·38	4·52	5·71	4·94	2·69	2·03	4·89	4·42	4·71	2·20	4·48
Somalia	1·86	5·43	4·64	5·18	4·61	2·48	—	—	—	—	—	—
Niger	1·88	5·49	4·90	5·31	4·88	2·60	—	—	—	—	—	—
Maldives	1·92	5·60	—	—	—	—	—	—	—	—	—	—
Haiti	2·02	5·88	—	5·54	—	—	—	—	—	—	—	—
Dem. Yemen	2·07	5·98	—	—	—	—	—	—	—	—	—	—
India‡	2·07	5·98	5·95	6·10	6·06	2·93	2·08	6·09	5·38	5·36	1·96	5·49

Table 4 (*cont.*)

Tanzania¶	2·09	6·04	5·30	5·81	5·27	2·52	2·16	5·29	5·20	5·20	2·30	5·40
Gambia	2·11	6·10	5·11	6·18	5·38	2·55	—	—	—	—	—	—
Comoros	2·13	6·15	—	—	—	—	—	—	—	—	—	—
E Timor	2·26	6·48	—	—	—	—	—	—	—	—	—	—
Khmer Rep.	2·63	7·43	7·21	7·53	7·34	2·79	—	—	—	—	—	—
Cent. African Rep.	2·65	7·48	6·65	7·26	6·64	2·51	—	—	—	—	—	—
Madagascar	2·78	7·79	7·16	7·40	6·97	2·51	2·81	6·96	5·70	5·75	—	5·70
Togo	2·80	7·84	7·06	7·65	7·07	2·53	3·18	7·69	6·70	6·62	—	7·80
Uganda	2·82	7·90	7·25	7·26	6·87	2·44	—	—	—	—	—	—
Sudan*	2·90	8·10	7·51	7·64	7·26	2·50	3·86	9·63	6·50	6·63	—	—
Kenya	2·98	8·30	7·46	7·92	7·33	2·45	2·97	7·25	6·88	7·06	3·12	6·79
Nigeria‡	3·03	8·40	7·78	7·83	7·44	2·46	3·67	9·24	7·70	7·58	—	9·80
Botswana	3·13	8·66	7·56	7·86	7·16	2·29	5·05	11·2	8·30	9·15	6·50	11·4
Tonga*	3·44	9·40	—	—	—	—	—	—	—	—	—	—
Mauritania	3·44	9·40	8·16	9·30	8·33	2·42	3·75	8·63	7·20	6·85	—	8·30
Sierra Leone*	3·49	9·50	8·65	9·39	8·74	2·51	3·52	8·84	8·30	7·73	3·80	8·80
Pakistan*	3·67	9·93	9·74	9·11	9·08	2·47	2·07	6·26	8·00	7·99	2·40	8·50
Samoa	3·69	9·98	—	—	—	—	—	—	—	—	—	—
Sri Lanka	3·74	10·1	9·47	10·0	9·53	2·55	3·38	8·95	9·98	9·14	3·54	10·0
Thailand	3·76	10·1	9·52	9·65	9·26	2·46	4·23	10·8	9·40	9·38	4·90	9·70
Cameroon*	3·86	10·4	9·53	9·87	9·31	2·41	4·89	11·4	8·40	8·58	—	8·80
Philippines	3·86	10·4	9·85	10·3	9·93	2·57	4·18	11·3	9·59	9·86	5·35	10·3
Solomon Is.	4·18	11·1	—	—	—	—	—	—	—	—	—	—
Bolivia	4·30	11·4	10·6	10·0	9·63	2·24	3·25	8·36	9·12	9·29	5·14	10·2
Senegal	4·51	11·8	11·0	11·5	10·9	2·41	3·97	9·85	8·80	9·78	4·10	9·60
Egypt*	4·53	11·9	11·4	10·9	10·7	2·37	4·20	10·8	10·0	9·88	4·20	10·1
Morocco	4·68	12·2	11·5	11·7	11·3	2·41	5·14	11·8	9·80	6·00	5·50	11·3
Mozambique	4·76	12·4	—	—	—	—	—	—	—	—	—	—
Mauritius	4·86	12·6	11·2	12·5	11·4	2·35	6·62	14·0	12·7	12·6	9·70	16·9
St Vincent	4·89	12·6	—	—	—	—	—	—	—	—	—	—

