# A NEW SET OF INTERNATIONAL COMPARISONS OF REAL PRODUCT AND PRICE LEVELS ESTIMATES FOR 130 COUNTRIES, 1950-1985

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A new set of international comparisons covering the period 1950-85 is developed here for 121 market and 9 centrally planned economies. This new so-called Penn World Table (Mark 4), a completely revised and updated expansion of an equivalent table published by the authors in 1984, draws on the data of two previously unavailable international comparison benchmark studies. This article presents a detailed description of all estimation procedures, and excerpts from the overall DATA TABLE covering two years, 1980 and 1985. Three computer diskettes accompanying this article (and also available from the authors) contain the complete 36-year, 60,000 entry DATA TABLE in a form that economizes on scarce journal space and is immediately machine-readable. For the 121 market economies, the DATA TABLE gives annually, in addition to population and exchange rates, real product and price level estimates for four different national income concepts, and for the major subaggregates, consumption, investment, and government. Only population and real gross domestic product estimates are given for the nine centrally planned economies, however.

This new table is one more step toward the goal of establishing a new worldwide System of *Real National Accounts*.

## I. INTRODUCTION

The data systems of the nations of the world have been standardized, generally speaking, to conform to the System of National Accounts (SNA) of the United Nations. While the SNA provides comparable information over time about individual countries, many comparisons across countries cannot be made because each country's data system is denominated in its own national currency units. Entries in a so far non-existent System of <u>Real</u> National Accounts would be expressed in a way which would make intercountry comparisons possible. The benchmark pricing studies of the United Nations International Comparison Project and other international organizations may be thought of as the basic raw materials which when combined properly with normal SNA data will make possible the achievement of an SRNA. This paper is part of a continuing effort to make an SRNA a reality.

In a previous paper, Summers and Heston (1984), the authors provided a very large DATA TABLE of internationally comparable estimates of real product—for gross domestic product (GDP) and its components, consumption, investment, and government—and of corresponding price levels. (Hereafter, Summers and Heston (1984) and its DATA TABLE will be referred to as PWT3, standing for Penn World Table (Mark 3).) These comparisons, covering 124 countries and

the years 1950–80, were developed by suitably combining the data accumulated by the ICP in its work up to 1984[1] and a United Nations Development Centre national accounts data bank. Two newly available benchmark studies[2] and new national accounts data from the World Bank make possible the expansion, complete revision, and updating provided in the present paper. (Hereafter, this new SRNA effort will be referred to as PWT4.) We now make available to researchers a DATA TABLE on computer diskettes which covers 130 countries—including a number of oil-exporting countries not in PWT3—for the period 1950–85. The expanded coverage of the new DATA TABLE, in countries and years, and in computer accessibility, should make it more useful than its predecessor. In addition, a new chain, Divisia-type index for total product per capita has been added to the DATA TABLE.

More important than the expanded coverage, however, is that the new DATA TABLE's estimates for many of the 124 countries in the 1950–80 period should now be much more accurate. Major changes have been made in the treatment of both countries that have been included in multiple benchmark studies and countries that have not been included in a benchmark study at all. For the multiple-benchmark countries, an improved methodology has been devised to reconcile observed inconsistencies between the interspatial (ICP) and intertemporal (national accounts) data sets. In the case of non-benchmark countries, price survey data collected by the United Nations International Civil Service Commission and a UK-based organization[3] are now used along with exchange-rate information in estimating real income. In addition, experience with PWT3 has suggested a modification in approach is needed for one group of countries. Between these new procedures and the availability of new benchmark data, we think PWT4 will prove much more accurate than PWT3.

In section II, we review the procedures followed in PWT3 because PWT4 is developed in much the same way. The discussion here is divided into subsections on the 115 market economies and 9 centrally planned economies of PWT3.

An assessment of the accuracy of PWT3 was undertaken in Summers and Heston (1987), and the empirical results reported there are described in the first part of section III. The assessment, comparing 1980 GDP estimates from PWT3 with the results of the ICP's 1980 Phase 4, confirmed two expectations and

[1] PWT3 drew upon the methodology and empirical estimates of the first three phases of the ICP:

Phase 1: a development of an international comparison methodology, with very preliminary empirical estimates for six countries in 1967 and 10 countries in 1970 (Kravis, Heston, Kenessy, and Summers (1975)).

Phase 2: Empirical estimates for 1970 and 1973 for 16 countries. Because the two sets of estimates were not independent, only the 1970 estimates of Phase 2 were used in the construction of PWT3 (Kravis, Heston, and Summers (1978b)).

Phase 3: Empirical estimates for 1975 for 34 countries (Kravis, Heston, and Summers (1982)).

[2] The ICP's Phase 4 benchmark study for 1980 covered 60 countries (United Nations and Eurostat (1986)). Its Phase 5 benchmark study is not yet finished, but a preliminary version covering 22 countries of the Organization for Economic Co-operation and Development has been presented in Organization for Economic Co-operation and Development (1987).

[3] The United Nations International Civil Service regularly estimates relative costs of living for international civil servants in most of the countries of the world. The estimates appear in the United Nations *Monthly Bulletin of Statistics.* Employment Conditions Abroad, an English company, makes cost-of-living estimates for firms and governments with employees abroad. B. Rodin of ECA kindly furnished their 1980 estimates.

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contained an unpleasant surprise. Experience with the data of rich countries and poor in the ICP prepared us for the finding that PWT3 was much more accurate for rich countries than for poor. Furthermore, since the short-cut procedure for estimating non-benchmark country incomes is necessarily much less reliable than the full-scale pricing procedure used in an ICP benchmark study, finding much greater accuracy for Phase 3 countries than for non-Phase 3 countries confirmed the need for more benchmark studies. (Happily, Phase 4's extensive coverage—60 countries in all, including 28 countries that had not previously been covered in either Phase 2 or Phase 3—now reduces considerably the number of countries in PWT4 that must be handled with the short-cut procedure.) The unpleasant surprise was that PWT3 non-benchmark estimates for African countries were much worse than could be accounted for by their low incomes.

The second part of Section III addresses the problem of how to deal with inconsistencies between changes in a country's benchmark estimates over time and the country's growth rates as recorded in its national accounts. Basically, for each Phase 3 country, the PWT3 assessment amounts to a comparison of two 1975–80 growth rates: the rate implied by output estimates obtained in the 1975 and 1980 benchmark studies and the rate embedded in the country's national income accounts. A discrepancy between the growth rates reflects a difference between benchmark price indexes—estimated purchasing power parities (PPPs)—and national accounts price indexes. This way of looking at discrepancies leaves open the question of whether the mis-matches are a result of inaccurate interspatial benchmark price indexes or inaccurate intertemporal national accounts price indexes. The blame for the discrepancies almost certainly does not lie exclusively with either of the price indexes. The second part of section III lays out a "consistentizing" methodology for reconciling the observed discrepancies by adjusting both the intertemporal and interspatial price indexes.

A very brief description of the procedures followed in constructing PWT4 is given in section IV. The section follows the organization of section 2 where the preparation of PWT3 was described.

Section V presents a guide to the use of the broad PWT4 DATA TABLE. The DATA TABLE as a whole appears in computer-readable form on three diskettes distributed with this issue of the *Review of Income and Wealth*, and it is also available directly from the authors. Hard-copy excerpts from the DATA TABLE provided here cover only the years 1980 and 1985. The whole PWT4 consists of 130 blocks, one for each country. Each block contains data on 17 variables and 36 years for each of the 121 market economies (but some market economy histories start later than 1950) and on two variables and 36 years for each of nine centrally planned economies. (Some countries' data sets do not begin until after 1950, but with only a very few exceptions, all countries are represented after 1960.)

The paper ends in section VI with a brief discussion of the prospects of further development of a System of Real National Accounts.

Scarcity of journal space makes it necessary to keep brief in section IV the description of the procedures followed in preparing PWT4. A fully documented blueprint, along with a list of data sources, appears on the DATA TABLE diskettes as Appendix B. A printed copy may be obtained from the authors. We invite replication!

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## II. PENN WORLD TABLE (MARK 3)

As remarked above, the motivation for this brief review of PWT3 is that the new PWT4 follows its general procedures, and it is instructive to see what changes have been made.

### A. *Market Economies*

In addition to population figures, PWT3 contained estimates of the real product per capita and price level of 115 market economies for the years 1950–80.[4] The product estimates were for GDP *per capita* under three different concepts and for $C$, $I$, and $G$; the price-level estimates were for corresponding aggregates. The estimates were derived directly or indirectly from the real income and price comparisons of the ICP's Phase 2 (1970) and Phase 3 (1975) benchmark studies and the countries' national accounts.

### 1975: Benchmark Countries

The 115 market economies in PWT3 included 30 countries for which ICP Phase 3 benchmark data were available.[5] The PWT3 1975 entries for these countries, both real product and price-level values, were virtually all taken directly from the ICP.

### 1975: Non-benchmark Countries

In the absence of direct benchmark data for the other 85 countries, their 1975 PWT3 entries were obtained using an indirect "short-cut" procedure.[6] Two sets of equations were developed, one based on the 1970 data of Phase 2 and the other on the 1975 data of Phase 3, that related ICP real-product numbers and their national accounts data. These equations could be used to estimate a country's real-product values when only its national accounts data and its exchange rate were known.[7] Since a country's purchasing power parities (PPPs) over GDP, $C$, $I$, and $G$ are the ratios of its domestic-currency expenditures to its corresponding real expenditures measured in international prices, the equations make possible estimation of all relevant PPPs and therefore price-levels (price-level = PPP/exchange rate) using only national accounts data. *A priori*, it was clear that the short-cut equations provided a much less satisfactory set of PWT3 estimates for the non-benchmark countries than those based on the ICP Phase 3 benchmark study. (Incidentally, this was explicitly acknowledged in the quality grades assigned to the country estimates at the end of PWT3, and was confirmed in the PWT3 assessment of Summers and Heston (1987), discussed in

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[4] The printed version of PWT3 that appeared in this *Review* contained market economy estimates for 11 variables, but the computer-tape version was more complete with 16. In addition, the tape version's coverage extended to 1981.

[5] Phase 3 covered 30 market economies and 4 centrally planned economies. These included the 15 market economies and 1 centrally planned economy covered in Phase 2.

[6] The specific details of the PWT3 short-cut procedures are given in Summers and Heston (1984), which also gives references to earlier work of this sort. Kravis, Heston, and Summers (1978a) laid out the original rationale for the approach used.

[7] Pairs of real-product estimates for non-benchmarket countries in 1975 were obtained from Phase 2 and Phase 3 regression equations. For the details of how the pairs of estimates were averaged together to get the values placed in PWT3, see Summers and Heston (1984).

section III below.) To anticipate what will be emphasized in section III, the following may be said about the sources of improvement in PWT4 over PWT3: the reduced reliance in PWT4 on short-cut estimates is undoubtedly more important than the improvement in the quality of short-cut estimating.

Extrapolation to Other Years

All country estimates for 1975 were extrapolated to other years using the current- and constant-price series in the national accounts. Growth rates bearing on real-product values—at the level of $C$, $I$, and $G$—were derived from the constant-prices series; PPP and price-level extrapolations for the same components were based on price indexes derived from both the current- and constant-price series.

The three aggregate output measures in PWT3 for any particular year were (i) RGDP, *per capita* GDP denominated in 1975 international prices; (ii) RGDY, *per capita* GDP denominated in the current year's international prices (strictly speaking, RGDY information was given in the form of $y$, a country's RGDY expressed relative to the US's RGDY); and (iii) RGDP*, a blend of RGDP and RGDY which is designed to allow for changes in the terms of trade by valuing domestic absorption at 1975 international prices and NFB at current prices.

Of course, in PWT3 RGDP and RGDY are the same for 1975, the base year. A noteworthy feature of RGDP was the way in which its growth rates differed from domestic growth rates. Both were the weighted average of the growth rates of $C$, $I$, and $G$, but RGDP's weights were the real shares of the components while the domestic growth rate's weights were the country's own domestic-price shares. RGDP's were directly comparable across countries and time, but were based on a single year's relative prices, usually a different year from the one(s) of substantive interest. RGDYs, on the other hand, are directly comparable across countries, in terms of contemporary relative prices, but are not comparable across time. (It should be clear that RGDY is what is being estimated in benchmark studies.)

B. *Centrally Planned Economies*

Besides population, PWT3 provided only a single entry, RGNP based upon 1975 international prices, for the nine centrally planned economies (CPEs) it covered. Estimates intended to be directly comparable with the market economy RGDPs were obtained for 1975 from a blending of ICP Phase 3 results for four CPEs (Hungary, Poland, Romania, and Yugoslavia) with comparisons obtained from a variety of sources for five other CPEs (Bulgaria, China, Czechoslovakia, the Democratic Republic of Germany, and the Soviet Union). The extrapolations backward to 1950 and forward to 1980 were carried out using national accounts constant-price GDP estimates series obtained from a number of western sources.

