Approaches to Purchasing Power Parity and Real Product Comparisons Using Shortcuts and Reduced Information

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It is generally recognized that international comparisons of relative levels of income should be carried out with national incomes converted to a common currency using purchasing power parities (PPP). The usual practice has been to make the conversion using exchange rates, and this has been shown to give very inaccurate results. Unfortunately, reliable estimates of PPPs are available for only a handful of countries because the standard benchmark method of making estimates of them requires a very substantial commitment of time and resources. The present work investigates various procedures for estimating PPPs (or, equivalently, real national incomes) which are more economical in their requirements.

Two approaches are pursued here: (1) a short-cut approach which attempts to exploit structural relationships between real national income in a country and associated monetary and/or non-monetary indicators; and (2) a reduced information approach in which PPPs are estimated on the basis of small subsets of price data which can be collected cheaply in the countries being compared.

Shortcuts based on a monetary indicator, nominal income, and supplemented with other financial and physical indicator variables, provide a basis for estimating PPPs which is a substantial improvement over the use of exchange rates. Furthermore, a systematic experimentation with a large data base collected for international comparisons suggests that a significant reduction in the number of prices collected in each country could be carried out without serious degradation of the quality of PPP estimates.

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TABLE OF CONTENTS

LIST OF TABLES

APPROACHES TO PURCHASING POWER PARITY AND REAL PRODUCT COMPARISONS USING SHORTCUTS AND REDUCED INFORMATION

1. INTRODUCTION

The inadequacy of official rates of exchange as a basis for comparing the Gross Domestic Products (GDP) of different countries has been widely recognized in economic literature. For instance, in 1970 and 1973, real GDP in India relative to the US based upon an estimate of the overall purchasing power parity (PPP) of the Indian currency, was more than three times the value shown when the conversion was made using exchange rates. 1/ Further, changes in exchange rates either as a result of a country's devaluation or as a consequence of its decision to allow its rate to float freely may produce comparisons which are totally unrelated, over both time and space, to relative real growth in the countries being compared. The recent experience of Japan vis-a-vis the US is a case in point. From mid-1977 to mid-1978, real per capita GDP grew by 4.4 percent in Japan and 3.1 percent in the US, raising the level of per capita GDP in Japan relative to that in the US by 1.3 percent. However, if official exchange rates which registered a 33 percent appreciation in the Japanese yen over the same period, were used, the per capita real GDP in Japan relative to the US appeared to have increased in just one year by 35 percent!

Obviously, there needs to be a better alternative to conversions by exchange rates. A proper alternative is the true

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1/ Irving B. Kravis, Alan Heston and Robert Summers, International Comparisons of Real Product and Purchasing Power (Baltimore: Johns Hopkins University Press, 1978), p. 10. This work is referred to here as the ICP Phase II Report, or KHS (1978a).

purchasing power parity of a currency as observed not merely over internationally traded goods and services, but over the entire GDP. Estimating the PPP involves pricing comparable sets of commodities and services in different countries and combining the individual price relatives with appropriate quantity weights.

The pioneer work in this field was that of Gilbert and Kravis (1954), 2/ which produced binary comparisons between the US and four European countries--the United Kingdom (UK), France, Germany and Italy—for 1950. Gilbert and Associates (1958) 3/ later extended the comparisons to a few more European countries for both 1950 and 1955. Other national and international agencies have calculated purchasing power parities for groups of countries. 4/

The most comprehensive work in this area is being undertaken by the International Comparison Project (ICP) of the UN Statistical Office. 5/ Reports on the first two of the three phases

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2/ Milton Gilbert and Irving B. Kravis, An International Comparison of National Products and Purchasing Power of Currencies (Paris: OEEC, 1954)

3/ Milton Gilbert and Associates, Comparative National Products and Price Levels (Paris: OEEC, 1958).

4/ For example, UN Commission for Latin America, A Measurement of Price Levels and the Purchasing Power of Currencies in Latin America, 1960-62 (New York: United Nations Economic and Social Council, 1963) (E/CN. 12/653); Japan Economic Planning Agency (EPA), Analysis of Price Comparisons in Japan and the United States (Tokyo: EPA, 1963), (Economic Bulletin no. 13) Tsunehiko Watanabe and Ryutaro Komiya, "Findings from Price Comparisons: Principally Japan vs. the United States," Weltwirtschaftliches Archiv (Hamburg: Institute fur Weltwirtschaft, 1958) Bd. LXXXI.

5/ The ICP is a cooperative undertaking of the United Nations Statistical Office, the World Bank and the International Comparison Unit of the University of Pennsylvania.

of the ICP 6/ have been published in Kravis, Kenessey, Heston and Summers (1975) 7/ and Kravis, Heston and Summers (1978). 8/

Both Gilbert and Kravis (1954) and Gilbert and Associates (1958) had dealt only with European countries and mainly had made binary comparisons with the US. The ICP extended that work in two fundamental ways. First, it included countries with widely varying geographic locations (four continents), economic performance (poor as well as rich) and organization of production and distribution (socialist as well as capitalist). The purpose was to develop a methodology that could encompass all the countries in the world. Second, it emphasized multilateral comparisons, the main purpose being the simultaneous solution of all possible parities so as to achieve transitive base-invariant comparisons among the countries.

The project has also produced benchmark data that are invaluable for future work. Between the Phase I and Phase II reports, the ICP produced comparisons for 16 countries for 1970 and 1973, and for seven of these countries, for 1967 also. The work of

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6/ For a brief description of the many phases of the ICP, see Irving B. Kravis, Robert Summers, Alan Heston and Alicia Civitello, "The Three Phases of the International Comparison Project," International Association for Research in Income and Wealth Fourteenth General Conference, Aulanko, Finland, August 1975.

7/ Irving B. Kravis, Zoltan Kenessey, Alan Heston and Robert Summers, A System of International Comparisons of Gross Product and Purchasing Power (Baltimore: Johns Hopkins University Press, 1975). This is referred to in the present study as A System or ICP Phase I Report.

8/ Kravis, Heston and Summers (1978a).

Phase III now in progress is expected to extend the comparison to a total of 34 countries.

Another project--on Latin American real product and purchasing power parity comparisons, initiated by the Inter American Development Bank, the ECIEL and the UN Economic Commission for Latin America and implemented in cooperation with the ICP--would extend the coverage even further and perhaps will succeed in developing linkages among the various regional and interregional comparisons.

1.1 Subject of This Investigation

There are a number of drawbacks to the extensive projects such as the ICP. Unfortunately, they involve resources far beyond the capabilities of individual researchers. Further, they require the cooperation of many national organizations. Many countries do not have high levels of interests in this type of projects or sophisticated statistical organizations to undertake the work. Additionally, even for countries participating in such projects, their scope makes it impractical to produce full-scale comparisons for more than some benchmark years, perhaps evey five or ten years. For intervening years, some simpler procedures must be adopted.

Thus, for reasons of cost, lack of interest and expertise, and in order to fill the gaps in intra-benchmark years, shortcut methods or methods based on reduced information need to be found, methods that can duplicate the results of the ICP-type study, but which will not involve as much work and expense. The present study is an investigation into such procedures.

1.2. The Methods Analyzed

The methods being investigated here may be divided into two broad categories. One is called shortcuts because the methods seek to produce real income comparisons with the help of various monetary and non-monetary indicators and would eliminate price collection. The shortcut methods are in turn divided into two sub-categories: those based upon monetary indicators and those based upon physical indicators. The former seek to establish, using available data, the relationship between PPP and some readily available monetary indicators such as official exchange rates and to predict the relative real income levels for countries and time periods for which reliable PPP estimates are not available. The second subcategory--shortcuts using physical indicators--are designed to achieve the same results by estimating relationships between real per capita income (or consumption) and various physical or non-monetary indicators such as consumption of cement, milk or newsprint, or stocks of telephones, motor vehicles, or television sets.

The second category of methods, called reduced information methods, involves defining a basket of items which is much smaller than the total ICP sample but which will nevertheless represent the entire country efficiently in a price comparison. These methods should be capable of producing comparisons at the highest levels of aggregation, viz., the GDP, but at the same time provide enough detail on price structures to permit comparisons of various major components such as consumption, capital formation, or goverment, or even of more detailed subaggregates such as food, clothing or transportation. Three kinds of reduced information procedures are addressed here: (a) those using published data; (b) those using mechanical or ad hoc approaches to reduced information; and (c) those using systematic or regression methods of reduced information.

The reason for the search for reduced information procedures is, as noted, a desire to minimize the cost of collecting the prices needed for ICP-type comparisons. This cost will be less if regularly published data can be used. An often-mentioned source is the set of data underlying the Consumer Price Index (CPI), but these data lack international comparability in terms of quality and coverage. The primary use for such data is for time-to-time comparisons, as contrasted with place-to-place comparisons.

Large bodies of data on international costs of living do exist which are more or less internationally comparable; however, they are collected to compute compensatory allowances for employees stationed in various countries. The best known sources are those of the UN and governmental agencies of the US and the Federal Republic of Germany. 9/ These data cover many countries and are available at no cost. In the present work, the UN and US data were examined to see how, if at all, they could be used in estimating a system of PPPs.

The reduced information procedures that seek to produce ICP-type comparisons with a minimum of data on prices and expenditures

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9/ United Nations, "Retail Price Indexes Relating to Living Expenditures of United Nations Officials," Monthly Bulletin of Statistics, March and September issues; US Department of Labor, BLS, "U.S. Department of State Indexes of Living Costs Abroad," Labor Developments Abroad (Washington, D.C.); Federal Republic of Germany, Statistiches Bundesamt, Internationaler Verleich der Preise Fur die Lebenshaltung, Reihe 10 (Wiesbaden).

are based on the premise that item prices are correlated and, therefore, that it should be possible to eliminate some items without materially affecting the final comparisons.