Table 4 (*cont.*)

	1970						1973				1974	
		Real, based on equation				Exchange rate deviation index			Extrapolated from 1970 with terms of trade			
	Nominal	A_{70}	B_{70}	C_{70}	D_{70}		Nominal	Equation D_{73}	Changed	Constant	Nominal	Real
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
S. Viet Nam	4·91	12·7	12·2	13·6	13·1	2·67	2·52	7·53	11·4	11·3	—	12·2
Congo	4·97	12·8	11·5	12·3	11·4	2·29	—	—	—	—	—	—
Paraguay	5·20	13·3	13·0	12·6	12·5	2·40	6·02	14·2	12·6	12·2	7·31	13·9
Jordan	5·32	13·5	12·6	12·7	12·1	2·27	5·14	10·7	—	—	—	—
Ghana	5·36	13·6	13·1	13·6	13·2	2·45	3·10	8·16	11·2	11·5	3·00	12·7
Korea	5·39	13·7	13·0	13·7	13·2	2·44	5·91	14·1	15·0	15·3	7·60	17·0
Guinea Bissau	5·45	13·8	—	—	—	—	—	—	—	—	—	—
St Kitts	5·45	13·8	—	—	—	—	—	—	—	—	—	—
Eq. Guinea	5·51	13·9	—	—	—	—	—	—	—	—	—	—
Ecuador	5·60	14·1	13·6	13·4	13·1	2·34	6·23	15·6	13·9	14·0	8·07	15·6
Liberia	5·60	14·1	12·7	13·5	12·6	2·25	5·39	12·2	11·0	11·8	6·40	11·1
Syria	5·62	14·1	13·5	13·2	12·9	2·29	5·78	13·7	13·2	12·9	8·23	16·5
Swaziland*	5·64	14·2	12·6	12·5	11·5	2·05	7·99	16·3	11·5	12·1	—	12·1
Papua	5·85	14·6	13·8	13·8	13·3	2·28	8·98	19·7	12·0	16·0	7·60	12·9
Tunisia	5·87	14·7	13·9	14·3	13·7	2·34	8·28	17·6	15·2	15·2	9·40	17·9
Rhodesia	5·91	14·7	—	13·4	—	—	—	—	—	—	—	—
Honduras	5·95	14·8	13·9	13·4	12·9	2·17	5·22	12·5	11·7	11·8	4·98	11·6
Dominica	5·97	14·9	—	—	—	—	—	—	—	—	—	—
El Salvador	6·07	15·1	14·2	14·6	14·0	2·31	5·56	13·4	13·5	13·6	6·00	14·5
Angola	6·20	15·3	—	—	—	—	—	—	—	—	—	—
St Lucia	6·43	15·8	—	—	—	—	—	—	—	—	—	—
Algeria	6·76	16·4	15·6	15·5	15·0	2·21	8·12	16·7	16·5	14·3	10·7	20·4
Peru	6·93	16·8	16·5	16·5	16·3	2·35	6·72	15·9	15·9	15·8	7·13	17·6
Colombia	7·24	17·4	17·3	17·5	17·5	2·42	7·11	17·7	17·6	17·5	7·84	19·2
Ivory Coast	7·24	17·4	16·0	16·3	15·5	2·13	8·85	18·2	14·3	15·4	9·70	13·9

Table 4 (*cont.*)