### III. An Assessment of Penn World Table (Mark 3) and the Implied Need for "Consistentization"

A. *An Assessment of Penn World Table (Mark 3)*

PWT3 was prepared in early 1983 on the basis of benchmark and national accounts data available six months earlier. Subsequently, in early 1986, the United

Nations reported its version of the ICP's Phase 4 output comparisons for 1980 (United Nations and Eurostat (1986)) based on national accounts data available to the UN in 1985. In Summers and Heston (1987), the PWT3 entries for 1980 were compared with corresponding Phase 4 values. To make the comparisons meaningful, however, two kinds of adjustments were made to the PWT3 and UN numbers: (i) both sets of numbers were recalculated on the basis of a single vintage-1986 data base covering the years 1970–80; and (ii) the recalculation was done after the UN's Phase 4 methodology was recast to make it directly comparable with the Phase 2 and Phase 3 methodology underlying PWT3.

The diversity of kinds of output in different countries and our necessarily imperfect knowledge about expenditures and prices of those outputs makes it inevitable that ICP-type comparisons of national *per capita* GDPs will be imprecise. Still, it would seem reasonable that the best estimates available for comparative *per capita* GDPs in 1980 are to be found in the Phase 4 benchmark study for that year. After all, the countries in Phase 4 were all subjected simultaneously to the same intense direct ICP scrutiny. It will be argued below in the second part of this section that for many countries one can do better than simply take Phase 4 estimates as the definitive 1980 estimates. But for the purpose of assessing PWT3, the Phase 4 comparisions will stand for "Truth."

The accuracy of PWT3 is measured here by the differences between its 1980 RGDY entries and corresponding Phase 4 entries. (This is because the Phase 4 GDP *per capita* estimates are denominated in 1980 prices.[8]) In this abbreviated recapitulation of part of Summers and Heston (1987), a table and a regression equation are provided to show how PWT3 compares with Phase 4.

Table 1 is organized to throw in relief three factors that make for relatively good or bad PWT3 estimates: (i) the level of development of the country is certain to be important, so a breakdown by broad category of income is introduced into the table;[9] (ii) a 1980 PWT3 estimate based on a previous benchmark estimate is very likely to be better than one derived from short-cut procedures, so a distinction is made in the table between Phase 3 and non-Phase 3 countries; and (iii) even among countries at the same level of development, differences in country characteristics somehow tied to geographic propinquity may be important, so "continent" is included in the table.

The 57 countries for which PWT3-Phase 4 comparisons may be made were divided up into 32 categories: 4 income brackets, the Phase 3 vs. non-Phase 3 distinction, and 4 continental groups. Table 1 shows the number of countries falling within each of the 32 individual cells (some being empty) and gives the average of the *absolute values* of the percentage differences between the PWT3 and Phase 4 values (the latter being in the denominator) for those countries within the cell. These absolute-value errors have a pattern that stands out conspicuously:

(i) With only one exception (easily explained by small-sample considerations), as one moves from lower to higher income countries while

[8] Strictly speaking, it is the $y$'s, the RGDYs expressed relative to the US RGDY, which are of concern.

[9] Perhaps a country's *per capita* income is actually just a proxy here for the quality of its statistical expertise.

TABLE 1

ABSOLUTE VALUE OF THE PERCENTAGE DIFFERENCE BETWEEN PENN WORLD TABLE (MARK 3) AND ICP PHASE 4 ESTIMATES, 1980: BY INCOME, CONTINENT, AND WHETHER COUNTRIES WERE INCLUDED IN THE ICP'S PHASE 3

| | | Income: $Y(\%)$ | | | | | | | | | |
| | | $Y < 15$ |ERROR| | | $15 \le Y < 25$ |ERROR| | | $25 \le Y < 50$ |ERROR| | | $50 \le Y$ |ERROR| | | ALL |ERROR| | |
| | | $N$ | Mean | $N$ | Mean | $N$ | Mean | $N$ | Mean | $N$ | Mean |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Africa | Ph3 | 3 | 21.57 | — | — | — | — | — | — | 3 | 21.57 |
| | Non-Ph3 | 11 | 48.25 | 1 | 45.10 | — | — | — | — | 12 | 47.98 |
| | Total | 14 | 42.53 | 1 | 45.10 | — | — | — | — | 15 | 42.70 |
| Asia | Ph3 | 3 | 11.47 | 2 | 14.25 | — | — | 1 | 1.30 | 6 | 10.70 |
| | Non-Ph3 | 1 | 11.00 | — | — | — | — | 2 | 2.40 | 3 | 5.27 |
| | Total | 4 | 11.35 | 2 | 14.25 | — | — | 3 | 2.03 | 9 | 8.89 |
| South and Central America | Ph3 | — | — | 1 | 8.90 | 3 | 7.53 | — | — | 4 | 7.87 |
| | Non-Ph3 | 3 | 19.00 | 5 | 17.50 | 5 | 12.56 | — | — | 13 | 15.95 |
| | Total | 3 | 19.00 | 6 | 16.07 | 8 | 10.67 | — | — | 17 | 14.05 |
| Europe and North America | Ph3 | — | — | — | — | 1 | 7.20 | 10 | 6.23 | 11 | 6.32 |
| | Non-Ph3 | — | — | — | — | 2 | 19.15 | 3 | 5.53 | 5 | 10.98 |
| | Total | — | — | — | — | 3 | 15.17 | 13 | 6.07 | 16 | 7.77 |
| All | Ph3 | 6 | 16.52 | 3 | 12.47 | 4 | 7.45 | 11 | 5.78 | 24 | 9.58 |
| | Non-Ph3 | 15 | 39.91 | 6 | 22.10 | 7 | 14.44 | 5 | 4.28 | 33 | 25.87 |
| | Total | 21 | 33.23 | 9 | 18.89 | 11 | 11.90 | 16 | 5.31 | 57 | 19.01 |

$Y$: *Per capita* gross domestic product expressed as a percentage of U.S. *per capita* gross domestic product.
|ERROR|: Absolute value of $(Y^{PWT} - Y^{Ph4})/Y^{Ph4}$.
Ph3: Countries for which Phase 3 entries are available.
Non-Ph3: Countries for which only short-cut estimates are available.

holding Ph3/non-Ph3 and continent constant, the errors go down. Ignoring continent, the errors *always* go down with income.

(ii)  With two exceptions (both statistically insignificant), as one moves from Phase 3 to non-Phase 3 holding income and continent constant, the errors go up. There is a very slight departure from the general pattern in the highest income category, but it is of no substantive importance.

(iii)  African countries have much, much larger errors than those on other continents, even after allowing for income and Ph3/non-Ph3 differences. The absolute value character of the error hides something important here. What is not visible in Table 1 is the pattern of pluses and minuses of the discrepancies between PWT3 and Phase 4. In all cells but the African ones, the numbers of pluses and minuses were more or less equal. However, in the case of the non-Phase 3 African cells, *all* of the signs are positive. That is, *all* of the short-cut estimates for the African countries were too high, and *much* too high at that. In fact, the average of the ratios (the geometric average, that is) of the short-cut African estimates to the corresponding Phase 4 values was 1.31!

To state the findings in general terms, the salient facts about PWT3 seem to be:

(a)  Estimates for rich countries are likely to be good whether they are based on previous benchmark treatment or not. (Both 5.78 and 4.28 are very small.)

(b)  The estimates for countries with incomes less than half that of the United States' are certainly worse, but still quite acceptable—the errors averaging 10 percent—if they are based on previous benchmark data.

(c)  Even the non-Ph3 estimates—the errors averaging about 16 percent—are usable for poor non-African countries.

(d)  The PWT3 estimates for 3 Ph3 African countries are very poor—21.57 percent—but still are informative.

(e)  The short-cut estimates for the 11 non-Ph3 African countries are quite unacceptable with an arithmetic average error of 48 percent.

The regression equation given in (1) summarizes the data underlying Table 1 in a different way. Using the 57 Phase 4 observations for which there are 1980 PWT3 estimates, the absolute value of the error has been regressed on 1980 Phase 4 income and dummy variables representing Ph3/non-Ph3 and the continents. It is apparent that the sign and size of the coefficients and their associated standard errors confirm the (a)–(e) story.

(1)  $\text{Error} = 18.1 - 0.18y + 8.4D_{\text{Ph3}} + 19.2C_1 - 6.9\,C_2 - 5.9\,C_3$
$\phantom{(1)\quad\text{Error} = }(9.8)\,(0.12)\quad(4.4)\qquad(9.8)\quad(8.2)\quad(8.0)$

where $D_{\text{Ph3}} = 0$ for Phase 3 countries and 1 for non-Phase 3 countries; and $C_1$, $C_2$, and $C_3$ equal 1 if the country is located in, respectively, Africa, Asia, or South and Central America, and zero otherwise. $\bar{R}^2 = 0.50$. (When the two statistically insignificant country dummies are dropped, the role of $y$ weakens slightly, the role of Phase 3 stays the same, and the role of Africa strengthens. These changes occur because of the income pattern across continents.)

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Points (a)-(d) are all quite encouraging but point (e) seems discouraging in the extreme. It testifies to our inability as we embarked on PWT3 to find a short-cut procedure that properly captured the elusive differences between African and non-African countries. Fortunately, this grey cloud has a shiny, silver lining. The World Bank identifies 53 distinct political subdivisions in Africa.[10] Of these, 43 with 98 percent of the total African population were big enough to be represented in PWT3. Going into PWT3, three of the 43 countries—with only 6 percent of the African population—had previously been in a benchmark study, leaving 40 countries with 94 percent of the population requiring shortcut treatment. After Phase 4, 15 African countries with about 49 percent of the population have been in a benchmark study, so now only 28 countries, comprising 51 percent of the population, require the high-risk short-cut technique. More than that, with 15 African benchmark observations, the equations of the short-cut procedures can be made more effective this time around.

## B. "Consistentization" of Country Data

### 1. Countries in Both Phases 3 and 4

The PWT3 estimate of each Phase 3 country's 1980 RGDY was based on both Phase 3 and national accounts information. All countries' 1975 PPP's for $C$, $I$, and $G$ from Phase 3 were extrapolated forward to 1980 using national accounts price indexes. These 1980 PPP's were then combined with the 1980 current-price $C$, $I$, and $G$ expenditures following a procedure very much like the standard ICP benchmark technique. In effect, 1980 extrapolations were obtained for real $C$, $I$, and $G$, and these were aggregated, along with the NFB, using 1980 international prices to get RGDY for 1980. In the previous section, the assessment of PWT3 was carried out on the assumption that Phase 4 comparisons were correct and discrepancies between Phase 4 and PWT3 values were the result of incorrect Phase 3 and/or national accounts data. While that may indeed be the case, it would be more realistic to recognize explicitly that the failure of the extrapolated Phase 3 comparisons to match the Phase 4 ones could be a consequence of errors in Phase 4 also—or most likely, errors in some combination of the three sources. Whatever the merit might be of assuming the Phase 4 comparisons are correct in assessing PWT3, the use of both Phase 3 and Phase 4 comparisons—and Phase 2 comparisons as well—directly in PWT4 calls for a more comprehensive treatment now.

An essential rule of an SRNA is that its entries should obey all temporal identities of the form "the value at $t_2$ equals the value at $t_1$ times the growth rate between $t_1$ and $t_2$." Discrepancies like those observed between 1980 PWT3 and Phase 4 values indicate that in an SRNA built up out of Phase 3 and Phase 4 estimates, such a temporal identity is violated.

Unless there is a compelling reason for thinking one data source is accurate while the others are not, it is better to allow for inaccuracy in all data sources. (Note that such healthy skepticism does not dictate a perfectly symmetric treatment of all data sets, as will be shown below.) The interplay of conflicting numbers

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[10] World Bank (1979).

and need for resolution can be illustrated as follows. Suppose the 1980 Phase 4 Consumption estimate of Country A is 66 percent of United States 1980 Consumption. How should that 66 percent figure be viewed if the following is learned: the Phase 3 1975 relative Consumption value is 65 percent and the Country A and United States Consumption growth rates between 1975 and 1980 were 4 percent and 1 percent per year respectively? A person having any degree of confidence in the Phase 3 benchmark study and the national accounts growth rates would surely want to shade upward the 66 percent Phase 4 figure. More than that, it seems reasonable to think in light of the Phase 4 figure and the growth rates that the Phase 3 65 percent figure is too high. And a person aware of all the difficulties of deriving the intertemporal price indexes on which the national accounts growth rates are based would certainly worry that the relative growth rate figure is high in light of the 66 percent and 65 percent benchmark figures.