The simple, ad hoc or mechanical method of reduced information, seeks to eliminate categories or items on the basis of arbitrary cutoff points determined by the expenditure weights associated with a category or by the frequency with which the ICP sample of countries responded to requests for prices of items. The more systematic reduced information method seeks to determine, using a regression equation procedure, a set of item prices that offers the best basis for predicting the PPP at a predetermined level of aggregation. However, no price or expenditure information is truly redundant, and reducing the sample size involves errors. Thus, the greater the cuts in the sample size, the greater the savings in the costs of collection, and the greater the errors. The objective with reduced information procedures, then, is to maximize the reduction of the sample size relative to the cost of errors associated with the reduction.

There may be other ways of getting a measure of the importance or redundancy of items for PPP calculations. In the ICP work, all items are classified into categories on the basis of the functions they perform, as viewed by the final purchaser. However, the differences in the price structures of countries are more indicative of the way inputs are organized to produce an item than of the way the item is put to use in final consumption. In poorer countries, services are traditionally cheaper and capital-intensive manufactures more expensive than in richer countries. If the ICP items are reclassified along lines that differentiate input requirements and organization of production, viz., service, agricultural products, non-processed and processed food, durable and non-durable consumer goods and the like, the comparisons may reveal tendencies which allow the sample size to be reduced substantially while still getting acceptable results. However, an investigation along these lines has not been attempted because benchmark data for intermediate products have not been available.

2. SHORTCUT COMPARISONS WITH MONETARY INDICATORS

The evidence suggests that compared with purchasing power parities (PPP), exchange rates (ER) systematically underestimate the income levels of developing countries relative to developed countries. Further, the extent of the underestimation increases with the disparity between the per capita income levels of countries. When per capita GDP, as converted using exchange rates, is denoted as nominal (Z) and the corresponding PPP converted value as real income (Y), and both are expressed as indices using US = 100, the index of nominal GDP (z) was, for every country in the ICP Phase I report, invariably lower than the corresponding index of real GDP (y). The ratio of the real index to the nominal one (which is the same thing as the ratio of the exchange rate to the PPP) was as high as 3.05 for India, a low-income country, and as low as 1.15 for Germany, a high-income country.

Attempts have been made to explain this phenomenon in terms of a productivity differential hypothesis; it has been put forward at various times by Ricardo, Viner, Harrod and Balassa. The arguments which have been summarized in KHS (1978b) 10/ are briefly as follows. International trade tends to equalize prices of traded goods, mainly commodities, in different countries. Countries with higher productivity will enjoy higher wages. Internal competition will tend to establish the level of wages of the high-trade sector in the non-traded or services sector. Since international productivity differentials are higher in traded goods than in non-traded goods, the relative price of services will be higher in high-income countries than in low-income countries. Exchange rates reflect prices of traded goods, while the PPPs are computed from prices of all goods and services, traded or not. Thus the poorer a country, the lower will be the relative prices of its non-traded goods and the greater will be the tendency for exchange rates to underestimate its real income relative to that of a richer country.

In the real world, many circumstances may frustrate these arguments. A poor country with an abundance of natural resources and human capital may have a high relative price of services. 11/ The existence of transport costs, trade restrictions, exchange controls and large unrequited transfers may prevent the development of the clear and

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10/ Irving Kravis, Alan Heston and Robert Summers, "Real GDP Per Capita for More Than One Hundred Countries," The Economic Journal, Vol. 88, June 1978, pp. 215-242. Hereafter this work is referred to as KHS (1978b).

11/ Christopher Clague and Vito Tanzi, "Human Capital, Natural Resources and the Purchasing Power Parity Doctrine: Some Empirical Results," Economia Internazionale, Vol. 25, No. 1 (February 1972), pp. 3-18.

consistent pattern of differences between PPPs and exchange rates that would be expected under the productivity differential model.

If it is indeed true that the apparent disparity between exchange rates and PPPs, as measured by exchange rate deviation indices (defined as the ratio of the exchange rate to the PPP), can be explained by relative levels of real per capita income, then a shortcut method for making international comparisons can be developed by estimating a relationship between nominal and real income indices, using available data and predicting the relative real income levels of countries for which only nominal income figures are available.

A number of writers have put forward such shortcut formulas. Widely cited is that of David, 12/ which states that the real percentage gap between the per capita GDP of the US and that of another country is only fourth-ninths the percentage gap as measured by values when converted by exchange rates. Using data from Gilbert and Kravis (1954), Gilbert and Associates (1958) and Maddison (1967), David estimated the equation:

$$\left(\frac{1}{y} - 1\right) = B \left(\frac{1}{z} - 1\right) + u \qquad (1)$$

in which

$$\hat{B} = .441, \text{ or four-ninths.} \qquad (2)$$

12/ Paul David, "Just How Misleading Are Official Exchange Rate Conversions?" The Economic Journal, Vol. 82, September 1972, pp. 269-90.

The "rule-of-four-ninths" as formulated by David was questioned by Balassa, Samuelson and Hulsman-Vejsova. 13/ An extensive search for a new formula using not only the observations David used but also additional observations taken from the ICP Phase I report reveals that the "rule-of-four-ninths" cannot be supported: the value of the coefficient which provides the "rule" changes from sample to sample and is not stable.

The following quadratic equation in nominal index is, on the other hand, found to have high $\bar{R}^2$ and stable coefficients, with an additional property—as compared with other plausible alternatives, it produces smaller errors for the poorer countries for which it is more likely to be used:

$$y_i = 1 + \underset{(19.5)}{1.409} (z_i - 1) - \underset{(-7.8)}{.450} (z_i^2 - 1) \qquad (3)$$

$\bar{R}^2 = .98$ df = 32

However, the stability of this quadratic formula has been demonstrated only for the pre-1971 era, when there were fixed exchange rates. There is considerable doubt about its validity in the current

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13/ Bela Balassa, "Just How Misleading Are Official Exchange Rate Conversions? A comment,"The Economic Journal, Vol. 83, December 1973, pp. 1258-67; Paul Samuelson, "Analytical Notes on Intenational Real Income Measures," The Economic Journal, Vol. 84, September 1974, pp. 595-608. For a detailed critique of David's formulation, see Marie Hulsman-Vejsova, "Misleading Official Exchange Rate Conversion," The Economic Journal, Vol. 85, March 1975, pp. 140-147.

regime of managed floating currencies. Beside, any formula such as this which has only one independent variable would fail to change the ranking in terms of estimated values of countries observed in the nominal index. Thus two countries with the same nominal income index would appear to have the same real income index. This in turn implies that they also have the same levels of prices when converted by exchange rates. However, a number of factors might lead to different price levels for countries with the same nominal income indices, among them the ratio of exports plus imports to GDP, the extent of deficits in the balance of trade, direct taxes as a proportion of GDP, current receipts from tourism, and the ratio of the increase in exports of manufacturers to the increase in manufactured outputs. Attempts were made to use these factors as independent variables in regression equations explaining the overall PPP. The results were disappointing. Kravis, Heston and Summers successfully used two variables--openness and price isolation. 14/ That their results are further improved by using these variables in conjunction with physical or non-monetary indicators is discussed below.

3. SHORTCUTS WITH NON-MONETARY OR PHYSICAL INDICATORS

A shortcut with physical indicators seeks to establish relationships between per capita real income on the one hand and various physical or non-monetary indicators such as consumption of energy, meat or newsprint, or stocks of telephones, motor vehicles or radios, on the other. These relationships are then used to predict the per capita real income positions of countries for which only these

14/ KHS, 1978b.

physical indicators are available. The theoretical underpinnings, though not set out in the writings, would appear to rest on an Engel curve-type hypothesis; that is, that there is an association between the absorption of the good or service and per capita GDP.

This approach, which is usually associated with the name of Beckerman, 15/ had not been thoroughly tested because of the lack of reliable measures of per capita real incomes for a sufficiently large number of countries. However, new data generated by the ICP provided an opportunity for a re-examination of the physical indicators approach.

To be successful, the method must satisfy certain conditions: the physical indicators used must be easily available in all the countries; the relationship with real income must be amenable to easy economic interpretation; and the algebraic function relating these indicators to real income must be stable over time and space.

In this exercise, eight indicators for which consistent data were available for a large number of countries were tried as candidates: consumption of cement, steel, energy and newsprint, stocks of road vehicles, telephones and radio receivers, and circulation of letters. All variables were expressed as per capita indices with US = 100. Since these variables explained GDP and consumption equally well, the focus was only on GDP. Data for a total of 56 observations were

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15/ Wilfred Beckerman, International Comparisons of Real Incomes (Paris: OECD, 1966); Wilfred Beckerman and Robert Bacon, "International Comparisons of Real Income Levels: A Suggested New Measure," The Economic Journal, Vol. 76, September 1966, pp. 519-36.

assembled from various sources. 16/ After experimenting with several functional forms, log-log equations of the following form were chosen for obtaining the final results:

$$\ln y = a + B_1 \ln x_1 + B_2 \ln x_2 + \ldots + B_n \ln x_n + u \qquad (4)$$

where y = index of real per capita income and the x's are the indices of various physical indicators, with US = 100. This equation was estimated with all possible combinations of the variables over all available observations, both by separate years and by several yearly samples pooled in various ways.