Grenada	7·29	17·4	—	—	—	—	—	—	—	—	—	—
Antigua	7·29	17·4	—	—	—	—	—	—	—	—	—	—
Turkey	7·62	18·1	18·9	17·7	18·4	2·41	8·96	21·2	19·0	18·8	11·4	20·8
Dominican Rep.	7·64	18·1	17·6	17·4	17·1	2·24	8·54	19·2	19·3	19·6	9·60	21·8
Guyana	7·74	18·3	16·5	18·0	16·6	2·15	6·43	14·0	13·7	14·2	8·20	14·5
Guatemala	7·79	18·4	18·0	17·9	17·7	2·27	7·49	17·9	17·0	17·7	7·84	18·0
Oman	7·93	18·6	17·0	18·0	16·9	2·13	11·0	22·9	22·6	12·8	33·5	58·4
Iraq	7·98	18·7	17·8	17·4	16·9	2·11	8·64	19·6	17·1	16·3	16·0	27·5
Malaysia	8·10	18·9	17·5	18·3	17·3	2·13	10·2	20·4	18·7	18·6	12·4	21·2
Iran**	8·37	19·4	19·0	18·7	18·4	2·20	14·8	29·9	24·5	22·4	22·7	33·3
Zambia	8·79	20·2	18·4	20·8	19·3	2·20	8·59	18·0	16·5	16·7	8·90	17·0
Belize	8·81	20·2	—	—	—	—	—	—	—	—	—	—
Fiji	8·83	20·3	18·4	19·7	18·3	2·08	12·5	22·1	20·8	19·9	15·1	22·6
Nicaragua	9·46	21·4	20·4	20·5	19·9	2·11	9·22	19·9	18·6	18·3	10·6	21·8
Cook Is.	9·71	21·8	—	—	—	—	—	—	—	—	—	—
Brazil	10·3	22·8	23·8	22·1	23·0	2·23	12·4	27·9	26·6	26·2	14·4	29·4
Montserrat	10·4	23·0	—	—	—	—	—	—	—	—	—	—
Saudi Arabia††	10·4	23·0	21·3	22·1	20·9	2·01	21·0	32·9	34·9	28·2	49·3	66·1
Costa Rica	11·8	25·3	24·0	24·0	23·3	1·97	13·2	24·6	22·8	23·9	13·1	23·9
Lebanon	12·6	26·5	24·4	25·8	24·3	1·93	—	—	—	—	—	—
Barbados	12·6	26·5	23·8	26·0	23·9	1·90	14·6	24·3	—	—	—	—
Mexico	13·8	28·3	29·5	24·6	26·0	1·88	14·3	29·7	24·9	25·0	16·9	26·5
Gabon	14·0	28·6	25·9	28·0	26·0	1·86	22·5	34·1	33·0	30·2	44·8	47·2
Jamaica	14·3	29·1	27·2	28·3	27·0	1·88	14·7	27·6	25·7	26·9	17·6	28·2
Malta	14·4	29·2	26·3	29·7	27·3	1·90	15·9	28·9	27·3	28·8	16·1	30·2
Portugal	14·8	29·9	28·7	27·7	27·1	1·82	21·4	33·1	32·4	31·3	23·0	33·8
Chile	14·9	29·9	30·8	30·1	30·8	2·07	10·3	26·8	27·3	27·0	10·9	28·4
Guadeloupe	15·1	30·2	—	—	—	—	—	—	—	—	—	—
Panama	15·3	30·5	28·6	29·2	27·9	1·83	15·1	28·2	26·9	28·2	16·1	27·7
S. Africa‡‡	15·7	31·2	30·3	27·2	27·1	1·72	17·4	30·5	26·4	25·0	19·3	28·3

Table 4 (*cont.*)