Since the development of these consistentization notions, it was pointed out to the authors that the same basic ideas were introduced into national income accounting almost half a century ago. Stone, Champernowne and Meade (1942) were concerned with the failure of independent estimates of gross product and factor income to add up to the same total. They devised a method very similar to the one outlined below to make their estimates obey the national income identity requiring that total product be equal to total income generated by the production of the product.

## 2. Countries in Multiple Benchmark Studies

A straightforward errors-in-variables model can be used to adjust both benchmark and national accounts data to make them consistent. (That is, in the example above, to find the right "optimal" adjustment factors—less than one for the Phase 3 and 1975-to-1980 growth rate estimates, and greater than one for the Phase 4 estimate—so that the new Phase 4 number is equal to the new Phase 3 number multiplied by the new 1975-to-1980 growth rate.) Such a model can be used to bring to bear any *a priori* information available about the relative reliabilities of the data sources. The model is defined by equations (2) through (9) for the case of three benchmark values and two intervening national accounts growth rates, but it can be applied equally well to the (two benchmark, one growth-rate) or (four benchmark, three growth-rate) cases.[11]

Let $X_1$, $X_2$, and $X_3$ be the *true* values of a country's output at a particular level of aggregation (e.g., Consumption), expressed in *per capita* terms and relative to corresponding values for the United States, for three time points, $t_1$, $t_2$, and $t_3$; and let $G_1$ and $G_2$ be the *true* values of the country's growth rates, for the same aggregate, expressed in the same *per capita* units relative to the United

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[11] The multiple benchmark pattern of the ICP's three phases and the OECD's comparisons is as follows:

|  | No. of countries |  | No. of countries |
|---|---|---|---|
| (1970, 1975) | 2 | (1970, 1975, 1980) | 14 |
| (1975, 1980) | 13 |  |  |

States, for the $(t_1, t_2)$ and $(t_2, t_3)$ periods, respectively. Then the temporal identity requires that

(2)
$$X_2 = X_1 \cdot G_1$$

and

(3)
$$X_3 = X_2 \cdot G_2.$$

Now let the lower-case symbols, $x_1$, $x_2$, $x_3$, $g_1$, and $g_2$ stand for *estimated* values equivalent to corresponding upper-case ones, obtained from benchmark studies or the national accounts. The errors-in-variables specification we assume is given by (4), (5), and (6).

(4)
$$x_i = X_i \cdot v_i, \qquad i = 1, 2, 3$$

(5)
$$g_1 = G_1 v_4$$

(6)
$$g_2 = G_2 v_5$$

where the five $v$'s are joint random variables with a multivariate lognormal distribution $\Omega\,(0, \Sigma)$.

All *a priori* information about the relative accuracies of the data sources is brought to bear in the model through a specification of the entries in $\Sigma$, the variance-covariance matrix of the $v$'s. Specifically, the information is parametrized in the form of a five-element vector $(k_1, k_2, k_3, r_1, r_2)$, and an assumed pattern of independence among the $v$'s. The variances of the $v$'s relating to the $g$'s, the growth-rate $v$'s, are assumed to be the same, and without loss of generality equal to 1; the variances of the $v$'s associated with the $x$'s, the benchmark $v$'s, expressed relative to the variances of the growth-rate $v$'s, are given by the $k$'s; the correlation between $v_1$ and $v_2$ and also $v_2$ and $v_3$ is given by $r_1$; the correlation between $v_1$ and $v_3$, because a longer time interval has elapsed between the first and third benchmarks, is assumed equal to $r_1^2$; the correlation between the two growth-rate $v$'s is given by $r_2$; and the benchmark and growth-rate $v$'s are assumed to be independent.

All of this implies that $\Sigma$ takes the form specified by (7), (8), and (9).

(7)
$$\Sigma = \begin{bmatrix} \Sigma_x & 0 \\ 0 & \Sigma_g \end{bmatrix}$$

where

(8)
$$\Sigma_x = \begin{bmatrix} k_1 & r_1\sqrt{k_1 k_2} & r_1^2\sqrt{k_1 k_3} \\ r_1\sqrt{k_1 k_2} & k_2 & r_1\sqrt{k_2 k_3} \\ r_1^2\sqrt{k_1 k_3} & r_1\sqrt{k_2 k_3} & k_3 \end{bmatrix}$$

and

(9)
$$\Sigma_g = \begin{bmatrix} 1 & r_2 \\ r_2 & 1 \end{bmatrix}.$$

The likelihood function in this model is given in (10):

(10)    $\ln L(X_1, X_2, X_3, G_1, G_2/x_1, x_2, x_3, g_1, g_2; \Sigma)$

$$= K - \tfrac{1}{2}\ln \Sigma - \frac{1}{2}\left\{\sum_1^3 \sum_1^3 \lambda_{ij}, (\ln x_i - \ln X_i)(\ln x_j - \ln X_j)\right.$$

$$\left. + \sum_4^5 \sum_4^5 \lambda_{ij}(\ln g_{i-3} - \ln G_{i-3})(\ln g_{j-3} - \ln G_{j-3})\right\}$$

where the $\lambda_{ij}$'s are the elements of $\Sigma^{-1}$. The important thing to keep in mind here is that $\ln L$ is subject to the temporal conditions given in (3) and (4). Maximum likelihood estimates of the $X$'s and $G$'s can be found easily because the first-order maximization conditions here can be reduced to a set of linear equations in just the $X$'s. It is somewhat more convenient to work with transformations of the $X$ and $G$ variables, $F_i = X_i/x_i$, $i = 1, 2, 3$, and $F_i = G_{i-3}/g_{i-3}$, $i = 4, 5$, and maximize the new likelihood function with respect to the $F$'s. (Observe that the $F$'s may be regarded as adjustment factors that can be applied to the observed $x$'s and $g$'s to get maximum likelihood estimates of the true values, the $X$'s and the $G$'s.) The first-order equations in the $F$'s are still linear, and the likelihood-maximizing $F$'s turn out to have a particularly simple structure;

(12)    $$F_i = \Delta_1^{\Phi_i(k's,r's)} \cdot \Delta_2^{\theta_i(k's,r's)}$$

where $\Delta_1 = x_2/(x_1 g_1)$ and $\Delta_2 = x_3/(x_2 g_2)$, and $\Phi_1$ and $\theta_1$ are functions of only the *a priori* variances and covariances of the $v$'s—that is, functions of the $k$'s and $r$'s.[12] The $\Delta$'s, essentially the "errors" of the assessment process described above, turn out to be sufficient statistics![13]

In this section, consistentizing using an errors-in-variables maximum likelihood approach has been described in some detail. However, this section has dealt only with "straightening" out the data sources so they are consistent. How the consistent data are put together in forming PWT4 is discussed in the next section. (Appendix B contains the details of the construction of PWT3. It gives quantitative information about the magnitudes of the consistentization adjustment factors for reasonable values of the $k$'s and $r$'s.)

## IV. The Construction of Penn World Table (Mark 4)

### A. *Coverage*

The DATA TABLE of PWT4 presents numerical estimates of 17 variables for each of 121 market economies in each of the 36 years from 1950 to 1985.

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[12] In the (two-benchmark, one growth-rate case), (12) can be written out explicitly:

$$F_1 = \Delta^{(k_1 - r_1\sqrt{k_1 k_2})/M}; \qquad F_2 = \Delta^{-(k_2 - r_1\sqrt{k_1 k_2})/M};$$
$$\text{and } F_3 = \Delta^{1/M}, \text{ where } M = k_1 + k_2 + 1 - 2r_1\sqrt{k_1 k_2}$$

[13] Sufficiency apart, the usual attractiveness of the method of maximum likelihood may well be regarded as limited here. None of the desirable asymptotic properties of maximum likelihood estimates can be claimed in this consistentization application because additional parameters are added as more time points are introduced. However, it can be shown that the maximum likelihood estimates are the same as variance-minimizing estimates obtained from averaging all possible unbiased point estimates. (For example, in the (two benchmark, one growth-rate) case, if $x_1$ and $x_2/g_1$ are both unbiased estimators of $X_1$, then the variance-minimizing geometric mean of the two will be the same as $F_1 \cdot x_1$.)

Estimates of 2 variables are given for each of 9 CPE's for the same 36 years. (The coverage begins after 1950 for some countries but in only a few cases after 1959.) The country coverage for the market economies can be seen in the 1980 and 1985 excerpts from the DATA TABLE which appear as Tables 2 and 3, and the CPE countries are listed in Table 4.[14]

The variables estimated for the market economies and the CPE's are listed in Appendix A. A new chain-type index for *per capita* GDP, RGDP2, has been added to the variables of PWT3. PWT3 presented *per capita* GDP under three concepts: RGDP, now called RGDP1 (quantities valued at base-year 1975 international prices), RGDY (quantities valued at current year international prices), and RGDP*, now called RGDP3 (domestic absorption quantities valued at base-year international prices but exports and imports valued at current prices). The RGDP1 and RGDP3 series can be used for intertemporal comparisons, but the 1980 base-year price weights are fairly remote for the purposes of comparing sets of years far from 1980. The new RGDP2 series is defined in terms of a chain of ratios of consecutive years' *per capita* GDP. Each element of the chain is the ratio of *per capita* $GDP_{j,t+1}$ to *per capita* $GDP_{j,t}$ where both the numerator and denominator are valued in the $t$-th year's international prices. This chain index has the substantial merit that price weights are much more current in intertemporal comparisons.

## B. *Market Economies*

1980: Benchmark Countries

In all, a total of 70 countries have been involved in the ICP and OECD benchmark studies. The estimates in the DATA TABLE for these countries are based upon the following general treatment of benchmark results.

1. The benchmark comparisons were made initially on the basis of detailed expenditure and price data collected from the countries. The benchmark computation algorithm (the so-called Geary-Khamis method[15]) was originally applied to the detailed expenditure *composition* and price data, and the national accounts subaggregate estimates for C, I, and G that were available at the time of the original study. Direct comparability across the studies was problematical because of data concerns and changing methodological procedures: (i) The studies were done at roughly 5 year intervals, so they were based on national accounts data series of different vintages. That is, the values of C, I, and G used for the original Phase 2 1970 study were best estimates as of about 1976 while the original Phase 3 1975 study was based on national accounts information of 1981 and the UN's published Phase 4 results for 1980 were based on a mix of vintages between 1982 and 1984. (ii) The methodology used in the studies was not uniform with respect to the treatment of certain service categories and in the way countries were weighted or aggregated into blocs. The non-comparabilities across studies were minimized by rerunning the

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[14] The number of countries in PWT4 falls short of all the political subdivisions of the world, but PWT4 covers over 99 percent of the world population.

[15] The Geary-Khamis algorithm is described in detail in Kravis, Heston and Summers (1978), and (1982).

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TABLE 2

ESTIMATES OF REAL PER CAPITA PRODUCT AND PRICE LEVEL (GROSS DOMESTIC PRODUCT, CONSUMPTION, GROSS DOMESTIC INVESTMENT, AND GOVERNMENT), POPULATION, AND EXCHANGE RATE: 121 MARKET ECONOMIES, 1980 (BASE YEAR: 1980)