The physical indicators chosen were highly intercorrelated, such that once three or four variables were included in the regression equation, additional ones failed to produce significant coefficients and/or raise $\bar{R}^2$s. Three indicators, Letters (L), Steel (S), and Energy (E) were found to perform consistently well in all the samples, so much so that a combination of all the three produced the best equation that could be estimated with physical indicators alone. It had the highest $\bar{R}^2$ in most of the recent samples, and the sets of coefficients were found to be remarkably stable in the different

16/ Gilbert and Associates (1958); KHS, 1978a; UN, Monthly Bulletin of Statistics; World Bank, World Tables.

$y = a x^{b} y^{c}$
$\ln y = a + b z$

samples. The log-log equation estimated from the 1970-73 sample was as follows:

$$
\begin{aligned}
\ln y = \underset{(21.7)}{1.6253} &+ \underset{(3.34)}{0.2850} \ln L + \underset{(3.13)}{0.2340} \ln S \\
&+ \underset{(1.89)}{0.1383} \ln E
\end{aligned}
\tag{5}
$$

$\bar{R}^2 = .9657 \qquad \text{SEE} = .1685$

Physical indicators by themselves produced acceptably good regressions, but the nominal index z alone generally produced better results. Happily, a combination of one physical indicator, L, and the nominal index, in a single equation improved the results obtained using the variables individually. The $\bar{R}^2$ improved, and the sets of coefficients were found to be homogeneous over the more recent samples of 1967 to 1973. This equation in log-log form and estimated over the 1970-73 sample is:

$$
\begin{aligned}
\ln y = \underset{(11.4)}{1.0073} &+ \underset{(11.2)}{0.8808} \ln z - \underset{(-5.45)}{0.0755} (\ln z)^2 \\
&+ \underset{(5.05)}{0.2368} \ln L
\end{aligned}
\tag{6}
$$

$\bar{R}^2 = .9909 \qquad \text{SEE} = .0367$

As noted, recently, KHS (1978b) reported success with the variables openness (O) and price isolation (PI). Openness (O) is measured by the average over the preceding several years of the ratio of exports plus imports to GNP; price isolation (PI) is measured by the mean squared deviation of a country's implicit GNP inflator from the "world" implicit deflator.

These two variables generally improved the level of explanation offered by the nominal index alone. However, a single physical indicator, L, was even better than PI and 0 in raising $\bar{R}^2$. Moreover, when PI and 0 and L were all used as independent variables in a quadratic equation in nominal index, the $\bar{R}^2$ was invariably raised in each sample. The log-log equation estimated for the 1970-73 sample is:

$$\begin{aligned} \ln y = \underset{(9.06)}{1.1618} &+ \underset{(13.9)}{1.0067} \ln z - \underset{(-7.08)}{0.0862} (\ln z)^2 \\ &+ \underset{(3.21)}{0.0224} \ln PI - \underset{(-2.98)}{0.0682} \ln 0 \\ &+ \underset{(4.84)}{0.1852} \ln L \end{aligned} \qquad (7)$$

$\bar{R}^2 = .9945$ $\qquad$ SEE = .0675

The purpose of estimating these equations is to use them for making predictions for observations outside the sample in both time and space. To evaluate their relative performance, various preferred equations estimated on the basis of the 1970 ICP data for 16 countries were used to predict the real income values for the same set of countries for 1973.

In this test, the equation with PI and O performed better than the ones without them. However, when regressions based upon the 10 Phase I ICP countries in 1970 were used to predict real income for the additional six countries in Phase II, the equation including PI and O performed worse than the ones excluding them.

Since all the preferred equations lacked predictive power one way or another, the order of preference had to be based on the coefficients of determination.

4. REDUCED INFORMATION PROCEDURES WITH PUBLISHED DATA

The second alternative tested here was to use reduced information methods based on published data. As noted, both the UN data on post-adjustment allowances and the US Department of State (USDS) data on costs of living abroad provide costs of living for only a very special group of people: foreign officials stationed abroad for a relatively short period of time who wish to maintain the level of living they would have had if they lived in New York or Washington, D.C. These people usually live in cities, patronize special outlets and in general do not have the same pattern of consumption as that of the indigenous population. It is therefore not appropriate, strictly speaking, to use these data for PPP computations. However, these data have high international comparability: they refer to a more or less fixed basket of goods and services and to a homogeneous group of consumers worldwide. Further, they are collected regularly for almost all countries of the world and are available for international product comparisons free of cost. If the PPPs computed from these prices and national expenditure weights were found either to match the ICP estimates or to deviate from them with some consistent pattern, then it might indeed be possible to derive an inexpensive system for computing PPPs for most of the countries of the world.

To determine if this were possible, PPPs were computed from these data sets and compared with those computed from corresponding ICP data.

4.1 UN Post Adjustment Data

The original detailed price data collected for the UN post-adjustment allowance computations were available for 1973 for nine 17/ of the sixteen countries included in the ICP Phase II report. The UN data, which refer to capital cities, were carefully matched with ICP category classifications. After correcting for time of reporting and unit of measurement, individual item prices were expressed as price relatives by dividing them by the corresponding US prices. Price relatives for a category were calculated as a simple geometric mean of the price relatives of items included in each category.

The first measure of differences between the UN and the ICP price data was obtained at the category level in the form of a ratio of the UN to ICP price relatives for each of the 66 categories for which the UN data were available. The average of these ratios for

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17/ The nine countries are Colombia, India, Iran, Japan, Kenya, Korea, Malaysia, Philippines and the US.

the countries in the sample, shown below in Table 1, ranged from .604 to 5.023, with an unweighted mean of 1.492. The category PPPs from the UN data were in general higher than those from the ICP data, and the magnitude of the difference had no clearcut pattern except that it varied a great deal from country to country.

To see the differences between the results based upon UN and ICP data at various levels of aggregations, binary comparisons were made using per capita expenditure weights taken from the ICP. At the highest level of aggregation, consumption, the UN PPPs were, on the average, 20 percent higher than the ICP PPPs, suggesting that an estimate of the ICP-type PPP can be obtained by computing it from the UN data and reducing it by 20 percent (see Table 2). However, the spread of the deviation between the low and the high estimates -- 2.3 percent for Japan and 50 percent for Iran -- was so large that such estimates were unlikely to be acceptable except for the crudest calculations. There was no consistent pattern for the differences in the consumption PPPs that could be explained by inter-country differences in per capita income.

The results were generally worse at lower levels of aggregation. However, the block of UN data with the best chance of meeting the need for ICP-type price collection was Food, Beverage and Tobacco, where the average of the ratio between UN to ICP PPP was 1.095, with a coefficient of variation of 14 percent. On the other hand, in the area of non-food consumption, where the savings in costs of collecting

Table 1: SUMMARY STATISTICS ON COMPARISONS OF PPPs COMPUTED FROM UN AND ICP DATA, DETAILED CATEGORIES, 1973

	DETAILED CATEGORY		RATIO OF UN TO ICP PPP MEAN (1)	STANDARD DEVIATION (2)	COEFFICIENT OF VARIATION (3)
1	1101	RICE	0.881	0.219	25
2	1102	MEAL & OTHER CEREALS	1.308	0.789	60
3	1103	BREAD	1.059	0.399	38
4	1104	BISCUITS, CAKES, ETC.	1.611	2.165	134
5	1105	CEREAL PREPARATIONS	1.874	1.383	74
6	1106	MACARONI, SPAGHETTI	1.613	0.774	48
7	1111	FRESH BEEF AND VEAL	1.260	0.719	57
8	1112	FRESH LAMB AND MUTTON	1.115	0.616	55
9	1113	FRESH PORK	1.402	0.611	44
10	1114	CHICKEN	0.936	0.534	57
11	1115	OTHER FRESH MEAT	1.550	0.391	25
12	1121	FISH FRESH, FROZEN	1.212	0.555	46
13	1122	FISH CANNED	1.341	1.328	99
14	1131	FRESH MILK	0.604	0.118	20
15	1132	MILK PRODUCTS	1.402	1.325	95
16	1141	BUTTER	1.541	1.583	103
17	1142	MARGARINE, EDIBLE OILS	1.312	0.573	44
18	1151	FRESH FRUITS, TROPICAL	2.690	3.241	120
19	1152	FRESH FRUITS, OTHER	1.489	0.950	69
20	1153	FRESH VEGETABLES	1.292	0.449	35
21	1161	FRUIT OTHER THAN FRESH	1.395	0.444	32
22	1162	VEGS. OTHER THAN FRESH	1.193	0.501	42
23	1170	POTATOES, MANIOC, TUBERS	1.428	1.294	91
24	1191	COFFEE	0.877	0.154	18
25	1192	TEA	2.048	0.739	36
26	1180	SUGAR	1.061	0.585	55
27	1201	JAM, SYRUP, HONEY	0.810	0.396	48
28	1202	CHOCOLATE, ICE CREAM	1.099	0.605	55
29	1203	SALT, SPICES, SAUCES	2.342	0.765	33
30	1310	NON-ALCOHOLIC BEVERAGES	0.931	0.477	51