	1970						1973				1974	
		Real, based on equation				Exchange rate deviation index			Extrapolated from 1970 with terms of trade			
	Nominal	A_{70}	B_{70}	C_{70}	D_{70}		Nominal	Equation D_{73}	Changed	Constant	Nominal	Real
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Reunion	16·1	31·6	—	—	—	—	—	—	—	—	—	—
Hong Kong	16·1	31·7	28·3	29·4	27·1	1·69	22·9	32·2	30·5	29·1	23·6	30·7
Surinam	16·6	32·3	—	—	—	—	—	—	—	—	—	—
Uruguay	17·7	33·8	34·5	35·3	35·6	2·02	15·7	33·3	31·7	29·7	18·4	31·1
Martinique	18·0	34·2	—	—	—	—	—	—	—	—	—	—
Cyprus	18·0	34·3	32·0	34·8	32·8	1·82	24·6	38·3	35·8	35·7	19·3	28·8
Trinidad	18·3	34·7	32·5	34·4	32·7	1·78	20·7	33·9	32·0	31·4	24·8	39·8
Singapore	19·1	35·8	31·1	35·3	31·7	1·66	30·9	39·1	37·6	38·2	35·0	40·2
Hungary	21·6	38·9	37·9	43·6	42·1	1·95	26·1	43·5	43·9	—	—	—
Argentina	22·0	39·4	41·5	40·5	42·0	1·91	23·9	45·0	42·9	41·4	33·7	46·4
Spain	22·7	40·3	40·4	39·6	39·7	1·75	32·8	49·1	42·9	42·5	36·6	45·1
Afars and Issars	23·0	40·6	—	—	—	—	—	—	—	—	—	—
Venezuela	23·5	41·2	39·8	43·1	41·7	1·78	25·4	38·0	41·4	39·1	33·6	50·6
Greece	23·7	41·4	41·1	38·5	38·7	1·64	29·3	45·7	42·6	42·6	32·3	42·2
Bahrain	23·7	41·5	—	—	—	—	—	—	—	—	—	—
Virgin Is.	26·1	44·2	—	—	—	—	—	—	—	—	—	—
Ireland	27·9	46·2	42·9	45·1	42·6	1·53	34·7	43·6	44·6	41·9	32·9	42·3
N. Antilles	28·7	47·2	—	—	—	—	—	—	—	—	—	—
Brunei	28·8	47·2	—	—	—	—	—	—	—	—	—	—
Italy	35·9	54·6	53·2	49·0	48·7	1·35	40·8	48·7	46·7	47·4	40·8	48·0
Libya	39·0	57·5	52·1	57·8	53·4	1·37	52·6	57·7	59·2	44·6	86·7	92·5
Japan	39·8	58·2	59·2	56·8	57·7	1·45	60·4	74·3	62·9	63·1	62·6	62·6
Israel	40·3	58·6	54·4	59·9	56·2	1·40	50·0	63·5	59·4	59·7	60·7	63·7
Austria	40·3	58·7	55·1	54·2	52·1	1·29	58·4	63·5	54·5	54·1	66·1	59·5
Puerto Rico*	42·9	61·0	—	58·3	—	—	—	—	—	—	—	—

Table 4 (*cont.*)

Fr. Polynesia	44·0	62·0	—	—	—	—	—	—	—	—	—	—
U.K.	45·7	63·5	60·5	65·2	62·5	1·37	50·6	60·7	61·4	61·8	50·9	61·4
New Zealand‡	46·7	64·3	60·9	67·9	64·6	1·38	65·1	69·0	—	61·9	—	—
Finland	47·0	64·6	60·6	66·6	63·1	1·34	60·4	63·9	65·0	65·1	70·9	68·9
Iceland	50·6	67·5	61·0	73·6	67·2	1·33	81·4	75·1	77·9	72·4	95·4	76·8
Netherlands	50·8	67·7	60·6	68·0	62·3	1·23	71·1	67·6	63·3	62·1	77·0	64·5
Belgium	55·1	71·1	63·9	67·2	62·3	1·13	74·6	66·9	65·1	64·3	82·2	68·4
France	58·2	73·5	70·8	74·0	71·7	1·23	77·1	74·7	74·5	73·3	76·5	77·0
Norway	60·0	74·8	66·9	74·6	68·4	1·14	78·7	69·6	68·6	68·4	87·8	72·7
Australia*	61·5	75·9	72·9	71·3	69·6	1·13	88·5	81·0	72·1	68·4	95·9	71·5
Germany	64·1	77·8	72·9	78·5	74·5	1·16	89·4	84·1	74·1	72·9	93·4	75·7
Luxembourg	65·5	78·7	—	80·3	—	—	—	—	—	—	—	—
Denmark	65·9	79·1	71·8	79·3	73·4	1·11	88·0	75·3	73·5	71·8	90·8	73·1
Switzerland	66·7	79·6	71·8	78·3	72·4	1·09	100	82·8	—	69·0	—	—
N. Caledonia	67·7	80·3	—	—	—	—	—	—	—	—	—	—
Kuwait‡	75·0	85·2	74·5	87·3	78·3	1·04	131	94·9	134	58·3	177	161
Canada	81·1	89·0	81·7	87·4	81·9	1·01	88·6	76·6	85·3	85·2	97·4	90·4
Sweden	85·8	91·9	83·4	93·6	86·6	1·01	100	77·1	83·0	81·8	104	86·0
Qatar	90·9	94·9	—	92·0	—	—	—	—	—	—	—	—
U.S.A.	100·0	100·0	100·0	100·0	100·0	1·00	100	100·0	100·0	100·0	100·0	100·0