| | | [1]<br>POP | [2]<br>RGDP1 | [3]<br>c | [4]<br>i | [5]<br>g | [8]<br>y | [13]<br>P | [14]<br>PC | [15]<br>PI | [16]<br>PG | [17]<br>XR | [18]<br>Q |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Africa | | | | | | | | | | | | | |
| 1 | Algeria | 18,667 | 1,998 | 45.93 | 31.87 | 18.27 | 17.52 | 112.93 | 107.41 | 155.47 | 67.76 | 3.838 | D |
| 2 | Angola | 7,581 | 694 | 49.12 | 5.99 | 29.08 | 6.09 | 72.51 | 73.60 | 113.22 | 42.49 | 49.431 | D |
| 3 | Benin | 3,464 | 534 | 86.40 | 10.66 | 14.28 | 4.68 | 60.44 | 67.36 | 104.04 | 28.96 | 210.974 | D |
| 4 | Botswana | 893 | 1,477 | 52.16 | 38.95 | 25.25 | 12.95 | 74.38 | 77.49 | 94.90 | 55.40 | 0.777 | C |
| 5 | Burkina | 6,161 | 358 | 81.73 | 12.41 | 22.85 | 3.14 | 57.85 | 67.20 | 102.69 | 34.59 | 211.300 | D |
| 6 | Burundi | 4,114 | 333 | 82.05 | 8.73 | 18.80 | 2.92 | 64.92 | 71.73 | 115.68 | 34.76 | 90.013 | D |
| 7 | Cameroon | 8,701 | 875 | 69.46 | 18.77 | 16.36 | 7.67 | 105.88 | 104.35 | 175.49 | 48.16 | 210.972 | C |
| 8 | Central Afr. Rep. | 2,286 | 487 | 72.85 | 9.39 | 29.26 | 4.27 | 71.75 | 79.88 | 122.81 | 44.46 | 210.975 | D |
| 9 | Chad | 4,477 | 353 | 72.55 | 7.78 | 30.99 | 3.10 | 63.68 | 72.57 | 116.72 | 40.38 | 210.981 | D |
| 10 | Congo, Prop. Rep. | 1,605 | 981 | 43.32 | 27.16 | 23.44 | 8.60 | 108.54 | 106.17 | 154.77 | 65.27 | 210.968 | D |
| 11 | Egypt | 42,289 | 995 | 60.85 | 20.95 | 22.04 | 8.72 | 61.28 | 63.84 | 90.44 | 36.32 | 0.700 | D |
| 12 | Ethiopia | 37,717 | 325 | 75.38 | 5.48 | 20.37 | 2.85 | 34.89 | 36.85 | 83.27 | 19.67 | 2.070 | D+ |
| 13 | Gabon | 1,074 | 2,973 | 28.95 | 27.10 | 14.14 | 26.07 | 131.60 | 131.01 | 197.44 | 88.64 | 210.972 | D |
| 14 | Gambia, The | 652 | 556 | 84.54 | 29.86 | 34.29 | 4.88 | 67.05 | 79.40 | 113.33 | 45.49 | 1.719 | D |
| 15 | Ghana | 11,500 | 421 | 69.67 | 8.45 | 22.41 | 3.69 | 85.50 | 90.90 | 142.80 | 48.41 | 8.950 | D |
| 16 | Guinea | 5,457 | 449 | 65.84 | 10.34 | 22.68 | 3.94 | 72.53 | 76.31 | 115.77 | 41.25 | 18.968 | D |
| 17 | Ivory Coast | 8,358 | 1,110 | 61.75 | 18.42 | 26.86 | 9.74 | 114.10 | 113.78 | 189.93 | 61.96 | 210.970 | C |
| 18 | Kenya | 16,642 | 662 | 60.13 | 20.23 | 26.95 | 5.80 | 64.24 | 67.40 | 103.11 | 38.75 | 7.440 | C |
| 19 | Lesotho | 1,339 | 694 | 94.75 | 18.79 | 33.41 | 6.08 | 44.42 | 65.37 | 93.11 | 36.74 | 0.778 | D |
| 20 | Liberia | 1,871 | 680 | 51.85 | 21.66 | 26.53 | 5.97 | 71.99 | 73.20 | 104.85 | 43.19 | 1.000 | D |
| 21 | Madagascar | 8,714 | 589 | 82.50 | 10.27 | 17.99 | 5.16 | 63.70 | 60.80 | 158.08 | 48.47 | 210.974 | D |
| 22 | Malawi | 6,123 | 417 | 69.96 | 11.94 | 25.06 | 3.66 | 48.74 | 50.50 | 113.31 | 28.73 | 0.812 | D+ |
| 23 | Mali | 6,699 | 356 | 75.56 | 7.15 | 27.18 | 3.12 | 59.78 | 69.11 | 152.52 | 26.60 | 421.953 | D+ |
| 24 | Mauritania | 1,529 | 576 | 68.03 | 22.36 | 34.98 | 5.05 | 78.53 | 85.97 | 122.23 | 30.41 | 45.916 | D |
| 25 | Mauritius | 957 | 1,484 | 74.84 | 15.42 | 17.91 | 13.01 | 79.65 | 84.25 | 115.97 | 45.78 | 7.688 | D |
| 26 | Morocco | 19.245 | 1,199 | 71.19 | 10.69 | 25.16 | 10.51 | 77.38 | 74.25 | 178.61 | 49.64 | 3.930 | C |
| 27 | Mozambique | 12,094 | 637 | 77.37 | 5.79 | 20.69 | 5.59 | 56.95 | 62.51 | 103.97 | 32.52 | 32.000 | D |
| 28 | Niger | 5,532 | 441 | 72.35 | 23.82 | 17.24 | 3.87 | 102.74 | 102.98 | 151.12 | 49.88 | 210.969 | D |
| 29 | Nigeria | 84,732 | 824 | 59.47 | 19.48 | 15.32 | 7.22 | 121.95 | 126.54 | 168.41 | 68.16 | 0.547 | D+ |
| 30 | Rwanda | 5,139 | 379 | 78.35 | 10.19 | 18.59 | 3.33 | 59.69 | 65.54 | 102.19 | 32.16 | 92.839 | D |
| 31 | Senegal | 5,696 | 744 | 74.05 | 8.25 | 28.94 | 6.53 | 71.26 | 76.90 | 160.49 | 41.84 | 212.763 | C |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 32 | Sierra Leone | 3,296 | 512 | 86.66 | 12.59 | 12.95 | 4.49 | 72.94 | 78.76 | 119.77 | 31.49 | 1.050 | D |
| 33 | Somalia | 4,674 | 415 | 61.58 | 16.86 | 34.81 | 3.64 | 70.72 | 78.19 | 112.78 | 45.51 | 6.295 | D |
| 34 | S. Africa | 28,612 | 4,286 | 54.19 | 25.22 | 15.25 | 37.59 | 65.66 | 63.32 | 80.72 | 43.50 | 0.778 | C |
| 35 | Sudan | 18,945 | 652 | 73.38 | 13.95 | 20.98 | 5.71 | 65.65 | 71.24 | 104.46 | 37.62 | 0.500 | D |
| 36 | Swaziland | 633 | 1,079 | 66.97 | 27.48 | 28.84 | 9.47 | 87.57 | 91.00 | 127.19 | 54.33 | 0.778 | D |
| 37 | Tanzania | 18,757 | 353 | 66.05 | 17.86 | 26.30 | 3.10 | 74.93 | 92.85 | 94.70 | 30.82 | 8.195 | C |
| 38 | Togo | 2,578 | 625 | 65.10 | 25.94 | 20.64 | 5.48 | 70.30 | 73.35 | 106.50 | 39.65 | 210.967 | D |
| 39 | Tunisia | 6,369 | 1,845 | 72.33 | 15.18 | 16.48 | 16.18 | 73.98 | 65.20 | 153.46 | 52.39 | 0.405 | C |
| 40 | Uganda | 12,630 | 257 | 79.87 | 2.66 | 20.34 | 2.25 | 59.77 | 65.42 | 150.91 | 32.75 | 47.618 | D |
| 41 | Zaire | 28,893 | 224 | 60.86 | 17.74 | 22.95 | 1.97 | 96.28 | 99.09 | 146.30 | 53.93 | 2.756 | D |
| 42 | Zambia | 5,647 | 716 | 48.95 | 19.22 | 36.76 | 6.28 | 93.32 | 105.10 | 123.74 | 57.67 | 0.789 | D+ |
| 43 | Zimbabwe | 6,976 | 930 | 69.50 | 12.37 | 20.60 | 8.16 | 84.61 | 85.49 | 112.02 | 65.08 | 0.643 | C |

Asia

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 44 | Afghanistan | 15,950 | 596 | 77.92 | 8.84 | 11.12 | 5.22 | 35.39 | 35.51 | 55.50 | 13.98 | 44.164 | D |
| 45 | Bahrain | 347 | 9,185 | 39.39 | 33.14 | 11.54 | 80.54 | 113.68 | 108.20 | 135.77 | 103.58 | 0.377 | D |
| 46 | Bangladesh | 88,513 | 540 | 87.65 | 5.99 | 9.19 | 4.73 | 31.68 | 35.26 | 60.34 | 10.77 | 15.415 | D |
| 47 | Burma | 33,415 | 483 | 68.07 | 14.60 | 18.54 | 4.24 | 36.14 | 36.18 | 56.60 | 19.59 | 6.607 | D |
| 48 | Hong Kong | 5,039 | 7,268 | 74.86 | 24.19 | 4.37 | 63.74 | 74.22 | 63.72 | 119.33 | 87.50 | 5.040 | B |
| 49 | India | 687,332 | 614 | 59.30 | 18.07 | 24.00 | 5.39 | 38.42 | 46.08 | 56.30 | 13.11 | 7.861 | C |
| 50 | Iran | 38,790 | 2,944 | 55.07 | 20.62 | 23.84 | 25.82 | 78.09 | 78.59 | 97.25 | 57.77 | 70.622 | C |
| 52 | Iraq | 13,205 | 4,408 | 34.95 | 30,21 | 19,40 | 38,65 | 64.35 | 54.18 | 75.15 | 39.69 | 0.295 | D |
| 52 | Israel | 3,878 | 6,145 | 52.67 | 22.67 | 35.60 | 53.88 | 90.42 | 101.12 | 92.61 | 68.40 | 5.124 | B |
| 53 | Japan | 116,782 | 8,117 | 55.87 | 37.83 | 7.31 | 71.18 | 110.25 | 118.69 | 103.03 | 120.94 | 225.734 | A |
| 54 | Jordan | 2,923 | 1,885 | 74.67 | 28.30 | 26.95 | 16.53 | 60.62 | 70.79 | 93.87 | 44.02 | 0.299 | D |
| 55 | Korea, Rep. of | 38,124 | 2,369 | 61.76 | 28.87 | 13.83 | 20.77 | 64.64 | 69.37 | 73.04 | 47.09 | 606.061 | C |
| 56 | Kuwait | 1,372 | 19,454 | 29.11 | 14.45 | 9.12 | 170.59 | 103.39 | 108.26 | 102.31 | 104.52 | 0.270 | D |
| 57 | Malaysia | 13,870 | 3,112 | 52.42 | 29.09 | 16.55 | 27.29 | 55.19 | 55.31 | 58.74 | 45.43 | 2.176 | B |
| 58 | Nepal | 14,640 | 490 | 79.80 | 10.01 | 12.15 | 4.30 | 27.13 | 29.75 | 46.26 | 12.00 | 12.001 | D |
| 59 | Oman | 978 | 6,209 | 17.57 | 21.80 | 35.10 | 54.45 | 91.70 | 91.87 | 110.10 | 64.78 | 0.345 | D |
| 60 | Pakistan | 82,061 | 989 | 81.16 | 9.55 | 12.58 | 8.67 | 35.09 | 37.29 | 64.21 | 21.65 | 9.900 | C+ |
| 61 | Philippines | 48,300 | 1,551 | 66.78 | 18.40 | 17.44 | 13.60 | 47.22 | 48.93 | 84.88 | 17.30 | 7.518 | B |
| 62 | Saudi Arabia | 9,229 | 11,101 | 25.40 | 18.47 | 19.13 | 97.35 | 113.18 | 122.09 | 137.12 | 95.34 | 3.327 | D |
| 63 | Singapore | 2,414 | 5,817 | 58.84 | 40.59 | 9.34 | 51.01 | 80.82 | 77.37 | 99.62 | 69.91 | 2.140 | C |
| 64 | Sri Lanka | 14,738 | 1,119 | 71.79 | 17.52 | 15.84 | 10.51 | 23.45 | 26.37 | 49.27 | 11.57 | 16.493 | C+ |
| 65 | Syrian Arab Rep. | 8,702 | 3,071 | 71.42 | 18.19 | 17.88 | 26.93 | 49.39 | 46.38 | 80.12 | 50.78 | 3.925 | C |
| 66 | Taiwan | 17,805 | 2,921 | 53.28 | 27.86 | 19.91 | 25.62 | 77.10 | 76.35 | 102.33 | 49.98 | 35.980 | C |
| 67 | Thailand | 46,455 | 1,694 | 68.90 | 19.85 | 13.55 | 14.85 | 42.51 | 41.75 | 64.66 | 30.11 | 20.475 | C |
| 68 | U. Arab Emirates | 1,016 | 25,646 | 18.48 | 25.43 | 6.22 | 224.89 | 114.90 | 110.95 | 138.88 | 161.72 | 3.671 | D |
| 69 | Yemen | 7,039 | 957 | 77.42 | 25.18 | 25.07 | 8.39 | 42.70 | 56.16 | 78.93 | 31.66 | 4.563 | D |

TABLE 2—cont.