Table 1 -- Continued

		DETAILED CATEGORY	RATIO OF UN TO ICP PPP MEAN (1)	STANDARD DEVIATION (2)	COEFFICIENT OF VARIATION (3)
31	1321	SPIRITS	1.179	0.768	65
32	1322	WINE, CIDER	0.778	0.276	36
33	1323	BEER	1.118	0.358	32
34	1410	CIGARETTES	1.228	0.652	53
35	2121	MEN´S CLOTHING	1.140	0.587	52
36	2122	WOMEN´S CLOTHING	0.647	0.270	42
37	2123	BOYS`, GIRLS´ CLOTHING	1.409	0.307	22
38	2131	UNDERWEAR, MENS, BOYS	0.975	0.260	27
39	2132	UNDERWEAR, WOMEN, GIRLS	1.342	0.447	33
40	2211	FOOTWEAR, MENS	1.725	0.427	25
41	2212	FOOTWEAR, WOMENS	3.374	3.133	93
42	2213	FOOTWEAR, CHILDREN	1.790	1.050	59
43	2220	FOOTWEAR, REPAIRS	1.779	1.424	80
44	4200	HOUSEHOLD TEXTILES, ETC.	1.612	0.631	39
45	4310	REFRIGERATORS, FREEZERS	0.690	0.404	59
46	4330	COOKING APPLIANCES	1.286	0.720	56
47	4510	NONDURABLE H´HLD GOODS	1.744	0.723	41
48	4530	HOUSEHOLD SERVICES	1.495	0.440	29
49	5110	DRUGS, MEDICAL PREPARATION	1.645	0.838	51
50	5120	MEDICAL SUPPLIES	1.140	0.537	47
51	5310	PHYSICIANS´ SERVICES	2.329	1.386	60
52	5320	DENTISTS´ SERVICES	2.852	1.214	43
53	6210	TIRES, TUBES, ETC.	0.666	0.163	24
54	6220	REPAIR CHARGES	0.916	0.431	47
55	6230	GASOLINE, OIL, GREASE	0.807	0.302	37
56	6310	LOCAL TRANSPORT	1.728	1.444	84
57	6410	POSTAL COMMUNICATION	1.736	0.716	41
58	6420	TELEPHONE, TELEGRAPH	5.023	6.307	126
59	7130	OTHER REC. EQUIPMENT	1.500	0.661	44
60	7210	PUBLIC ENTERTAINMENT	1.923	0.619	32
61	7230	OTHER RECR. ACTIVITIES	2.113	1.593	75
62	7310	BOOKS, PAPERS, MAGAZINES	1.635	0.746	46
63	7320	STATIONERY	0.650	0.277	43
64	8100	BARBER, BEAUTY SHOPS	2.786	1.632	59
65	8210	TOILET ARTICLES	1.168	0.514	44
66	8220	OTHER PERSONAL CARE GOODS	1.866	1.363	73

Table 2: SUMMARY STATISTICS ON COMPARISONS BETWEEN PPPs COMPUTED FROM UN AND ICP DATA, 1973, MAJOR AGGREGATES

	Major Aggregates	Ratio of UN to ICP PPP		
		MEAN (1)	STANDARD DEVIATION (2)	COEFFICIENT OF VARIATION (%) (3)
1.	Consumption	1.202	0.152	13
2.	Food, Beverage, Tobacco	1.095	0.140	13
3.	Food	1.107	0.146	13
4.	Bread and Cereals	1.085	0.253	23
5.	Meat	1.106	0.488	44
6.	Fish	0.795	0.191	17
7.	Milk, Cheese, Eggs	1.402	1.325	94
8.	Oils and Fats	1.283	0.515	40
9.	Fruits and Vegetables	1.354	0.351	26
10.	Coffee, Tea, Cocoa	1.222	0.386	32
11.	Spices, Sweets, Sugars	1.157	0.282	24
12.	Beverages	1.001	0.369	37
13.	Tobacco	1.228	0.652	53
14.	Clothing and Footwear	1.074	0.335	31
15.	Clothing	0.914	0.236	26
16.	Footwear	1.829	1.059	58
17.	House Furnishings and Operation	1.445	0.198	14
18.	Furniture, Appliances	1.235	0.281	23
19.	Supplies and Operation	1.662	0.457	27
20.	Medical Care	1.733	0.410	24
21.	Transport and Communication	1.203	0.564	47
22.	Operation Costs	0.787	0.237	30
23.	Purchased Transport	1.728	1.444	84
24.	Communication	3.635	3.277	90
25.	Recreation and Education	1.656	0.638	39
26.	Recreation	1.656	0.638	39
27.	Other Expenditure	1.724	0.946	55
28.	Personal Care	1.724	0.946	55

prices would be substantial, the UN data hold little promise of being useful in ICP-type PPP computations.

4.2. US Department of State (USDS) Data

Data from the US Department of State, which were available for all the 16 countries in the ICP sample, were similarly processed. Individual items were assigned to appropriate ICP categories, and the category PPPs were computed as simple geometric means of the item price relatives included in the respective categories. The 64 categories for which USDS data were available were further aggregated into binary comparisons, with national expenditure weights available from the ICP.

The results both at the category level and at various levels of aggregation were compared with those from the ICP data. The conclusions were very similar to those drawn from the UN data. The category PPPs from USDS data were generally higher than those from the ICP data, and the difference varied a great deal from one country to another (Table 3). For the 16 countries in the sample, the average of the ratios of the USDS to ICP PPPs for the highest level of aggregation--consumption--was 1.37, with a coefficient of variation of 14 percent (Table 4). Since the spread between the highest and the lowest estimates was a large 61 percent, an estimate of PPPs based on the USDS data would be far off the mark for many countries. As in the case of UN data, there was no consistent pattern between the ratio of the USDS to the ICP PPPs and per capita income. Further, unlike with the UN

Table 3: SUMMARY STATISTICS OF COMPARISONS BETWEEN PPPs COMPUTED FROM US DEPARTMENT OF STATE (USDS) AND ICP DATA, DETAILED CATEGORIES, 1973

	DETAILED CATEGORY		RATIO OF USDS TO ICP PPPs MEAN (1)	STANDARD DEVIATION (2)	COEFFICIENT OF VARIATION (%) (3)
1	1101	RICE	1.031	0.543	53
2	1102	MEAL & OTHER CEREALS	1.435	0.939	65
3	1103	BREAD	1.584	0.805	51
4	1104	BISCUITS, CAKES, ETC.	1.702	1.099	64
5	1105	CEREAL PREPARATIONS	1.621	1.304	80
6	1111	FRESH BEEF AND VEAL	1.178	0.445	38
7	1112	FRESH LAMB AND MUTTON	0.876	0.450	51
8	1113	FRESH PORK	1.182	0.266	22
9	1114	CHICKEN	1.198	0.291	24
10	1116	MEAT FROZEN, SALTED	1.378	0.348	25
11	1121	FISH FRESH, FROZEN	1.953	1.081	55
12	1131	FRESH MILK	1.223	0.261	21
13	1132	MILK PRODUCTS	2.052	0.957	47
14	1133	EGGS, EGG PRODUCTS	1.120	0.202	18
15	1142	MARGARINE, EDIBLE OIL	1.669	0.532	32
16	1143	LARD, EDIBLE FAT	0.844	0.265	31
17	1151	FRESH FRUITS, TROPICAL	1.917	2.187	114
18	1152	FRESH FRUITS, OTHER	1.587	0.706	44
19	1153	FRESH VEGETABLES	2.092	0.899	43
20	1161	FRUIT OTHER THAN FRESH	1.674	1.069	64
21	1162	VEGS. OTHER THAN FRESH	1.321	0.598	45
22	1170	POTATOES, MANIOC, TUBERS	1.433	0.705	49
23	1191	COFFEE	0.907	0.427	47
24	1180	SUGAR	1.035	0.478	46
25	1202	CHOCOLATE, ICE CREAM	0.895	0.501	56
26	1310	NON-ALCOHOLIC BEV.	1.493	0.525	35
27	1321	SPIRITS	3.286	3.070	93
28	1323	BEER	1.326	0.357	27
29	1410	CIGARETTES	3.059	2.232	73
30	2121	MENS CLOTHING	1.652	0.607	37

Table 3 -- Continued

		DETAILED CATEGORY	RATIO OF USDS TO ICP PPPs MEAN (1)	STANDARD DEVIATION (2)	COEFFICIENT OF VARI- TION (%) (3)
31	2122	WOMENS CLOTHING	1.730	0.732	42
32	2131	UNDERWEAR, MENS, BOYS	1.648	0.661	40
33	2132	UNDERWEAR, WOMEN, GIRL	1.214	0.486	40
34	2212	FOOTWEAR, WOMENS	2.699	2.104	78
35	2213	FOOTWEAR, CHILDREN	1.577	0.983	62
36	4200	HSEHOLD TEXTILES, ETC.	1.756	1.021	58
37	4320	WASHING APPLIANCES	0.896	0.347	39
38	4340	HEATING APPLIANCES	0.754	0.249	33
39	4350	CLEANING APPLIANCES	0.641	0.076	12
40	4360	OTHER H'HOLD APPLIANCES	0.708	0.261	37
41	4400	HOUSEHOLD UTENSILS	1.429	0.501	35
42	4510	NONDURABLE H'HLD GOODS	1.537	0.427	28
43	4520	DOMESTIC SERVICES	1.721	0.924	54
44	4530	HOUSEHOLD SERVICES	1.346	0.478	35
45	5110	DRUGS, MEDICAL PREPARATION	2.259	0.882	39
46	5310	PHYSICIANS' SERVICES	2.874	2.422	84
47	5320	DENTISTS' SERVICES	3.337	1.909	57
48	5410	HOSPITALS, PHYS. FACILITY	1.752	0.990	56
49	6120	OTHER PERS. TRANSPORT	0.929	0.195	21
50	6210	TIRES, TUBES, ACCESSORIES	0.824	0.253	31
51	6220	REPAIR CHARGES	1.368	1.015	74
52	6230	GASOLINE, OIL, GREASE	1.079	0.333	31
53	6310	LOCAL TRANSPORT	1.226	0.727	59
54	6323	AIR TRANSPORT	1.146	0.732	64
55	6420	TELEPHONE, TELEGRAPH	1.688	0.807	48
56	7110	RADIO, TV, PHONOGRAPH	1.076	0.286	26
57	7130	OTHER RECREATION EQUIPMENT	1.022	0.310	30
58	7210	PUBLIC ENTERTAINMENT	2.055	1.828	89
59	7230	OTHER RECR. ACTIVITIES	3.861	4.735	123
60	7310	BOOKS, PAPERS, MAGAZINES	1.846	0.685	37
61	8100	BARBER, BEAUTY SHOPS	2.108	0.977	46
62	8210	TOILET ARTICLES	1.028	0.376	37
63	8220	OTHER PERS. CARE GOODS	1.161	0.726	62
64	8310	RESTAURANT, CAFES	1.460	0.497	34