Columns (1), (7), (11). Nominal GDP *per capita* for year 1970 is from U.N. *Yearbook of National Accounts Statistics*, 1975, vol. III, table 1A, except ICP countries, which are from table 1. For years 1973 and 1974, same source used where possible, otherwise calculated from U.N. *Monthly Bulletin of Statistics* data, August 1977 issue, or from revised data for IBRD, *World Tables*. The base values for the U.S. are $4,790 in 1970, $6,192 in 1973 and $6,633 in 1974.

Columns (2)–(5). From equations A_{70}, B_{70}, C_{70} and D_{70} of Table 2. The estimates produced by each equation have been normalised by dividing by the U.S. value produced by the equation. Since the U.S. is taken as the base country, the base values for real GDP *per capita* in each year are the same as those for nominal GDP *per capita* (see previous note).

Column (6). Column (5)/column (1).

Column (8). From equation D_{73} of Table 2. See notes to columns (2)–(5).

Columns (9), (12). Extrapolators based on correlative price indexes for major expenditure categories (consumption, exports, etc.) from U.N. *Yearbook of National Accounts Statistics*, 1975 and IBRD *World Tables*.

Column (10). Extrapolators based on implicit deflator for GDP as a whole from same source for each country as columns (9) and (12).

* Year beginning 1 July.
† Year ending 7 July.
‡ Year beginning 1 April.
§ Year ending 15 July.
|| Year ending 30 September.
¶ Former Tanganyika only.
** Year beginning 21 March.
†† Estimates relate to Hejra fiscal year.
‡‡ Including Namibia.

Estimated indexes of real GDP *per capita* are presented in Table 4 for 1974 also. These figures are derived, for the non-ICP countries, by extrapolation from the 1970 indexes by the method outlined above.[1]

The extrapolations of the 1970 indexes to 1973 and 1974 for non-ICP countries and from 1973 and 1974 for ICP countries are subject not only to the errors in the 1970 estimates for non-ICP countries, discussed above, but also to errors in the price indexes for consumption, capital formation, government, and exports and imports. In most countries, including some of the most developed ones, the knowledge of the movements of purchasers' prices for major economic sectors, including particularly capital goods and exports and imports, can only be described as poor. Price indexes for capital goods usually exclude more complex types of equipment, and it is in these types that rapid technological progress has most likely been made. Export and import price indexes exist in only a few countries, and the unit value indexes that are usually employed in their stead are defective proxies for price movements. Because the resulting errors in the measurement of the changes in real income may differ from one country to another in sign as well as magnitude, the extrapolated figures are subject to wider margins of error than the 1970 data.