| | [1]<br>POP | [2]<br>RGDP1 | [3]<br>c | [4]<br>i | [5]<br>g | [8]<br>y | [13]<br>P | [14]<br>PC | [15]<br>PI | [16]<br>PG | [17]<br>XR | [18]<br>Q |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Europe | | | | | | | | | | | | |
| 70 Austria | 7,554 | 8,230 | 60.55 | 25.92 | 15.93 | 72.17 | 124.14 | 116.95 | 149.28 | 111.72 | 12.917 | A |
| 71 Belgium | 9,847 | 9,228 | 66.71 | 23.13 | 13.68 | 80.92 | 129.13 | 127.13 | 128.08 | 135.60 | 29.197 | A |
| 72 Cyprus | 629 | 4,282 | 66.40 | 32.31 | 15.53 | 37.55 | 78.25 | 79.89 | 99.75 | 58.51 | 0.353 | C |
| 73 Denmark | 5,123 | 9,598 | 55.76 | 21.45 | 24.19 | 84.17 | 135.07 | 139.67 | 126.21 | 119.36 | 5.628 | A |
| 74 Finland | 4,780 | 8,393 | 50.00 | 35.64 | 15.35 | 73.60 | 124.91 | 140.14 | 105.71 | 121.31 | 3.727 | A |
| 75 France | 53,714 | 9,688 | 63.17 | 26.57 | 12.49 | 84.95 | 125.93 | 129.93 | 120.19 | 122.97 | 4.220 | A |
| 76 Germany, Fed. Rep. | 61,566 | 9,795 | 56.95 | 27.27 | 16.47 | 85.89 | 135.34 | 138.12 | 129.49 | 132.48 | 1.815 | A |
| 77 Greece | 9,643 | 4,383 | 63.02 | 28.12 | 14.15 | 38.43 | 95.24 | 97.46 | 98.08 | 88.16 | 42.499 | A |
| 78 Iceland | 228 | 9,285 | 62.48 | 28.33 | 8.20 | 81.42 | 138.55 | 138.59 | 143.12 | 158.64 | 471.900 | B |
| 79 Ireland | 3,401 | 4,929 | 64.78 | 29.48 | 20.06 | 43.22 | 108.82 | 109.90 | 113.95 | 92.50 | 0.486 | A |
| 80 Italy | 56,416 | 7,164 | 62.78 | 25.86 | 14.20 | 62.82 | 98.06 | 99.12 | 102.64 | 90.92 | 854.701 | A |
| 81 Luxembourg | 365 | 10,173 | 63.09 | 29.62 | 10.98 | 89.20 | 125.08 | 119.48 | 128.92 | 149.55 | 29.197 | A |
| 82 Malta | 364 | 4,630 | 64.14 | 21.90 | 17.64 | 40.60 | 67.42 | 70.16 | 82.06 | 49.55 | 0.345 | B |
| 83 Netherlands | 14,150 | 9,036 | 64.22 | 22.57 | 13.04 | 79.24 | 132.67 | 128.90 | 137.06 | 145.98 | 1.985 | A |
| 84 Norway | 4,091 | 11,094 | 46.86 | 26.88 | 18.49 | 97.28 | 127.21 | 132.97 | 141.87 | 103.47 | 4.937 | A |
| 85 Portugal | 9,909 | 3,733 | 65.38 | 25.39 | 19.48 | 32.74 | 66.55 | 70.03 | 96.56 | 40.34 | 50.025 | A |
| 86 Spain | 37,386 | 6,131 | 75.54 | 16.36 | 10.39 | 53.76 | 92.62 | 96.75 | 89.58 | 81.57 | 71.531 | A |
| 87 Sweden | 8,310 | 8,863 | 51.46 | 23.21 | 28.54 | 77.72 | 168.66 | 175.15 | 167.68 | 136.52 | 4.227 | A |
| 88 Switzerland | 6,385 | 10,013 | 67.05 | 30.88 | 7.69 | 87.80 | 159.25 | 155.94 | 151.85 | 211.41 | 1.673 | B |
| 89 Turkey | 44,438 | 2,319 | 63.77 | 21.73 | 18.93 | 20.34 | 55.28 | 65.84 | 60.27 | 29.40 | 76.038 | B |
| 90 United Kingdom | 56,360 | 7,975 | 58.67 | 14.72 | 23.66 | 69.93 | 117.06 | 123.81 | 137.25 | 84.99 | 0.430 | A |
| N. and Central America | | | | | | | | | | | | |
| 91 Barbados | 249 | 4,454 | 62.94 | 21.73 | 16.82 | 39.06 | 77.59 | 79.51 | 94.81 | 55.18 | 2.011 | C |
| 92 Canada | 24,042 | 11,332 | 62.11 | 23.16 | 12.90 | 99.37 | 95.13 | 88.42 | 100.16 | 116.03 | 1.169 | A |
| 93 Costa Rica | 2,245 | 3,031 | 64.43 | 20.43 | 22.49 | 26.57 | 71.01 | 74.58 | 100.02 | 46.12 | 8.570 | C |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 94 | Dominican Rep. | 5,558 | 1,868 | 75.88 | 21.01 | 9.34 | 16.38 | 63.79 | 66.37 | 84.40 | 41.66 | 1.000 | C |
| 95 | El Salvador | 4,797 | 1,410 | 70.90 | 6.85 | 21.77 | 12.36 | 52.74 | 110.68 | 55.16 | 27.15 | 2.500 | C |
| 96 | Guatemala | 7,262 | 1,952 | 84.87 | 8.52 | 8.14 | 17.12 | 55.58 | 53.34 | 112.28 | 43.53 | 1.000 | C |
| 97 | Haiti | 5,0009 | 696 | 77.39 | 11.79 | 15.86 | 6.11 | 39.79 | 44.52 | 66.43 | 21.33 | 5.000 | D |
| 98 | Honduras | 3,691 | 1,075 | 70.68 | 17.60 | 16.78 | 9.42 | 62.73 | 62.46 | 101.08 | 41.06 | 2.000 | C |
| 99 | Jamaica | 2,172 | 1,858 | 61.80 | 12.50 | 27.08 | 16.93 | 65.93 | 72.39 | 88.85 | 40.59 | 1.781 | C |
| 100 | Mexico | 69,393 | 4,333 | 66.82 | 24.96 | 8.81 | 38.00 | 61.97 | 59.36 | 75.60 | 61.04 | 22.951 | C |
| 101 | Nicaragua | 2,672 | 2,012 | 72.81 | 11.81 | 22.70 | 17.65 | 38.78 | 45.45 | 59.26 | 26.81 | 10.050 | D |
| 102 | Panama | 1,835 | 2,810 | 50.70 | 26.62 | 24.97 | 24.64 | 69.01 | 79.35 | 77.84 | 42.36 | 1.000 | C |
| 103 | Trinidad & Tobago | 1,068 | 7,161 | 51.21 | 29.66 | 9.04 | 62.80 | 84.43 | 79.86 | 98.05 | 69.70 | 2.401 | C |
| 104 | United States | 227,704 | 11,404 | 66.59 | 19.72 | 14.51 | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | 1.00 | A |

South America

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 105 | Argentina | 28,237 | 4,342 | 64.58 | 29.68 | 8.46 | 38.08 | 125.29 | 132.50 | 104.13 | 156.97 | 1,839.927 | C |
| 106 | Bolivia | 5,570 | 1,529 | 67.60 | 11.45 | 20.66 | 13.41 | 61.66 | 67.52 | 76.15 | 35.31 | 24.510 | C |
| 107 | Brazil | 121,286 | 3,356 | 68.84 | 23.31 | 9.14 | 29.43 | 61.35 | 65.15 | 64.20 | 47.12 | 52.714 | C |
| 108 | Chile | 11,104 | 4,271 | 49.50 | 35.52 | 17.43 | 37.45 | 58.95 | 86.95 | 37.70 | 33.76 | 38.462 | C |
| 109 | Colombia | 25,892 | 2,552 | 71.85 | 16.79 | 10.92 | 22.38 | 50.61 | 50.88 | 62.23 | 37.51 | 47.214 | C |
| 110 | Ecuador | 7,593 | 2,607 | 54.14 | 28.59 | 17.41 | 22.86 | 59.28 | 67.37 | 58.62 | 39.62 | 25.000 | C |
| 111 | Guyana | 792 | 1,623 | 47.16 | 23.86 | 33.80 | 14.23 | 46.00 | 49.68 | 67.28 | 31.53 | 2.550 | D |
| 112 | Paraguay | 2,982 | 1,979 | 77.04 | 19.40 | 10.73 | 17.36 | 75.36 | 75.28 | 121.02 | 34.89 | 126.007 | C |
| 113 | Peru | 16,610 | 2,456 | 69.13 | 12.11 | 16.85 | 21.96 | 47.96 | 47.46 | 73.33 | 28.86 | 286.533 | C |
| 114 | Surinam | 356 | 3,760 | 64.68 | 15.48 | 23.40 | 32.97 | 74.71 | 79.57 | 91.66 | 52.46 | 1.785 | D |
| 115 | Uraguay | 2,908 | 4,502 | 68.43 | 22.07 | 14.32 | 39.48 | 77.44 | 89.29 | 65.89 | 53.96 | 9.099 | D |
| 116 | Venezuela | 15,620 | 4,424 | 59.85 | 17.88 | 15.23 | 38.79 | 85.66 | 78.73 | 128.04 | 62.28 | 4.293 | B |

Oceania

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 117 | Australia | 14,692 | 8,349 | 57.95 | 29.90 | 14.71 | 73.21 | 121.48 | 131.12 | 108.20 | 112.02 | 0.878 | A |
| 118 | Fiji | 634 | 3,005 | 58.65 | 25.05 | 19.40 | 26.79 | 61.81 | 63.23 | 82.39 | 40.99 | 0.817 | C |
| 119 | Indonesia | 146,345 | 1,063 | 62.82 | 20.10 | 13.21 | 9.32 | 46.71 | 46.43 | 52.56 | 29.25 | 625.001 | C |
| 120 | New Zealand | 3,113 | 7,363 | 60.33 | 17.91 | 22.95 | 64.56 | 102.50 | 107.43 | 140.86 | 61.49 | 1.027 | A |
| 121 | Papua New Guinea | 2,996 | 1,528 | 57.89 | 18.69 | 29.07 | 13.40 | 55.33 | 60.10 | 81.23 | 36.55 | 0.670 | D |

A description of the variables appears in Appendix A.

## TABLE 3

ESTIMATES OF REAL PER CAPITA PRODUCT AND PRICE LEVEL (FOUR DIFFERENT CONCEPTS OF GROSS DOMESTIC PRODUCT; CONSUMPTION; GROSS DOMESTIC INVESTMENT; AND GOVERNMENT), POPULATION, AND EXCHANGE RATE: 121 MARKET ECONOMIES, 1985 (BASE YEAR: 1980)