Table 4: SUMMARY STATISTICS ON COMPARISONS BETWEEN PPPs COMPUTED FROM US DEPARTMENT OF STATE AND ICP DATA, 1973
MAJOR AGGREGATES

		Ratio of UN to ICP PPP		
		MEAN (1)	STANDARD DEVIATION (2)	COEFFICIENT OF VARIATION (%) (3)
1.	Consumption	1.368	0.196	14
2.	Food, Beverage, Tobacco	1.377	0.225	16
3.	Food	1.282	0.226	18
4.	Bread and Cereals	1.401	0.545	39
5.	Meat	1.155	0.357	31
6.	Fish	1.953	1.081	55
7.	Milk	1.365	0.342	25
8.	Oils and Fats	1.568	0.543	35
9.	Fruits and Vegetables	1.574	0.536	34
10.	Coffee, Tea, Cocoa	0.907	0.427	47
11.	Spices, Sweets, Sugars	0.921	0.263	29
12.	Beverages	1.645	0.583	35
13.	Tobacco	3.059	2.232	73
14.	Clothing and Footwear	1.599	0.584	37
15.	Clothing	1.574	0.526	34
16.	Footwear	2.219	1.655	75
17.	House Furnishings, Operation	1.362	0.337	25
18.	Furniture, Appliances	1.099	0.358	33
19.	Supplies and Operation	1.480	0.310	21
20.	Medical Care	1.936	0.594	31
21.	Transport and Communication	1.088	0.316	29
22.	Operation Costs	1.068	0.394	37
23.	Purchase Transport	1.086	0.437	40
24.	Communication	1.688	0.807	48
25.	Recreation and Education	1.506	0.542	36
26.	Recreation	1.506	0.542	36
27.	Other Expenditure	1.376	0.379	28
28.	Personal Care	1.376	0.379	28

case, no block of USDS data could be singled out as providing an alternative to collecting prices for PPP computations.

5. MECHANICAL OR AD HOC METHODS OF REDUCED INFORMATION

Since the prospects for using published data did not appear bright, a decision was made to investigate whether the ICP results could be replicated with a much smaller data base than is being currently used. The ICP price data base for the Phase I Report was to include 1,300 price specifications classified into 153 categories, which covered the entire GDP. However, no country in the ICP set reported all 1,300 prices. In fact, an average of about 400 prices were reported per country covering most of the 153 expenditure categories.

In order to determine how much of this information could be dispensed with, without unduly affecting the final results, experiments were made by arbitarily limiting, first, the number of categories, and then, the number of items, and comparing the resultant PPPs with those computed from the full set of data. The 1970 data underlying the ICP Phase I report, which included 10 countries, 18/ were used for these experiments.

5.1. Deleting Categories

In order to see the effect of reducing the number of categories, three aggregates were chosen: Food, Beverage and Tobacco

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18/ The ICP Phase I countries were Colombia, France, Germany, Hungary, India, Italy, Japan, Kenya, UK and US.

(FBT), Non-Food Consumption, and Total Consumption. All the categories in each of these aggregates were arranged in order of importance as measured by their average expenditure weights in the three less developed countries (LDC) - Colombia, India and Kenya. These countries, which constituted the developing countries among the Phase I countries, were selected since it was anticipated that reduced information methods would be needed most for developing countries.

The procedure was as follows. First, a quarter of the categories which were least important were eliminated from each list. Then, successively, the least important half and two-thirds of these categories were eliminated. The three reduced samples drawn from the 39 categories in FBT, therefore, retained 30, 20 and 13 categories, respectively.

The item prices in the deleted categories were ignored, and the expenditures were redistributed among the remaining categories in the next higher aggregate. Binary PPPs were computed from the three abbreviated samples. These were expressed as ratios of the PPPs derived from the complete set of data covering all the 39 categories.

In order to see the effect of choosing the categories according to expenditure weights of a rich country, the 39 categories were reordered on the basis of expenditure weights of the richest country in the sample, the US, and another set of three reduced samples consisting of 30, 20 and 13 most important categories was chosen. The results of binary comparisons from these samples also were expressed as percentages of those derived from the total sample.

The same procedure was followed with the other two aggregates -- Non-Food Consumption with 80 categories and Total Consumption with 113 categories.

Thus for each of these broad aggregates, PPPs were estimated using the most important 75 percent, 50 percent and 33 percent of the categories -- importance being defined in two ways, first on the basis of importance in LDC´s and then on the basis of importance in the US. Not surprisingly, the errors of the abbreviated samples, as measured by mean absolute deviations and maximum absolute deviations, were lower when the samples were cut marginally, and they increased as greater cuts were made. Table 5 summarizes the errors.

However, with each successive reduction in the sample size, the PPP´s on the average got smaller and smaller. The mean of the ratios of PPPs derived from the truncated sample to the PPPs derived from the total sample, instead of fluctuating around 1.0, progressively declined as the sample size was reduced. For instance, in the case of FBT, the averages of the ratios were 98, 95 and 90 for the three successively smaller samples chosen on the basis of LDC expenditure weights. While the averages were different when the samples were chosen on the basis of US weights, they still invariably declined with the sample size. This means that the more important a category is in consumer budgets, the lower the category prices are in most countries relative to the US. Therefore reducing the sample size on the basis of expenditure weights will introduce a definite bias in the comparisons and consequently should be avoided.

Table 5: ERRORS IN PPPs COMPUTED FROM ABBREVIATED SAMPLES
(percentage deviations from PPPs computed from total samples)

Size of Sample (percent of total sample)	Food, Beverage, Tobacco		Non-Food Consumption		Total Consumption	
	Mean Absolute Deviation	Maximum Devia-tion	Mean Absolute Deviation	Maximum Devia-tion	Mean Absolute Deviation	Maximum Devia-tion
(1)	(2)	(3)	(4)	(5)	(6)	(7)
75	4	10	8	27	16	26
50	6	13	28	53	17	29
33	10	33	28	43	25	37

Source: International Comparison Project data bank.

5.2. Deleting Items

The objective of this experiment was to examine the effect on comparisons when deletions were made at the item level, but all categories were retained. To determine this, binary comparisons were calculated with the number of items per category arbitrarily limited, successively, to no more than five, four, three, two and finally one item. Items least frequently priced in the sample of countries were dropped first.

The results, expressed as before as ratios to the PPPs derived from the full sample, were more encouraging. For Total Consumption, limiting the number of items to 5, 4, 3, 2, and 1 per category reduced the overall size of the sample by 15, 21, 30, 43 and 70 percent respectively. The results presented in Table 6 show that it seems hardly necessary to have more than five items per category because the PPPs computed from no more than five items per category virtually matched those computed from the full sample, with no country deviating by more than one percent. With four items or less, the maximum deviation was within 3 percent. Even when only one item per category was retained, the sample size was reduced to 30 percent of the full size, while the maximum any-country error was still no more than 10 percent. It seems, therefore, that attempts to reduce the sample size by operating at the item level are likely to be productive.

Looking at the results of individual countries separately, it seemed that for most of the countries, the PPPs increased as the sample size was reduced. It was not apparent why this was so, but

Table 6: ERRORS IN PPPs FROM SAMPLES REDUCED BY DELETING ITEMS
(percentage deviations from PPPs computed from total samples)

	Food, Beverage and Tobacco (FBT)			Consumption Excluding FBT			Total Consumption		
Number of Items Per Category	Percent of Sample Retained	Mean Absolute Deviation %	Maximum Absolute Deviation %	Percent of Sample Retained	Mean Absolute Deviation %	Maximum Absolute Deviation %	Percent of Sample Retained	Mean Absolute Deviation %	Maximum Absolute Deviation %
5	94	.7	3	81	.6	3	85	.7	1
4	90	1.3	4	74	1.7	3	79	1.6	3
3	82	2.4	6	65	3.2	5	70	3.2	6
2	68	4.9	7	52	4.7	11	57	3.4	10
1	43	4.8	10	30	5.0	10	30	3.4	8

Source: Data bank of the International Comparison Project.

comparisons with items selected on the basis of a weighted frequency where the three EEC countries were counted as one did seem to reduce the bias. Perhaps in a larger sample of countries which is more evenly distributed between the rich and the poor, this kind of correction would not be necessary.

The results from these ad hoc procedures seem to agree with what intuition suggests: If it is necessary to operate on a reduced information basis, it is better to spread the risk by deleting items while retaining as many categories as possible than to pin hopes on a few categories found to be important in consumer budgets.

6. REDUCED INFORMATION: REGRESSIONS APPROACH

The ad hoc procedures discussed above reveal that it is better to reduce the sample size at the item level rather than at the category level. However, when prices are deleted in an ad hoc manner purely on the basis of frequency of response, the informational content of each piece of data is not properly evaluated. The prices, for instance, of beef, milk, hide or skin, all of which originate from the same animal, may be related to each other in such a way as to make one or more of these prices redundant for the purpose of computing PPPs.