In general, the indexes of real GDP *per capita* for 1973 and 1974 do not differ radically from those of 1970. The increases in index numbers tend to predominate indicating that most countries had a more rapid growth in real *per capita* income than the United States. Among the non-ICP countries Canada enjoyed one of the largest increases, improving its position relative to the United States by 8·5 percentage points between 1970 and 1974 (compare columns (5) and (12)). In this and other cases, however, the improvement was much more modest than is suggested by the nominal changes (the Canadian nominal index rose – compare columns (1) and (11) – by over 16 percentage points). Obviously, the depreciation of the dollar has produced a misleading impression of the extent of the relative income changes. Despite the rash of stories in the public press, these figures suggest that in 1974 at least the United States was still the country with the highest real GDP *per capita*.[2]

"WORLD" DISTRIBUTIONS

Further comparisons are provided in Tables 5 and 6 where the 1970 data are grouped by income level and by type of country and geographical region. In the first of these tables the countries are taken from an array by real *per capita* GDP and grouped into population deciles. (The aggregate GDPs of countries falling on the margin between two deciles were prorated so as to fill out the population of the lower decile and to assign the remainder to the higher decile.) Here as in Table 4 one can see the familiar tendency for the exchange-rate deviation index to be inversely correlated with real GDP *per capita*. How-

[1] The estimates are provided for those countries for which the necessary current-price GDP figures and implicit price indexes could be found in the 1975 U.N. *Yearbook of National Accounts Statistics* supplemented in a few cases by data in recent issues of the U.N. *Monthly Bulletin of Statistics*.

[2] A more detailed examination of the countries closest to the United States for 1975 shows this is still the case, at least if oil exporting countries are excluded.

Table 5

Distribution of Aggregate Nominal and Real GDP Among Countries Arrayed in Population Deciles in Ascending Order of Real per capita *GDP, 1970*

Population deciles*	Aggregate GDP Nominal (mil. U.S. $) (1)	Aggregate GDP Real (mil. U.S. $) (2)	Exchange-rate deviation index (3) = (2)/(1)	*Per capita* GDP Nominal (U.S. $) (4)	*Per capita* GDP Real (U.S. $) (5)	% share in "world" GDP† Nominal (6)	% share in "world" GDP† Real (7)
1	18,252	50,302	2·76	75	207	0·74	1·49
2	23,028	70,228	3·05	95	289	0·93	2·09
3	24,038	80,368	3·34	99	331	0·97	2·39
4	25,865	81,190	3·14	107	334	1·04	2·41
5	44,472	111,258	2·50	183	458	1·79	3·31
6	73,361	174,932	2·38	302	720	2·96	5·20
7	138,496	281,590	2·03	570	1,160	5·59	8·37
8	374,525	573,843	1·53	1,543	2,363	15·11	17·05
9	633,196	811,065	1·28	2,608	3,340	25·54	24·10
10	1,124,053	1,130,563	1·01	4,629	4,654	45·34	33·59
Total	2,479,292	3,365,354	—	1,021	1,386	100·00	100·00

* Total population of the 155 countries included is 2,429 million.

† All countries or areas for which *n* could be obtained from standard sources were included. See Table 3 for list of included countries; the main exclusions are the centrally planned economies other than Hungary.

ever, the presentation of the data in decile format calls attention to an initial rise in the exchange rate deviation index from the lowest to the third decile. This pattern appears at first glance to be dominated by the very high exchange-rate deviation index of populous India which constitutes the entire third decile as well as a substantial part of the second decile. Quite apart from India, however, there is little evidence of a declining trend among the 15 lowest income countries which fall squarely in the lowest decile in the array. Negative results were produced by a limited effort to explain this exception to the general rule in terms of the small population size of a number of the countries with very low income.

The most striking feature of the table, however, is the concentration of "world" production it displays. ("World" is placed in quotation marks to remind readers that, as the table footnote indicates, important and populous countries are not included in the data.) The concentration is measured using both exchange-rate converted and PPP-converted figures. The former (column 6) indicates that the most productive 10% of the world population produces nearly half of the world product while the highest fifth accounts for over two thirds. The actual concentration as measured by the latter (column 7) is less than this though still great: countries with 10% of the population produce one third of the world domestic product and countries with 20% produce over half. From the other side, column (7) shows that the least productive half of the people produce only about 12% of world output.