| | | [1] POP | [2] RGDP1 | [3] c | [4] i | [5] g | [6] RGDP2 | [7] RGDP3 | [8] y | [9] CGDP | [10] cc | [11] ci | [12] cg | [13] P | [14] PC | [15] PI | [16] PG | [17] XR |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Africa** | | | | | | | | | | | | | | | | | | |
| 1 | Algeria | 21,937 | 2,142 | 48.88 | 26.64 | 17.28 | 2,131 | 2,063 | 15.65 | 2,513 | 52.02 | 24.68 | 20.66 | 102.95 | 92.11 | 165.03 | 68.21 | 5.028 |
| 2 | Angola | 8,605 | 609 | 51.77 | 5.32 | 31.61 | 615 | 562 | 4.52 | 726 | 54.20 | 4.85 | 37.16 | 69.80 | 77.04 | 160.44 | 40.52 | 79.500 |
| 3 | Benin | 4,043 | 525 | 81.82 | 4.90 | 15.97 | 518 | 515 | 4.13 | 663 | 80.81 | 4.21 | 17.72 | 36.58 | 39.27 | 137.59 | 12.56 | 449.260 |
| 4 | Botswana | 1,072 | 1,762 | 48.31 | 24.51 | 31.87 | 1,712 | 13.86 | 1,712 | 13.86 | 2,225 | 47.76 | 21.10 | 35.38 | 33.80 | 49.57 | 25.13 | 1.888 |
| 5 | Burkina | 6,662 | 377 | 79.41 | 9.92 | 22.98 | 372 | 376 | 3.09 | 497 | 75.19 | 8.18 | 24.44 | 29.73 | 36.37 | 79.79 | 15.90 | 449.260 |
| 6 | Burundi | 4,702 | 345 | 83.14 | 6.23 | 18.65 | 341 | 349 | 2.78 | 446 | 80.21 | 5.23 | 20.21 | 54.18 | 60.10 | 130.11 | 24.76 | 120.690 |
| 7 | Cameroon | 10,190 | 1,095 | 59.59 | 17.48 | 15.99 | 1,060 | 1,084 | 8.25 | 1,325 | 61.45 | 15.70 | 18.51 | 68.08 | 63.68 | 132.23 | 29.47 | 449.260 |
| 8 | Central Afr. Rep. | 2,586 | 434 | 75.82 | 13.26 | 25.00 | 432 | 434 | 3.56 | 572 | 71.82 | 10.94 | 26.60 | 29.76 | 51.33 | 131.50 | 31.13 | 449.260 |
| 9 | Chad | 5,020 | 254 | 72.29 | 3.90 | 29.34 | 252 | 241 | 1.95 | 313 | 73.24 | 3.45 | 33.39 | 31.04 | 41.11 | 86.14 | 21.91 | 449.260 |
| 10 | Congo, Peop. Rep. | 1,878 | 1,338 | 37.13 | 19.58 | 17.26 | 1,258 | 1,216 | 8.66 | 1,390 | 44.61 | 20.49 | 23.29 | 80.26 | 68.57 | 136.37 | 49.24 | 449.260 |
| 11 | Egypt | 48,239 | 1,188 | 67.51 | 12.94 | 23.35 | 1,197 | 1,146 | 8.99 | 1,444 | 69.35 | 11.58 | 26.94 | 84.61 | 90.11 | 146.53 | 48.49 | 0.700 |
| 12 | Ethiopia | 42,234 | 310 | 70.60 | 7.58 | 23.39 | 312 | 304 | 2.43 | 390 | 70.08 | 6.55 | 26.07 | 30.11 | 33.30 | 74.28 | 17.38 | 2.070 |
| 13 | Gabon | 1,304 | 3,103 | 26.05 | 19.54 | 11.44 | 3,055 | 2,232 | 15.47 | 2,484 | 40.62 | 26.53 | 20.03 | 107.18 | 103.80 | 149.37 | 73.57 | 449.260 |
| 14 | Gambia, The | 762 | 526 | 77.07 | 22.02 | 34.82 | 504 | 518 | 4.51 | 724 | 69.96 | 17.41 | 35.49 | 32.80 | 48.20 | 86.11 | 21.23 | 3.894 |
| 15 | Ghana | 13,513 | 349 | 71.16 | 9.09 | 19.96 | 343 | 341 | 2.56 | 411 | 75.35 | 8.38 | 23.74 | 81.56 | 84.68 | 168.00 | 47.10 | 54.054 |
| 16 | Guinea | 6,081 | 452 | 66.95 | 10.21 | 21.49 | 452 | 443 | 3.49 | 561 | 67.33 | 8.95 | 24.28 | 72.08 | 74.50 | 146.39 | 39.20 | 22.473 |
| 17 | Ivory Coast | 10,116 | 920 | 64.13 | 5.76 | 22.32 | 891 | 973 | 7.32 | 1,175 | 62.70 | 4.90 | 24.51 | 59.09 | 55.66 | 168.41 | 32.00 | 449.260 |
| 18 | Kenya | 20,414 | 598 | 60.89 | 12.64 | 23.03 | 592 | 574 | 4.53 | 727 | 62.54 | 11.31 | 26.57 | 39.66 | 38.92 | 85.60 | 23.44 | 16.432 |
| 19 | Lesotho | 1,525 | 771 | 137.58 | 18.15 | 26.23 | 796 | 776 | 9.36 | 1,504 | 88.06 | 10.12 | 18.85 | 12.14 | 25.90 | 45.56 | 10.87 | 2.191 |
| 20 | Liberia | 2,210 | 491 | 58.76 | 6.58 | 33.08 | 491 | 499 | 3.97 | 638 | 56.46 | 5.50 | 35.69 | 60.31 | 62.80 | 119.51 | 40.49 | 1.000 |
| 21 | Madagascar | 10,164 | 497 | 80.15 | 6.05 | 15.94 | 497 | 493 | 3.92 | 629 | 79.06 | 5.20 | 17.66 | 36.53 | 36.06 | 111.28 | 24.04 | 662.480 |
| 22 | Malawi | 7,137 | 387 | 59.03 | 10.57 | 29.37 | 381 | 372 | 2.98 | 478 | 59.67 | 9.30 | 33.34 | 36.24 | 40.24 | 103.55 | 16.19 | 1.719 |
| 23 | Mali | 7,545 | 355 | 89.10 | 3.69 | 25.02 | 365 | 355 | 3.11 | 499 | 79.00 | 2.85 | 24.91 | 25.68 | 32.42 | 125.01 | 13.09 | 898.520 |
| 24 | Mauritania | 1,695 | 550 | 74.14 | 12.18 | 25.86 | 544 | 562 | 4.53 | 727 | 70.06 | 10.02 | 27.44 | 61.16 | 67.10 | 107.01 | 38.73 | 77.085 |
| 25 | Mauritius | 1,020 | 1,869 | 66.56 | 18.41 | 15.72 | 1,860 | 1,991 | 15,13 | 2,430 | 63.91 | 15.40 | 16.95 | 48.82 | 47.64 | 75.64 | 22.49 | 15.442 |
| 26 | Morocco | 21,797 | 1,221 | 70.13 | 8.33 | 25.84 | 1,201 | 1,220 | 9.86 | 1,582 | 67.57 | 6.99 | 27.96 | 34.46 | 34.84 | 121.73 | 18.38 | 10.062 |
| 27 | Mozambique | 14,084 | 528 | 79.95 | 5.55 | 22.18 | 527 | 520 | 4.12 | 661 | 79.70 | 4.82 | 24.83 | 39.59 | 46.89 | 93.20 | 26.83 | 43.400 |
| 28 | Niger | 6,418 | 429 | 68.02 | 11.85 | 15.10 | 418 | 358 | 3.05 | 490 | 74.44 | 11.29 | 18.56 | 47.29 | 52.34 | 71.50 | 26.12 | 449.260 |
| 29 | Nigeria | 99,753 | 581 | 63.01 | 12.44 | 14.25 | 562 | 555 | 4.24 | 681 | 67.09 | 11.54 | 17.04 | 108.47 | 129.00 | 108.70 | 34.71 | 0.892 |
| 30 | Rwanda | 6,034 | 341 | 78.17 | 14.71 | 17.35 | 338 | 355 | 2.77 | 445 | 74.71 | 12.24 | 18.63 | 60.02 | 63.72 | 106.49 | 30.62 | 101.260 |
| 31 | Senegal | 6,560 | 754 | 69.39 | 6.89 | 31.25 | 761 | 748 | 6.14 | 987 | 66.17 | 5.72 | 33.47 | 40.21 | 47.72 | 137.84 | 18.34 | 449.260 |

18

| | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 32 | Sierra Leone | 3,657 | 443 | 74.19 | 8.00 | 17.42 | 414 | 426 | 3.44 | 552 | 74.22 | 6.97 | 19.57 | 52.05 | 63.33 | 55.08 | 11.53 | 4.730 |
| 33 | Somaia | 5,351 | 348 | 64.63 | 21.35 | 28.03 | 356 | 396 | 3.11 | 499 | 56.36 | 16.21 | 27.45 | 57.03 | 60.19 | 46.90 | 51.72 | 39.487 |
| 34 | S. Africa | 32,404 | 3,885 | 56.63 | 16.33 | 18.07 | 3,836 | 3,788 | 28.54 | 4,583 | 59.92 | 15.05 | 21.47 | 36.61 | 33.15 | 55.65 | 23.36 | 2.191 |
| 35 | Sudan | 21,784 | 540 | 70.48 | 13.59 | 22.06 | 534 | 550 | 4.33 | 696 | 68.26 | 11.46 | 23.99 | 46.30 | 50.66 | 84.36 | 25.06 | 2.288 |
| 36 | Swaziland | 757 | 1,187 | 85.09 | 19.29 | 37.02 | 1,280 | 1,301 | 12.41 | 1,992 | 63.27 | 12.49 | 30.92 | 26.02 | 31.11 | 52.21 | 20.30 | 2.184 |
| 37 | Tanzania | 22,241 | 355 | 68.03 | 18.45 | 33.62 | 372 | 376 | 3.19 | 513 | 58.73 | 13.87 | 32.59 | 50.24 | 75.09 | 52.39 | 13.44 | 17.472 |
| 38 | Togo | 3,035 | 489 | 73.50 | 15.11 | 17.46 | 489 | 482 | 3.89 | 624 | 71.90 | 12.87 | 19.19 | 36.84 | 39.67 | 67.01 | 21.27 | 449.260 |
| 39 | Tunisia | 7,165 | 2,050 | 72.31 | 13.53 | 17.93 | 2,012 | 2,034 | 16.17 | 2,596 | 71.27 | 11.61 | 19.84 | 43.90 | 39.22 | 111.15 | 31.76 | 0.834 |
| 40 | Uganda | 14,695 | 347 | 89.79 | 5.84 | 23.73 | 379 | 368 | 3.24 | 521 | 74.74 | 4.23 | 22.18 | 16.03 | 18.22 | 38.45 | 8.45 | 672.021 |
| 41 | Zaire | 33,494 | 210 | 57.19 | 9.98 | 10.81 | 197 | 173 | 1.32 | 212 | 70.71 | 10.75 | 15.01 | 42.40 | 35.31 | 95.49 | 28.01 | 49.873 |
| 42 | Zambia | 6,704 | 584 | 48.59 | 9.91 | 32.11 | 596 | 544 | 4.30 | 691 | 51.28 | 9.11 | 38.05 | 49.49 | 50.25 | 98.20 | 32.33 | 2.714 |
| 43 | Zimbabwe | 8,394 | 948 | 61.90 | 17.07 | 23.20 | 931 | 967 | 7.57 | 1,216 | 60.28 | 14.48 | 25.37 | 50.09 | 49.08 | 86.96 | 32.44 | 1.612 |
| Asia | | | | | | | | | | | | | | | | | | |
| 44 | Afghanistan | 18,140 | 609 | 0.00 | 0.00 | 0.00 | 0 | 0 | 0.00 | 0 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.000 |
| 45 | Bahrain | 418 | 8,192 | 46.36 | 35.01 | 23.33 | 8,306 | 6,582 | 55.29 | 8,877 | 53.40 | 35.12 | 30.18 | 117.40 | 74.78 | 254.05 | 48.89 | 0.376 |
| 46 | Bangladesh | 100,595 | 647 | 87.42 | 6.66 | 9.01 | 648 | 648 | 5.12 | 822 | 85.88 | 5.70 | 9.94 | 22.14 | 23.72 | 37.67 | 12.87 | 26.000 |
| 47 | Burma | 36,859 | 557 | 68.96 | 12.07 | 18.80 | 556 | 553 | 4.34 | 697 | 68.82 | 10.49 | 21.07 | 27.25 | 28.82 | 47.79 | 14.00 | 8.162 |
| 48 | Hong Kong | 5,423 | 9,093 | 76.21 | 17.30 | 4.59 | 9,004 | 9,300 | 70.36 | 11,297 | 76.57 | 15.14 | 5.18 | 55.37 | 47.47 | 88.72 | 68.89 | 7.791 |
| 49 | India | 764,378 | 750 | 55.91 | 16.48 | 29.00 | 751 | 5.95 | 955 | 54.81 | 14.07 | 31.93 | 27.23 | 27.23 | 33.17 | 54.31 | 8.51 | 12.237 |
| 50 | Iran | 46,005 | 3,922 | 57.07 | 20.10 | 21.85 | 3,884 | 3,939 | 30.50 | 4,897 | 57.05 | 17.50 | 24.53 | 61.20 | 61.49 | 84.78 | 42.65 | 91.052 |
| 51 | Iraq | 15,784 | 2,813 | 36.03 | 24.50 | 23.83 | 2,617 | 2,091 | 16.85 | 2,706 | 46.75 | 27.69 | 34.73 | 116.23 | 105.45 | 208.94 | 61.54 | 0.293 |
| 52 | Israel | 4,233 | 6,270 | 56.36 | 19.33 | 32.89 | 6,183 | 6,340 | 51.12 | 8,208 | 53.74 | 16.06 | 35.22 | 67.68 | 75.86 | 78.26 | 51.08 | 1,178.800 |
| 53 | Japan | 120,754 | 9,447 | 51.96 | 36.33 | 6.97 | 9.363 | 9.452 | 69.60 | 11,176 | 54.83 | 33.38 | 8.25 | 96.57 | 102.37 | 92.84 | 100.23 | 238.540 |
| 54 | Jordan | 3,490 | 2,113 | 82.63 | 20.24 | 25.78 | 2,118 | 2,166 | 18.10 | 2,906 | 74.99 | 16.00 | 26.27 | 40.17 | 47.09 | 85.44 | 33.16 | 0.394 |
| 55 | Korea, Rep. of | 41,056 | 3,056 | 57.07 | 30.72 | 11.54 | 3,034 | 3,082 | 23.26 | 3,734 | 58.30 | 27.33 | 13.24 | 53.02 | 53.45 | 60.89 | 39.53 | 870.000 |
| 56 | Kuwait | 1,746 | 14,868 | 34.66 | 18.13 | 8.92 | 14,852 | 10,728 | 76.83 | 12,337 | 52.14 | 23.76 | 15.07 | 89.12 | 81.18 | 77.04 | 123.55 | 0.301 |
| 57 | Malaysia | 15,670 | 3,415 | 48.28 | 28.99 | 16.98 | 3,351 | 3,336 | 25.23 | 4,050 | 50.82 | 26.57 | 20.07 | 48.22 | 50.72 | 52.98 | 32.17 | 2.480 |
| 58 | Nepal | 16,527 | 526 | 81.31 | 10.31 | 11.75 | 527 | 529 | 4.15 | 667 | 80.04 | 8.84 | 12.99 | 22.81 | 23.09 | 47.37 | 17.00 | 17.777 |
| 59 | Oman | 1,234 | 7,792 | 25.57 | 26.18 | 34.04 | 7,806 | 7,341 | 56.98 | 9,149 | 27.18 | 24.24 | 40.64 | 82.75 | 90.49 | 121.01 | 51.21 | 0.345 |
| 60 | Pakistan | 95,483 | 1,153 | 76.98 | 11.56 | 15.05 | 1,158 | 1,143 | 9.03 | 1,450 | 76.43 | 9.99 | 16.78 | 26.24 | 28.70 | 49.02 | 16.69 | 15.160 |
| 61 | Phillipines | 54,734 | 1,361 | 73.65 | 7.26 | 17.43 | 1,364 | 1,360 | 10.65 | 1,710 | 73.18 | 6.28 | 19.44 | 35.02 | 36.79 | 84.46 | 10.71 | 18.700 |
| 62 | Saudi Arabia | 11,336 | 5,971 | 37.99 | 46.42 | 31.11 | 6,226 | 6,251 | 48.81 | 7,838 | 36.13 | 38.45 | 33.23 | 104.36 | 128.11 | 86.72 | 94.15 | 3.569 |
| 63 | Singapore | 2,558 | 9,834 | 45.05 | 28.97 | 8.35 | 9,425 | 9,686 | 69.65 | 11,183 | 49.45 | 27.69 | 10.30 | 76.27 | 60.47 | 104.91 | 67.77 | 2.200 |
| 64 | Sri Lanka | 15,837 | 1,539 | 79.62 | 10.49 | 15.57 | 1,537 | 1,569 | 12.43 | 1,995 | 76.64 | 8.79 | 16.83 | 19.05 | 18.30 | 68.23 | 10.33 | 27.163 |
| 65 | Syrian Arab Rep. | 10,371 | 2,900 | 70.67 | 18.85 | 19.52 | 2,932 | 2,919 | 23.30 | 3,741 | 68.40 | 15.89 | 21.21 | 52.64 | 47.66 | 90.32 | 52.38 | 3.925 |
| 66 | Taiwan | 19,258 | 3,581 | 52.54 | 16.00 | 19.43 | 3,556 | 3,630 | 27.54 | 4,422 | 53.10 | 14.88 | 22.06 | 68.45 | 65.98 | 91.79 | 44.69 | 39.824 |
| 67 | Thailand | 51,514 | 1,900 | 67.44 | 16.96 | 13.68 | 1,895 | 1,859 | 14.39 | 2,310 | 69.75 | 15.17 | 15.77 | 32.23 | 29.32 | 57.85 | 24.03 | 27.159 |
| 68 | U. Arab Emirates | 1,367 | 12,404 | 39.08 | 33.28 | 14.22 | 12,873 | 12,204 | 90.28 | 14,496 | 41.74 | 30.96 | 17.05 | 108.35 | 83.21 | 138.88 | 127.34 | 3.671 |
| 69 | Yemen | 7,963 | 978 | 70.57 | 15.16 | 30.81 | 981 | 978 | 7.86 | 1,261 | 68.28 | 12.77 | 33.48 | 41.84 | 57.26 | 69.31 | 24.63 | 6.414 |