Ruggles applied stepwise regression methods to the problems of redundancy of items with respect to the US wholesale price index. 19/

19/ Richard Ruggles, The Wholesale Price Index--Review and Evaluation, Executive Office of the President, Council on Wage and Price Stability, Council Report, June 1977 (Washington, D.C.: US Government Printing Office, 1977).

Since items are related to each other by degrees of complementarity and substitution in production as well as consumption, it is possible that prices of certain items are so systematically related to the appropriate PPPs that just a few of them may replicate the PPPs better than a larger number.

An attempt was therefore made to identify, with the help of multiple regression equations, the subsets of item price relatives that best "explained" the PPPs derived from the full ICP procedures. The hope was that in circumstances where the full ICP-type treatment is not possible, pricing could be restricted to a relatively small number of items and that the PPP estimates derived from regression equations using these prices would still be reasonably accurate.

The ICP data for the 16 Phase II countries 20/ for 1973 were used in this experiment. The subset of items that will produce the best fit with an aggregate PPP will obviously depend on the level of aggregation. The ICP Phase II data base has some 1,300 item specifications which are aggregated successively into 153 categories, 36 summary categories, 13 sub-aggregates, 3 main aggregates, and, finally, the GDP. After carefully weighing the need for economy of effort and for detail, six aggregates or sectors were chosen (the first three were sub-aggregates of consumption): (1) Food, Beverage and Tobacco (FBT); (2) Clothing, Furnishings and Other (CFO); (3) Rent, Medical Care, Transportation, and Recreation and Education (RMTR); (4) Producer

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20/ The Phase II countries are Belgium, Colombia, France, Germany, Hungary, India, Iran, Italy, Japan, Kenya, Korea, Malaysia, Netherlands, Philippines, UK and US (those underlined were not in Phase I).

Durables (PD); (5) Construction (CONSTR); and (6) Government (GOVT). For each of the sectors, the vector of PPPs over the 15 countries (the 16th country, US, being the numeraire) was expressed in a log-log equation as a function of many alternative sets of available item price relatives. An initial step was to find the set of prices that achieved either the highest coefficient of determination corrected for degrees of freedom ($\bar{R}^2$) or the lowest residual error for any country, and that contained prices that were available in all countries; it was expected that when this sample of prices was inserted in the appropriate regression equation, it would provide a good estimate of the sectoral PPP. The PPPs at higher levels of aggregation, e.g., GDP and Consumption, could then be computed in a multilateral mode in, say, a Geary-Khamis system of simultaneous equations.

It must be emphasized that what was being attempted was exploratory data analysis rather than statistical inference. The $\bar{R}^2$ was used to describe a body of data rather than to confirm or reject hypotheses. A collection of items that offers the best explanation for a sectoral PPP in a particular sample of countries in a given year may be expected to do the same in another set of countries at another point of time. However, such an expectation is not based on any theoretical construct so much as on a hope that the empirical relationship observed in the present data set is stable over time.

6.1. Methodological Issues

Before implementing the experiment, a series of methodological and practical issues had to be resolved. One issue was what conversion factors to use in converting all the PPPs and price relatives, which were expressed in local currency units, into a uniform currency dimension. Although overall PPPs were the ideal choice, the decision was made to use exchange rates, since the goal was to predict the PPPs themselves, and any operational scheme that required knowledge of the PPPs before they were available could not be implemented. (Since exchange rates are known to overstate PPP, thus giving biased results, an alternative, quite restrictive procedure was tried in which the PPPs were used in developing the equations, but not for making predictions. The detailed procedure is discussed below.)

Another question was whether to suppress the constant term and constrain the equation to make the sum of coefficients equal to 1.0. The reason for constraining the equation comes from the notion that the PPPs may be regarded as weighted sums of the item price relatives, with the regression coefficients supplying the weights. However, since in the best sub-set regressions the constant terms are often significantly different from zero and the sums of the coefficients are significantly different from 1.0, any constraint would lower $\bar{R}^2$ and raise the maximum residuals. On further reflection, it became apparent that the PPP were not necessarily an average of the prices of the selected items. For instance, if the price of carrots were the most highly correlated with the fruits and vegetables PPP, but carrot price relatives were 20 percent lower than the fruits and vegetables PPP, the regression coefficient for carrots would not be 1.0 but in the neighborhood of 1.2.

A decision was made to run the regression in log-log form rather than in linear form purely on empirical grounds -- the fit with log-log equations was consistently better.

The cumulative result of the various decisions was to run regressions of the following form:

$$\ln \left(\frac{PPP_j}{ER_j}\right) = a + \sum_{i=1}^{k} B_i \ln \left(\frac{P_{ij}/P_{i,us}}{ER_j}\right) + u \qquad (8)$$

$j = 1,2,....,15$ $\qquad\qquad$ $i = 1,2,...,k$

where

PPP_j = Sectoral PPP of jth country;

ER_j = Exchange rate: units of jth country's currency per US dollar;

P_{ij} = Price of ith item in jth country in local currency;

$P_{i,us}$ = Price of ith item in US in dollars.

The next question was how to determine the candidate variables for these regressions -- whether the subset of items considered best for explaining a sectoral PPP should be picked from all available items, regardless of sector, or should be restricted to items within the sector. The relations of complementarity and substitution need not be restricted within a sector -- shoes or an item of clothing may be related to various diary products, and nails may enter in consumption or producer durables as well as in construction. It was therefore conceivable that item prices taken from outside the sector would produce acceptable regressions.

For the most part, only items from the own sector were used as candidates to explain the respective sectoral PPPs. However, where own sectoral prices were not easily available or were inadequate in number, such as in Producer Durables, Construction and Government, items from outside the sector were used.

One particularly difficult problem was the question of missing prices. In the category Total Consumption, out of a total of 1,048 specifications for prices, all countries except the US reported less than 400. The overall price matrix had a great many holes. In fact, the number of items for which all 16 countries reported a price was only 23. Clearly, a way had to be found to use the rest of the data.

One way was to extend the number of candidate items to a reasonable number by estimating the missing prices. An attempt was made to use as much of the available data as possible by entering a synthetic correlation matrix rather than the raw data as input to the regressions. The correlation matrix was computed from a synthesized cross-product matrix, each element of which was formed by adding together products for all observed prices and dividing the sum by the number of products. Under this arrangement there were so many cells without an observation that a decision was made to limit the number of observations to those items which were priced in at least 12 of the 16 countries and in at least five of the seven less developed countries in the ICP Phase II sample.

Even though the synthesized cross-product matrix then had a number in each cell, the correlation matrix was not positive definite and, therefore, could not be used as an input to the regression programs. There was thus no alternative but to enter a full data matrix in the program, which meant that the missing prices had to be estimated. This was done by the Country-Product Dummy (CPD) method used by Kravis, Kenessey, Heston and Summers, 21/ which uses all available prices in a category and delivers a set of base-country-invariant price relatives.

The central question at this point was how to select the best subset of items from so many eligible candidates. Which price relatives would be the best ones to enter as independent variables in the regression equation? One way to decide would be to compute simple Pearsonian correlation coefficients for all candidate item prices with the particular dependent variable and then pick a set with the highest coefficients. However, the item price relatives that are highly correlated with the dependent variable are also highly correlated with each other. To correct for this multicollinearity, coefficients of partial correlation would have to have been used instead. But when the candidates are numerous, the computation becomes so complicated that an automatic procedure like stepwise regressions becomes attractive.

21/ A System, Chapter 5.

In stepwise regression programs, the variable added sequentially at each step is the one that makes the greatest reduction in the error sum of squares. New variables are added until some given stopping point is reached. It may be defined by the number of item prices selected or by the required minimum F-value for the selected independent variable. The most convenient feature of stepwise regression is that even though the maximum number of variables that can be entered into the regression is limited by the number of degrees of freedom, this selection can be made from a much larger set of candidate variables. The disadvantage is that, once selected, a variable is never dropped, so the particular subset chosen by stepwise regression may not necessarily be the best subset.

The alternative to stepwise regressions is to run all possible subset regressions in order to be able to pick the "best" one. However, the number of all possible subsets increases exponentially with the number of candidates [32767 with 15 candidates, 33.5 million with 25 candidates]. It would have been impractical to compute them.

Fortunately, there is an algorithm called Leaps-and-Bounds 22/ which can deliver the best subset regression without computing all possible subsets. Tests show that in every case where the subset selected by Leaps-and-Bounds is different from the one selected by stepwise regressions, the one selected by Leaps-and-Bounds has a higher $\bar{R}^2$ and/or lower maximum residual error. The disadvantage with Leaps-and-Bounds is that the number of item-price candidates it can consider must be less than the number of observations.

22/ G. M. Furnival, "Regressions by Leaps-and-Bounds," Technometrics, Vol. 16, No. 4, 1974, pp. 499-511.

Since in this experiment the number of candidate variables was often considerably larger than the number of observations, the selection of the best subset regression was performed in two stages; first, stepwise regression was used to select a maximum of 14 variables (the maximum number allowed by the degrees of freedom), and then these were fed into Leaps-and-Bounds to make the final selections. The regressions with the best subsets of different sizes delivered by Leaps-and-Bounds were then evaluated for coefficients of determination and maximum residuals.

6.2. Regression Results

Consumption

The regression treatment of the various sectors will be outlined first, and then the use of regressions in prediction is discussed. For the three consumption sectors, FBT, CFO and RMTR, the best subset regressions were chosen following the scheme outlined above. The candidate item prices were restricted to own sectors. The maximum residuals for the selected regressions were 1.2 percent for FBT, -0.2 percent for CFO and 1.9 percent for RMTR. A total of 33 item prices was selected. This must be regarded as truly a reduced information sample because the full ICP treatment currently requires at least 200 prices for consumption comparisons. The selected items along with their ICP specifications codes are listed in Tables 7, 8 and 9.