When the countries are classified by type and area (Table 6), it can be seen that the average real *per capita* GDP (column 11) in the developing countries

Table 6

Distribution of Aggregate Nominal and Real GDP Among Types of Countries and Geographical Regions, 1970

	Population		Aggregate GDP				Exchange-rate deviation index	*Per capita* GDP			
			U.S. $ (mil.)		% share in World* GDP			U.S. $		Index (world = 100)	
	Millions (1)	% share (2)	Nominal (3)	Real (4)	Nominal (5)	Real (6)	(7) = (4)/(3)	Nominal (8)	Real (9)	Nominal (10)	Real (11)
World	2,418·75	100·00	2,468,579	3,344,228	100·00	100·00	1·35	1,021	1,383	100·00	100·00
Developed Market Economies	739·42	30·6	2,102,883	2,471,954	85·2	73·9	1·18	2,844	3,343	279	242
North America	226·20	9·4	1,064,182	1,065,035	43·1	31·8	1·00	4,705	4,708	461	340
Europe	368·82	15·2	775,121	1,025,532	31·4	30·7	1·32	2,102	2,781	206	201
EEC	251·48	10·4	619,634	801,062	25·1	24·0	1·29	2,464	3,185	241	230
Other	117·34	4·9	155,487	224,470	6·3	6·7	1·44	1,325	1,913	130	138
Other†	114·40	6·0	263,580	381,388	10·7	11·4	1·45	1,825	2,641	179	191
Developing Market Economies	1,678·30	69·4	365,696	872,273	14·8	26·1	2·39	218	520	21	38
Africa	329·76	13·6	58,177	136,004	2·4	4·1	2·34	176	412	17	30
Asia	1,078·62	44·6	149,735	414,723	6·1	12·4	2·77	139	384	14	28
America	269·92	11·2	157,784	321,546	6·4	9·6	2·04	585	1,191	57	86

* See note to Table 5 for inclusions. Hungary has been omitted from this table.

† Japan, South Africa, Israel, Australia, and New Zealand.

of Asia and Africa is only between one fourth and one third of the world average. At the other extreme the average real *per capita* output of North America is 3·4 times the world average (rather than the 4·6 times indicated by the nominal figures). When the totality of the developed market economies is compared with the entire group of developing market economies, average real *per capita* GDP of the former is 6·4 times that of the latter rather than the more than 13-fold ratio produced by exchange conversions.

CONCLUSION

The real GDP *per capita* figures presented for countries in Table 4, we believe, are the best estimates available currently, but we recognise the individual numbers are subject to substantial margins of error. Our confidence in the estimates is bolstered by the fact that very similar values are obtained for most countries using a variety of kinds of data. That they are more accurate than the alternative estimates based upon exchange-rate conversions is indisputable for poor countries and almost certainly so for rich countries. Of course, it may be expected that aggregates covering a number of countries (such as those in Tables 5 and 6) are likely to be more accurate than figures for individual countries.

As work continues on purchasing-power studies and the number of benchmark countries grows, it should be possible using techniques like those described in this paper to sharpen the individual estimates. In particular, benchmark estimates for a larger number of countries will make it possible to make a better choice among the alternative independent variables and, indeed, between short-cut and reduced-information methods (or combinations of the two).

It should be clear, however, that such estimates cannot be regarded as substitutes that will make it possible to dispense with benchmark estimates of the ICP-type, costly as the latter are. It will be necessary to maintain a substantial nucleus of benchmark studies in a reasonably current form to provide a secure basis for preparing short-cut or reduced-information estimates of real GDP *per capita* for non-benchmark countries in the future. It must be borne in mind also that short-cut methods provide estimates only for aggregate GDP while the benchmark studies offer a rich source of information on comparative economic structure in that they include price and quantity comparisons for consumption, capital formation, and government and for subaggregates of these major sectors.