TABLE 3—cont.

| | | [1] | [2] | [3] | [4] | [5] | [6] | [7] | [8] | [9] | [10] | [11] | [12] | [13] | [14] | [15] | [16] | [17] |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | POP | RGDP1 | $c$ | $i$ | $g$ | RGDP2 | RGDP3 | $y$ | CGDP | $cc$ | $ci$ | $cg$ | P | PC | PI | PG | XR |
| Europe | | | | | | | | | | | | | | | | | | |
| 70 | Austria | 7,555 | 8,929 | 62.70 | 23.43 | 15.43 | 9,023 | 9,199 | 70.50 | 11,319 | 61.74 | 20.00 | 17.67 | 77.54 | 71.00 | 106.49 | 69.94 | 20.690 |
| 71 | Belgium | 8,857 | 9,717 | 63.53 | 17.80 | 13.21 | 9,595 | 9,450 | 72.12 | 11,580 | 66.54 | 16.24 | 15.54 | 69.33 | 68.10 | 73.86 | 65.74 | 59.378 |
| 72 | Cyprus | 665 | 5,310 | 69.00 | 26.98 | 15.57 | 5,259 | 5,464 | 43.13 | 6,925 | 66.05 | 22.49 | 16.74 | 51.71 | 50.50 | 79.59 | 40.41 | 0.613 |
| 73 | Denmark | 5,114 | 10,884 | 53.66 | 23.10 | 22.80 | 10,893 | 10,857 | 84.20 | 13,519 | 53.93 | 20.22 | 25.73 | 84.29 | 85.74 | 94.31 | 70.72 | 10.596 |
| 74 | Finland | 4,908 | 9,232 | 52.26 | 30.83 | 16.27 | 9,266 | 9,318 | 70.63 | 11,340 | 53.10 | 27.28 | 18.57 | 94.23 | 99.02 | 88.03 | 90.20 | 6.198 |
| 75 | France | 55,172 | 9,918 | 65.63 | 23.48 | 13.02 | 9,947 | 10,164 | 77,80 | 12,492 | 65.04 | 20.26 | 14.49 | 73.96 | 74.08 | 76.49 | 71.32 | 8.985 |
| 76 | Germany, Fed. Rep. | 61,015 | 10,708 | 54.34 | 23.72 | 16.13 | 10,600 | 10,605 | 79.91 | 12,831 | 56.60 | 21.52 | 18.87 | 79.97 | 79.00 | 86.84 | 72.14 | 2.944 |
| 77 | Greece | 9,935 | 4,464 | 70.94 | 23.05 | 15.99 | 4,511 | 4,367 | 35.52 | 5,703 | 69.31 | 19.61 | 17.55 | 58.87 | 52.95 | 96.65 | 58.55 | 138.120 |
| 78 | Iceland | 241 | 9,037 | 67.64 | 26.00 | 8.55 | 9,042 | 9,359 | 70.92 | 1,387 | 67.01 | 22.95 | 9.51 | 87.35 | 86.79 | 86.77 | 101.59 | 4,150.797 |
| 79 | Ireland | 3,552 | 5,205 | 53.82 | 26.00 | 19.58 | 5,056 | 5,374 | 50.83 | 6,556 | 53.34 | 22.44 | 21.79 | 74.47 | 76.14 | 81.49 | 60.57 | 0.938 |
| 80 | Italy | 57,128 | 7,425 | 62.64 | 21.34 | 16.69 | 7,445 | 7,431 | 57.48 | 9,230 | 62.90 | 18.67 | 18.82 | 67.97 | 67.57 | 77.66 | 60.13 | 1,909.400 |
| 81 | Luxembourg | 366 | 10,540 | 64.71 | 22.32 | 11.08 | 10,376 | 10,620 | 80.57 | 12,937 | 65.81 | 19.77 | 12.65 | 78.29 | 67.50 | 117.58 | 79.11 | 59.378 |
| 82 | Malta | 358 | 5,319 | 65.61 | 25.69 | 18.09 | 5,342 | 5,293 | 41.98 | 6,741 | 64.62 | 22.04 | 20.01 | 42.14 | 45.90 | 60.45 | 32.00 | 0.468 |
| 83 | Netherlands | 14,486 | 9,092 | 61.19 | 20.32 | 13.27 | 9,098 | 9,160 | 68.92 | 11,067 | 62.75 | 18.15 | 15.28 | 77.96 | 73.66 | 95.99 | 71.14 | 3.321 |
| 84 | Norway | 4,153 | 12,623 | 48.51 | 25.24 | 18.78 | 12,575 | 13,123 | 96.93 | 15,563 | 49.12 | 22.25 | 21.35 | 89.83 | 89.29 | 112.48 | 66.98 | 8.597 |
| 85 | Portugal | 10,229 | 3,729 | 60.98 | 16.81 | 21.74 | 3,622 | 3,638 | 28.65 | 4,601 | 61.69 | 14.81 | 24.70 | 43.82 | 48.32 | 69.46 | 21.59 | 170.390 |
| 86 | Spain | 38,602 | 6,437 | 72.27 | 13.13 | 11.78 | 6,385 | 6,369 | 49.07 | 7,879 | 73.70 | 11.66 | 13.49 | 55.14 | 55.40 | 63.33 | 43.25 | 170.040 |
| 87 | Sweden | 8,350 | 9,904 | 47.49 | 20.29 | 27.46 | 9,780 | 9,765 | 75.47 | 12,118 | 48.45 | 18.02 | 31.46 | 98.78 | 105.48 | 117.12 | 73.92 | 8.604 |
| 88 | Switzerland | 6,458 | 10,640 | 65.77 | 29.41 | 8.09 | 10,670 | 11,072 | 83.52 | 13,411 | 65.13 | 25.37 | 9.00 | 107.10 | 102.82 | 113.85 | 136.31 | 2.457 |
| 89 | Turkey | 50,052 | 2,533 | 63.14 | 21.58 | 17.15 | 2,521 | 2,535 | 19.70 | 3,163 | 63.11 | 18.78 | 19.26 | 33.42 | 39.39 | 42.03 | 12.57 | 521.980 |
| 90 | United Kingdom | 56,543 | 8,665 | 59.71 | 16.37 | 22.87 | 8,682 | 8,696 | 67.72 | 10,874 | 59.39 | 14.18 | 25.55 | 72.66 | 75.36 | 93.97 | 51.73 | 0.771 |
| North and Central America | | | | | | | | | | | | | | | | | | |
| 91 | Barbados | 254 | 5,212 | 70.06 | 17.87 | 10.86 | 5,105 | 5,194 | 39.94 | 6,413 | 71.07 | 15.79 | 12.37 | 75.29 | 73.54 | 80.86 | 77.46 | 2.011 |
| 92 | Canada | 25,379 | 12,196 | 60.59 | 21.32 | 12.28 | 12,159 | 11,867 | 90.58 | 14,544 | 63.41 | 19.44 | 14.43 | 92.64 | 84.11 | 104.95 | 111.29 | 1.365 |
| 93 | Costa Rica | 2,520 | 2,650 | 64.51 | 15.17 | 21.35 | 2,635 | 2,651 | 20.81 | 3,341 | 63.87 | 13.08 | 23.74 | 44.64 | 44.19 | 85.31 | 26.52 | 50.453 |