Table 7: REGRESSION EQUATION SELECTED FOR FOOD, BEVERAGE AND TOBACCO (FBT)

Dependent Variable		Constant Term	Coefficient		Independent Variable	ICP Code
ln FBT	=	0.11237 (8.7)	+ 0.084365 (3.4)	ln	Chicken	1114-A
			+ 0.227148 (19.7)	ln	Mackerel	1121-E
			+ 0.099550 (11.4)	ln	Sardines	1122-B
			- 0.181635 (-11.9)	ln	Milk	1131-A
			- 0.042595 (4.7)	ln	Apples	1152-A
			- 0.183228 (-11.1)	ln	Onions	1153-A
			+ 0.445992 (31.1)	ln	Lettuce	1153-F
			- 0.154656 (-8.3)	ln	Beans	1162-B
			+ 0.235275 (14.2)	ln	Potatoes	1170-A
			+ 0.433586 (38.0)	ln	Beer	1323-A

$\bar{R}^2$ = .9988

SEE = .0126

$F_{(10,3)}$ = 1171

Maximum residual = 1.2 percent computed from exponentiated values, $(=e^{\hat{u}})$.

Note: Figures in parentheses are the t ratios.

Table 8: REGRESSION EQUATION SELECTED FOR CLOTHING, FURNISHING, AND OTHER CONSUMPTION (CFO)

Dependent Variable		Constant Term	Coefficient		Independent Variable	ICP Code
ln CFO	=	- 0.213154 (-26.9)	+ 0.352281 (69.60)	ln	Business Shirt	2121 - K
			- 0.308486 (-46.93)	ln	Brassiere	2132 - C
			+ 0.302465 (79.01)	ln	Tailoring	2160 - B
			+ 0.056897 (12.97)	ln	Sewing Machine	4360 - A
			+ 0.295980 (36.72)	ln	Dry Cleaning	4530 - C
			+ 0.027079 (7.34)	ln	Haircut	8100 - A
			+ 0.095592 (27.58)	ln	Shampoo Set	8100 - C
			- 0.344980 (-61.01)	ln	Toilet Soap	8210 - A
			+ 0.271719 (101.7)	ln	Tooth Paste	8210 - B
			- 0.163867 (-33.16)	ln	Face Cream	8210 - H
			- 0.137977 (-19.55)	ln	Razor Blades	8220 - H
			- 0.063623 (23.40)	ln	Carbonated Beverage	8310 - H

$\bar{R}^2$ = 1.000

SEE = .003132

Maximum residual = -0.2% computed from exponentiated values (= $e^{\hat{u}}$).

$F_{(12,2)}$ = 24745

Note: Figures in parentheses are the t ratios.

Table 9: REGRESSION EQUATION SELECTED FOR RENT, MEDICAL CARE, TRANSPORTATION, RECREATION AND EDUCATION (RMTR)

Dependent Variable		Constant Term	Coefficient		Independent Variable	ICP Code
ln RMTR	=	0.092491 (2.192)	- 0.032078 (-2.942)	ln	Liquefied gas	3220-C
			+ 0.648333 (24.09)	ln	Boy's Bicycle	6120-A
			+ 0.302465 (8.329)	ln	Motor Oil	6230-B
			+ 0.166129 (11.59)	ln	Bus Fare	6310-A
			+ 0.133756 (7.650)	ln	Rail Coach Fare	6321-A
			+ 0.039880 (2.392)	ln	Postage, Letter	6410-A
			+ 0.031086 (1.874)	ln	Phone Service	6420-A
			- 0.397140 (-8.986)	ln	TV, 19" B&W	7110-A
			- 0.058768 (-3.254)	ln	Stereo Record	7130-A
			+ 0.224293 (7.163)	ln	Daily Newspaper	7310-A
			+ 0.105475 (9.231)	ln	Ballpoint Pen	7320-G

$\bar{R}^2$ = .9992

SEE = .015961

$F_{(11,3)}$ = 1676

Maximum residual = 1.9 percent, computed from exponentiated values (= $e^{\hat{y}}$).

Note: Figures in parentheses are the respective t ratios.

Producer Durables

The procedure outlined above could not be followed for the three non-consumption sectors: Producers' Durables (PD), Construction (CONSTR) and Government (GOVT). The ICP comparisons for PD are made by painstakingly matching specifications and obtaining special pricing for virtually each country separately. In order to use use reduced information procedure to select a sample of these products, substantial expertise and expense would still be needed to collect the prices. Building on the assumption that the prices for producer durables prevailing in an economy are not independent of the prices in other sectors, an attempt was made to explain the Producer Durables PPP with the help of items picked from certain "plausible" areas of consumption such as consumer durables, fuel, transportation, materials and various kinds of skilled and unskilled labor.

The selected regression included 10 item prices and had a maximum any-country residual error of -2.8 percent. The selected regression has been presented in Table 10.

Construction

The problem of missing observations in construction was so serious (only seven items were priced in 12 or more countries) that all the 106 specifications were first consolidated into 16 "sensible" groups in order to assure at least one price from every country for each of the consolidated specifications. After consolidation, the price tableau still had a few missing cells, which were estimated by CPD.

Table 10: REGRESSION EQUATION SELECTED FOR PRODUCERS' DURABLES (PD)

(from 17 Consumption and Government candidates)

Dependent Variable		Constant Term	Coefficient		Independent Variable	ICP Code
ln PD	=	-0.314701 (-5.64)	- 0.055549 (-4.12)	ln	Liquefied gas	3220-C
			+ 0.160477 (4.63)	ln	Sewing Machine	4360-A
			+ 0.200643 (3.92)	ln	Cleansing Tissue	4511-C
			+ 0.960309 (8.19)	ln	Boy's Bicycle	6120-A
			+ 0.422016 (10.5)	ln	Battery	6210-A
			- 0.445913 (-7.86)	ln	City Bus Fare	6322-A
			- 0.386912 (-4.26)	ln	Television	7110-A
			+ 0.174368 (6.66)	ln	Razor Blades	8220-H
			+ 0.154551 (5.47)	ln	Laborer	20100-D
			- 0.402000 (-7.43)	ln	Sanitary Engineer	20300-A

$\bar{R}^2$ = .9560

SEE = .026405

$F_{(10,4)}$ = 31.4

Maximum residual = -2.8 computed from exponentiated values (= $e^{\hat{u}}$).

Note: Figures in parentheses are the respective t ratios.

The search for the best subset regression -- conducted the same way as in consumption -- yielded 10 specifications. However, based on experience with price collection in construction items, to collect all these prices would still have been expensive. Three alternatives were tried. The first was to find one or two easily defined and generally available construction specifications and to "explain" the construction PPP by the prices of these specifications. The second was to use a shortcut to explain the construction PPP with the help of per capita nominal GDP. The third was to do the same thing as was done for producers´ durables -- i.e., "explain" construction PPP by a set of "plausible" consumption and labor items.

None of these alternatives had intuitive appeal, but the third was found to do an adequate job. A regression with a set of 10 specifications chosen from these "plausible" items was selected for predicting the construction PPP. This regression is presented in Table 11.

Government

The problem of missing prices was not serious in Govenment, so that, using a sequence of stepwise regressions and Leaps-and Bounds, an equation with 11 of the government item prices was quickly established. However, this equation was not usable for predictions because ICP´s experience showed that government prices were hard to get and caused delays in completing the work. Therefore, as in Producer Durables and Construction, the Government PPP also was predicted using

Table 11: REGRESSION EQUATON SELECTED FOR CONSTRUCTION (CONSTR)

(from 17 Consumption and Government Items)

Dependent Variable		Constant Term	Coefficient		Independent Variable	ICP Code
ln CONSTR	=	-0.075123 (-2.8)	+ 0.358368 (14.9)	ln	Half-Sole Repair	2220-B
			+ 0.175678 (19.4)	ln	Liquefied Gas	3220-C
			- 0.309092 (-14.5)	ln	Iron	4340-D
			- 0.215502 (-15.3)	ln	Sewing Machine	4360-A
			- 0.162123 (-3.76)	ln	Boy's Bicycle	6120-A
			- 0.458141 (-22.6)	ln	Battery	6210-A
			+ 0.376499 (21.5)	ln	City Bus	6322-A
			+ 0.635900 (15.6)	ln	Television	7110-A
			+ 0.172703 (11.7)	ln	Ballpoint Pen	7320-G
			+ 0.241109 (17.7)	ln	Sanitary Engineer	20300-A

$\bar{R}^2$ = .9988

SEE = .018107

$F_{(10,4)}$ = 1183

Maximum residual = 1.8 percent computed from exponentiated values (= $e^{\hat{u}}$)

Note: Figures in parentheses are the respective t ratios.

a set of 11 consumption and wages items, which have been shown in Table 12.

Summary

The six sectoral equations required a total of 46 item prices (some of the items were used in more than one sector). These items and the associated regressions constituted the core of the reduced information procedure. The $\bar{R}^2$ of these regressions were mostly above .99, and the maximum residuals for any country were no more than 3.8 percent. Consequently, this procedure replicated the 1973 comparisons almost perfectly. However, to see how it would perform for another set of countries at another point in time, it was used to predict in advance the results for the ICP Phase III countries for the year 1975.

6.3. Prediction

How should this scheme be used to predict PPPs in a country for which the full ICP type-treatment was not possible? There were three alternatives: the first was to use just the specification prices and the algebraic equations estimated from the 1973 sample. Each new country, threfore, would need to collect prices for these and only these specifications.