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Date of receipt of final typescript: November 1977

References

Aukrust, O. (1970). "PRIM: A Model of the Price and Income Distribution Mechanism of an Open Economy." *Review of Income and Wealth*, series 16, no. 1.

Balassa, B. (1964). "The Purchasing Power Parity Doctrine: A Reappraisal." *Journal of Political Economy* (December).

Beckerman, W. (1966). *International Comparisons of Real Income*. Paris: OECD Development Centre.

—— and Bacon, R. (1966). "International Comparisons for Income Levels: A Suggested New Measure." ECONOMIC JOURNAL, vol. 76 (September), pp. 519–36.

Clague, C. and Tanzi, V. (1972). "Human Capital, Natural Resources and the Purchasing Power Parity Doctrine: Some Empirical Results." *Economic Internazionale* (February).

David, P. A. (1972). "Just How Misleading Are Official Exchange Rate Conversions?" ECONOMIC JOURNAL (September), pp. 969–90.

Delahaut, J. P. and Kirschen, E. S. (1961). "Les Revenues Nationaux du Monde Non Communiste." *Cahiers Economiques de Bruxelles*, no. 10 (April).

Frankel, J. A. and Johnson, H. G. (1976) (eds.). *The Monetary Approach to the Balance of Payments*. Toronto and Buffalo: University of Toronto Press.

Gilbert, M. and associates (1958). *Comparative National Products and Price Levels*. Paris: Organisation for European Economic Co-operation.

—— and Kravis, I. (1954). *An International Comparison of National Products and the Purchasing Power of Currencies: A Study of the United States, the United Kingdom, France, Germany and Italy*. Paris, Organisation for European Economic Co-operation.

Hagen, E. E. (1957). "Comment", Conference on Research in Income and Wealth. *Problems in the International Comparison of Economic Accounts*. Studies in Income and Wealth, vol. 20. Princeton: Princeton University Press.

Harrod, R. F. (1939). *International Economics*. London: Nisbet and Co.; Cambridge University Press.

Heston, A. (1973). "A Comparison of Some Short-Cut Methods of Estimating Product Per Capita." *Review of Income and Wealth* (March).

Hulsman-Vejsova, M. (1975). "Misleading Official Exchange-Rate Conversions." ECONOMIC JOURNAL (March).

Kravis, I. B. (1970). "External Demand and Supply Factors in LDC Export Performance." *Banca Nazionale de Lavoro Quarterly Review*, no. 93 (June).

—— Heston, A. and Summers, R. (1978). *United Nations International Comparison Project: Phase II; International Comparisons of Real Product and Purchasing Power*. Baltimore, Ind.: Johns Hopkins University Press.

—— and Lipsey, R. E. (1977). "Export Prices and the Transmission of Inflation." *American Economic Review* (February).

Little, I., Scitovsky, T. and Scott, M. (1970) *Industry and Trade in Some Developing Countries*. London: Oxford University Press.

Officer, L. (1976). "The Productivity Bias in Purchasing Power Parity: An Economic Investigation." *IMF Staff Papers* (November).

Ohlin, B. (1935). *Interregional and International Trade*. Cambridge, Mass.: Harvard University Press.

Ricardo, D. (1911). *The Principles of Economy and Taxation*. London: J. M. Dent.

Samuelson, P. (1964). "Theoretical Notes on Trade Problems." *Review of Economics and Statistics*, vol. 46 (May).

Summers, R. and Ahmad, S. (1974). "Better Estimates of Dollar Gross Domestic Product for 101 Countries: Exchange Rate Bias Eliminated." Econometric Society meeting, discussion paper no. 297, University of Pennsylvania (December).

Taussig, F. W. (1928). *International Trade*. New York: Macmillan.

Usher, D. (1963). "The Transport Bias in Comparisons of National Income." *Economica* (May).

—— (1968). *The Price Mechanism and the Meaning of National Income Statistics*. Oxford: Clarendon Press.

Viner, J. (1937). *Studies in the Theory of International Trade*. New York and London: Harpers.