This alternative was used to predict the Phase III results presented here. However, most countries routinely collect prices for various national publications such as the Consumer Price Index. Therefore, more than 46 prices would normally be available for a new country without any additional effort, and it would be inefficient to

Table 12: REGRESSION EQUATION SELECTED FOR GOVERNMENT (GOVT)

(from 40 Consumption and Government Candidates)

Dependent Variable		Constant Term	Coefficient		Independent Variable	ICP Code
ln GOVT	=	-0.500322 (-6.45)	+ 0.403980 (7.94)	ln	Butter	1141-A
			- 0.589552 (-10.9)	ln	Apples	1152-A
			- 0.070658 (-2.37)	ln	Pajamas	2131-E
			+ 0.318589 (12.7)	ln	Water Rate	3120-P
			+ 0.192259 (6.65)	ln	Liquefied Gas	3220-C
			+ 0.122168 (2.64)	ln	Bath Towel	4200-C
			- 0.289662 (-5.18)	ln	Detergent	4512-A
			- 0.092046 (-3.40)	ln	Motor Oil	6230-B
			+ 0.149970 (4.57)	ln	Phone Service	6420-A
			+ 0.088218 (1.70)	ln	Soap	8210-A
			+ 0.130879 (2.34)	ln	Messenger	20100-B

$\bar{R}^2$ = .9985

SEE = .030375

$F_{(11,3)}$ = 827

Maximum residual = -3.8%, computed from exponentiated values (= $e^{\hat{u}}$).

Note: Figures in parentheses are the t ratios.

ignore this additional information. In those circumstances, a second alternative may be tried. In addition to making an estimate using these regressions, a second estimate may be made as a weighted average of the remaining price relatives, and the final prediction could be taken as an average of this and the 46-item prediction.

A final alternative would involve using a new set of regressions, tailor-made for each situation. The 46 specifications would be considered minimal, and countries would be encouraged to supply any additional prices. Then, using the latest ICP-type benchmark data, new subset regressions, estimated on the basis of all available prices as candidates, would then be used to estimate the new country's PPPs.

6.4. PPP vs. Exchange Rate as Conversion Factors

So far, the problem of using exchange rates as conversion factors instead of the PPPs has been ignored. The use of PPPs (at the GDP level) in place of exchange rates to convert the price relatives and sectoral PPPs would make the price relatives of the poorer countries in the sample relatively higher and would, conceivably, lead to the selection of a separate set of items which might be structurally more appropriate. Granting that this is possible, the problem is how to employ the scheme for the purpose of prediction.

It is possible to use the following formulation which will employ the PPPs as conversion factors for the purpose of estimating the regressions, but which will not require them for the purpose of prediction. Thus the equation could be estimated as

$$\ln \frac{PPP^{s}_{j}}{PPP^{g}_{j}} = \underset{i=1}{\overset{k}{S}} B_i \ln\left[\frac{P_{ij}/P_{i,us}}{PPP^{g}_{j}}\right] \qquad (9)$$

where the superscripts s and g stand for sector and GDP respectively, and all other symbols mean the same as before. From this, the PPP^{s}_{j} can be estimated as follows:

$$PPP^{s}_{j} = \underset{i=e}{\overset{k}{S}} B_i \ln (p_{i,j}/p_{i,us}) \qquad (10)$$

if

$$\underset{i=1}{\overset{k}{S}} B_i = 1.0 \qquad (11)$$

That is, not only should the constant term be suppressed, but the sum of coefficients must also be constrained to equal 1.0. Since the equation is estimated irrespective of the significance of the coefficients, the maximum residual errors are bound to increase.

The collection of item prices chosen on the basis of PPP converted values may be useful in yet another way: though the search procedure was conducted using PPP converted values, the regression equations to be used for prediction could be estimated on the basis of exchange rate conversions. In this way the collection of items might also be "proper" structurally. However, the equations might not be the best statistically, presenting a problem of choice: whether to use only exchange rates and risk having a structurally unsound set of predictors, or whether to select the right set of predictors but use them in a way that increases the residual errors.

Three alternative predictions were made (a) using exchange rate converted values both to select the variables and to make predictions, (b) using PPP converted values to select the variables but reestimating the equation so as to eliminate the need for conversion factors for making the predictions, and finally (c) using the PPP converted values to select the variables, but reestimating the predicting equation with values converted by exchange rates.

In order to help choose between the alternatives, Table 13 summarizes the maximum residual errors for the six sectors under each of these alternatives. The results under alternative (a) (column 1) must be the most highly regarded. The reduced information sample presented in Tables 7 through 12 has been chosen following this alternative.

Table 13: MAXIMUM RESIDUALS OF EQUATIONS SELECTED UNDER THREE ALTERNATIVES,* IN PERCENT

	Alternative (a) (1)	Alternative (b) (2)	Alternative (c) (3)
Food, Beverage, Tobacco	1.2	- 26.0	11.0
Clothing, Furnishings, Other	- 0.2	13.0	- 9.2
Rent, Medical Care, Transportation, Education and Recreation	1.9	13.0	17.4
Producer Durables	- 2.8	- 13.0	- 4.0
Construction	1.8	15.0	- 21.0
Government	- 3.8	- 15.0	- 20.0

*For a description of these alternatives, see page 53.

7. PREDICTIONS OF REAL GDP PER CAPITA FOR 1975 FOR PHASE III COUNTRIES AND CONCLUDING REMARKS

The work of the ICP Phase III now in progress will provide an opportunity to test the various shortcut and reduced information schemes developed here. In order to see how these formulae and schemes are likely to perform, they have been used to make alternative predictions of relative levels of per capita real GDP for 1975 for some of the new countries in Phase III of the ICP. Table 14 presents four different sets of predictions, three using shortcut formulae and a fourth that uses the PPPs estimated through reduced information procedures. The index of GDP per capita converted by exchange rates is also shown in the table. A comparison of these predictions with the actual ICP numbers which will soon be available will give clues as to which of the methods, if any, is likely to provide a viable alternative to a full ICP-type treatment.

Compared with the shortcut predictions, the results of reduced information prediction appear to fluctuate rather widely from country to country. Thus Austria, Luxembourg, Poland, Spain, and possibly also Pakistan appear to be clearly out of line. This is probably because of the tentative nature of some of the ICP Phase III prices used in these predictions. At this stage in the collection of data for Phase III, the price tableau shows extensive holes. The estimates of sectoral PPPs made through the Country-Product Dummy (CPD) method 23/ are based on a far smaller number of prices than will be available for the final ICP

23/ See A System, Chapter 5, for a description of CPD.

Table 14: PREDICTIONS OF ICP REAL GDP PER CAPITA, 1975
(US = 100)

	Predictions				
		Shortcuts			Reduced Information
	Nominal Index	Physical Indicators	Nominal and Physical Indicators	Nominal and Physical Indicators, PI and O	Reduced Information
	(1)	(2)	(3)	(4)	(5)
Austria	70.6	62.7	73.9	71.8	91.1
Brazil	16.0	17.6	22.5	25.7	28.5
Denmark	99.2	72.1	82.6	80.1	71.9
Ireland	36.6	40.2	51.7	48.9	43.7
Jamaica	20.2	22.6	32.6	32.0	38.2
Luxemborg	86.5	68.4	69.4	65.1	89.9
Malawi	1.95	3.89	4.70	4.30	5.84
Pakistan	2.10	6.68	5.68	5.60	9.92
Poland	36.5	50.8	44.1	----	----
Spain	40.8	49.3	54.5	56.8	82.6
Sri Lanka	3.52	10.2	13.9	12.3	9.36
Thailand	4.85	7.53	8.38	8.75	13.4
Uruguay	17.9	16.2	29.2	31.0	41.5
Yugoslavia	23.1	37.6	37.4	37.3	----
Zambia	7.02	7.68	11.2	11.4	9.00
US	100.00	100.00	100.00	100.00	100.00

Columns:

(1) : Based on actual GDP, exchange rate and population data in the ICP Phase III files.

(2) : Estimated by equation (5) and 1975 data taken from UN Statistical Yearbook, 1977.

(3) : Estimated by equation (6) from data used in Cols. (1) and (2).

(4) : Estimated by equation (7). Price Isolation and Openness data, taken from UN and World Bank sources, refer respectively to 1966 to 1975 and 1967 to 1975.

(5) : Reduced information PPPs computed from preliminary Phase III data and applied to actual localy currency GDP and population used in column (1).

exercise. An appropriate way of comparing the reduced information estimates with the final ICP results would be to re-estimate these reduced information predictions using the same actual prices as are ultimately used by the ICP.

The shortcut methods presented here are likely to be mistrusted in many quarters because they are based on average relationships observed in a certain set of countries over a certain period of time and applied to other countries at different times. Some of these other countries may not accept the results if the results do not suit their purpose. The assumption of a stable relationship across time and space may be reasonable for some purposes, but not for others.

Reduced information methods, on the other hand, based as they are on actual observations taken from the relevant countries and times concerned, are likely to be better received. PPPs based upon smaller sets of item prices sampled from all categories will be regarded as more attractive than those based upon shortcut procedures, even if the shortcuts happen to perform better for the ICP Phase III countries.

For some countries, such as the centrally planned ones, where viable price information may not be available, shortcuts may be the only hope.

When the new observations are available for the ICP Phase III study, it may be possible to refine both shortcuts and reduced information procedures. Under the current state of knowledge, however, if PPP converted values are to replace the exchange rate converted values on an international scale such as in the <u>World Bank Atlas</u>, the use of both shortcuts and reduced information procedures will be inevitable.

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