| No. | Country |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 94 | Dominican Rep. | 6,255 | 1,753 | 68.62 | 24.21 | 7.52 | 1,742 | 1,739 | 13.24 | 2,127 | 70.60 | 21.69 | 8.68 | 35.75 | 39.40 | 31.84 | 28.78 | 3.113 |
| 95 | El Salvador | 5,149 | 1,198 | 68.43 | 6.59 | 25.15 | 1,199 | 1,145 | 9.03 | 70.59 | 5.92 | 29.14 | 75.27 | 87.75 | 87.75 | 181.81 | 28.65 | 2.500 |
| 96 | Guatemala | 8,375 | 1,608 | 84.13 | 5.93 | 8.71 | 1,611 | 1,571 | 12.19 | 1,957 | 86.28 | 5.29 | 10.04 | 67.90 | 66.50 | 165.42 | 39.70 | 1.000 |
| 97 | Haiti | 5,485 | 631 | 74.57 | 11.25 | 18.34 | 633 | 625 | 4.91 | 788 | 74.54 | 9.80 | 20.59 | 45.82 | 50.81 | 82.66 | 24.47 | 5.000 |
| 98 | Honduras | 4,383 | 911 | 64.50 | 12.80 | 18.46 | 906 | 838 | 6.60 | 1,059 | 69.27 | 11.97 | 22.27 | 72.42 | 74.25 | 121.43 | 45.64 | 2.000 |
| 99 | Jamaica | 2,352 | 1,725 | 63.36 | 11.91 | 27.08 | 1,737 | 1,684 | 13.42 | 2,155 | 63.32 | 10.37 | 30.39 | 39.54 | 42.71 | 113.17 | 17.74 | 5.559 |
| 100 | Mexico | 78,927 | 3,985 | 65.81 | 18.05 | 10.13 | 3,976 | 3,865 | 29.51 | 4,739 | 69.07 | 16.50 | 11.94 | 47.42 | 44.03 | 69.21 | 32.49 | 256.870 |
| 101 | Nicaragua | 3,177 | 1,989 | 40.85 | 11.80 | 53.72 | 2,062 | 1,967 | 15.60 | 2,506 | 40.48 | 10.19 | 59.78 | 51.91 | 73.41 | 107.39 | 33.10 | 28.000 |
| 102 | Panama | 2,046 | 2,912 | 59.78 | 15.44 | 26.86 | 2,924 | 2,993 | 23.53 | 3,779 | 57.51 | 12.93 | 29.01 | 63.14 | 69.90 | 79.87 | 39.68 | 1.000 |
| 103 | Trinidad & Tobago | 1,170 | 6,884 | 52.93 | 25.66 | 22.06 | 6,903 | 7,372 | 56.34 | 9,047 | 50.27 | 21.22 | 23.53 | 81.15 | 76.74 | 94.92 | 72.50 | 2.450 |
| 104 | United States | 238,982 | 12,532 | 68.16 | 24.52 | 14.64 | 12,594 | 12,915 | 100.00 | 16,057 | 66.40 | 20.81 | 16.01 | 100.00 | 100.00 | 100.00 | 100.00 | 1.00 |
| | **South America** | | | | | | | | | | | | | | | | | |
| 105 | Argentina | 30,531 | 3,486 | 70.36 | 13.76 | 8.97 | 3,431 | 3,433 | 25.94 | 4,164 | 73.51 | 12.52 | 10.53 | 51.86 | 52.20 | 39.42 | 47.73 | 6,018,000.000 |
| 106 | Bolivia | 6,383 | 1,089 | 67.39 | 8.22 | 22.02 | 1,109 | 1,045 | 8.27 | 1,328 | 68.95 | 7.32 | 25.31 | 61.19 | 68.98 | 125.23 | 24.76 | 441,900.000 |
| 107 | Brazil | 135,564 | 3,282 | 71.38 | 16.07 | 8.63 | 3,253 | 3,257 | 24.78 | 3,979 | 73.49 | 14.40 | 9.98 | 43.55 | 40.85 | 58.36 | 35.06 | 6,200.000 |
| 108 | Chile | 12,074 | 3,486 | 53.03 | 21.68 | 19.55 | 3,443 | 3,349 | 25.74 | 4,132 | 55.85 | 19.88 | 23.12 | 32.81 | 41.67 | 22.96 | 16.51 | 161.080 |
| 109 | Colombia | 28,468 | 2,599 | 74.08 | 16.09 | 10.09 | 2,593 | 2,601 | 20.06 | 3,221 | 74.60 | 14.11 | 11.41 | 37.39 | 36.03 | 55.06 | 29.06 | 142.311 |
| 110 | Ecuador | 8,735 | 2,387 | 56.52 | 21.76 | 16.07 | 2,361 | 2,307 | 17.80 | 2,858 | 58.93 | 19.76 | 18.81 | 65.59 | 72.73 | 72.22 | 35.40 | 69.556 |
| 111 | Guyana | 820 | 1,259 | 42.02 | 23.76 | 36.54 | 1,223 | 1,216 | 9.76 | 1,567 | 42.12 | 20.75 | 41.14 | 36.25 | 36.73 | 61.28 | 28.29 | 4.252 |
| 112 | Paraguay | 3,475 | 1,996 | 77.09 | 12.95 | 13.33 | 1,946 | 1,821 | 15.15 | 2,432 | 78.97 | 11.55 | 15.34 | 67.11 | 73.03 | 100.40 | 29.56 | 240.000 |
| 113 | Peru | 18,655 | 2,114 | 70.02 | 6.39 | 16.77 | 2,114 | 2,042 | 15.92 | 2,556 | 72.31 | 5.75 | 19.45 | 34.04 | 32.97 | 76.22 | 17.41 | 10,974.000 |
| 114 | Surinam | 393 | 3,522 | 65.17 | 12.01 | 12.54 | 3,448 | 3,039 | 23.87 | 3,832 | 74.76 | 12.00 | 16.15 | 79.63 | 75.75 | 31.84 | 121.10 | 1.785 |
| 115 | Uraguay | 3,013 | 3,462 | 66.93 | 10.39 | 17.96 | 3,410 | 3,384 | 26.28 | 4,219 | 68.55 | 9.27 | 20.66 | 39.88 | 44.18 | 36.84 | 21.57 | 101.422 |
| 116 | Venezuela | 18,065 | 3,548 | 59.56 | 12.55 | 15.39 | 3,531 | 3,326 | 25.35 | 4,071 | 64.81 | 11.89 | 18.80 | 67.43 | 68.59 | 93.56 | 40.28 | 7.500 |
| | **Oceania** | | | | | | | | | | | | | | | | | |
| 117 | Australia | 15,752 | 8,850 | 60.03 | 29.64 | 15.38 | 8,887 | 8,744 | 68.21 | 10,953 | 60.55 | 26.04 | 17 42 | 93.23 | 96.14 | 96.98 | 83.10 | 1.427 |
| 118 | Fiji | 696 | 2,893 | 57.45 | 16.50 | 23.75 | 2,905 | 2,825 | 22.15 | 3,556 | 58.34 | 14.59 | 27.09 | 47.23 | 50.99 | 67.33 | 28.28 | 1.153 |
| 119 | Indonesia | 162,212 | 1,255 | 70.32 | 15.70 | 13.22 | 1,250 | 1,247 | 9.65 | 1,550 | 71.09 | 13.83 | 15.01 | 31.96 | 31.71 | 48.43 | 20.01 | 1,110.600 |
| 120 | New Zealand | 3,254 | 8,000 | 55.57 | 24.62 | 20.37 | 7,943 | 7,790 | 60.79 | 9,761 | 56.85 | 21.93 | 23.40 | 71.73 | 74.46 | 105.56 | 41.44 | 2.006 |
| 121 | Papua New Guinea | 3,393 | 1,374 | 61.57 | 12.52 | 28.22 | 1,370 | 1,330 | 10.72 | 1,722 | 61.30 | 10.86 | 31.56 | 38.93 | 40.48 | 89.47 | 25.34 | 1.000 |

A description of the variables appears in Appendix A.

TABLE 4

ESTIMATES OF REAL GROSS NATIONAL PRODUCT PER CAPITA (IN 1980 INTERNATIONAL
PRICES) AND POPULATION: 9 CENTRALLY PLANNED ECONOMIES, 1980 AND 1985

| Country | 1980 | | 1985 | |
|---------|------|------|------|------|
| | POP | RGNP | POP | RGNP |
| China | 1,017,561 | 1,619 | 1,078,276 | 2,444 |
| Bulgaria | 8,862 | 4,904 | 9,026 | 5,113 |
| Czechoslovakia | 15,225 | 7,002 | 15,539 | 7,424 |
| Germany, Dem. Rep. | 16,737 | 7,891 | 16,702 | 8,740 |
| Hungary | 10,711 | 5,508 | 10,625 | 5,765 |
| Poland | 35,578 | 5,006 | 37,189 | 4,913 |
| Romania | 22,201 | 3,946 | 22,703 | 4,273 |
| U.S.S.R. | 265,542 | 5,626 | 278,921 | 6,266 |
| Yugoslavia | 22,295 | 4,733 | 23,125 | 5,063 |

benchmark algorithm for 1970, 1975, and 1980 in a uniform way on national accounts series of the same vintage, 1987, to get fresh benchmark results for the three cross-sections. (The reruns were based on the detailed category purchasing power parities and expenditure compositions of the original studies along with the national accounts $C$, $I$, and $G$ totals of the UN Development Centre data base.)

2. All benchmark real expenditures obtained from the multiple benchmark studies were consistentized following the errors-in-variable approach described above. At the same time the UN Development Centre's constant-price national accounts series for $C$, $I$, and $G$ were adjusted to make them consistent with the benchmark comparisons. After rebasing all series to 1980, the DATA TABLE entries for the benchmark countries (with the exception of the new chain-type rgdp series) were computed as in PWT3 (see Summers and Heston (1984)). (In PWT3, all 1970 benchmark estimates were ignored. The PWT3 benchmark country entries were derived entirely from the Phase 3 1975 comparisons and the national accounts series of the UN Development Centre.)

1980: Non-benchmark Countries

Short-cut procedures used in PWT3 to estimate the real expenditures and price levels of countries for which benchmark information was not available were used again in PWT4, but with some modifications. The rather informal empirical relationships found in PWT3 by analyzing 1975 and 1970 data on benchmark countries made possible estimation of a country's PPP knowing only its exchange rate and its national accounts data.[16] A similar approach was followed in PWT4, working with the Phase 4 1980 data and some additional price information. It is not surprising that the great volatility of exchange rates of the Seventies caused changes between the (1970, 1975) and 1980 relationships that lead to some

[16] The label "informal" is a signal that the relationship had a fairly loose connection with a strong theoretically-plausible structural relationship. The extensive literature on country price-level determination would support dropping the adjective "informal" without apology except that in this treatment the roles of dependent and independent variables in the regression estimation are reversed.

switches in regression variables. The degree of openness to international trade of a country, quite important in the earlier years, lost its importance by 1980 so it was dropped. A new continent dummy variables for Africa was introduced to allow for the African divergence that was commented on above in the assessment of PWT3; but more important than either of these, specialized price information contained in a set of international post-allowance prices collected by the United Nations International Civil Service Commission[17] and Economic Conditions Abroad were brought into the short-cut regression as a replacement for exchange rates. Appendix B provides the regression details.

Non-benchmark country estimates needed no consistentization. It was only necessary to line them up appropriately with the benchmark country estimates.

### Extrapolation to Other Years

Once the national accounts data sets for the multiple-benchmark countries were consistentized—the non-benchmark national accounts needed no adjust-ment—the extrapolation to other years could proceed following precisely the procedure of PWT3.

## V. The Use of the DATA TABLE

The Penn World Table (Mark 4) of international comparisons, presented on three DATA TABLE $5\frac{1}{4}$ computer diskettes in so-called ASCII form, can easily be read into IBM and IBM-compatible computers and then used in conjunction with most standard software computing packages. "Index" and "Help" programs on the first of the diskettes give the definition and format of the estimates and instructions on how to access them.[18] (As in the computer-tape version of PWT3, the CPE estimates are all given at the end of the market economy list.)

A revised and updated DATA TABLE will be available from the authors periodically.

### The Precision of the Estimates

As in PWT3, judgments about the precision of the country estimates are provided. The last column, labeled $Q$, in Table 2 gives our informed but certainly imprecise view about the relative uncertainties in the DATA TABLE. (The previous precision estimates turned out to be reasonably accurate except that an extra grade below D should have been defined for the African non-benchmark countries.) Users of these data in analytical work would do well to take account of differential inaccuracies by appropriate weighting procedures.[19]

In PWT3 some suggestions were given on how to make comparisons between particular pairs of countries. The guidance in Summers and Heston (1984) was directed primarily at comparisons of benchmark and non-benchmark countries.

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[17] See footnote 3.

[18] Note that Appendix A lists the available variables.

[19] This kind of problem is approached in a different way in Stollar, Grubaugh, and Thompson (1987).

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Again we recommend that if the researcher thinks the countries are similar with respect to their residuals in the short-cut regression, the benchmark countries estimates should be modified by its observed residual.[20]

## VI. CONCLUSION

Though four years later it is not particularly heartening to do so, the authors find they can still strongly endorse their PWT3 closing remarks: "It is self-evident that it would be highly desirable to have a complete set of real national accounts figures denominated in a common currency covering a large number of countries and a long period of time.... the extrapolations and disaggregation procedures followed here, (and in PWT4) while certainly improvable, are likely to have substantial staying power because the prohibitive cost of benchmark studies will inevitably leave time gaps that must be filled in."

We think the new DATA TABLE is significantly better than the old one and will have greater staying power, and that the Mark 5 version in its time will be better still. In the words of Judge Learned Hand (1952): "Life is a dicers throw and reason a smoky torch. We move by what light we have; but some light we need to move at all. That commandment then be ours; with it we will grope our way."

## APPENDIX A

### VARIABLES IN THE DATA TABLE OF PENN WORLD TABLE (MARK 4)

| Column No. | Variable | Description |
|---|---|---|
| | | *Market Economies* |
| [1] | $POP_{jt}$ | Population |
| [2] | $RGDP1_{jt}$ | Real gross domestic product *per capita* (1980 international prices) |
| [3] | $c_{jt}$ | Consumption share (1980 international prices) |
| [4] | $i_{jt}$ | Gross domestic investment share (1980 international prices) |
| [5] | $g_{jt}$ | Government goods and services share (1980 international prices) |
| [6] | $RGDP2_{jt}$ | Chain index of real domestic product *per capita* (base year: 1980) |
| [7] | $RGDP3_{jt}$ | Real gross domestic product *per capita* with terms of trade adjustment (domestic absorption: 1980 international prices; net foreign balance: current international prices) |
| [8] | $y_{jt} = CGDP_{jt}/CGDP_{US,t}$ | Real gross product *per capita* relative to U.S. (current international prices) |
| [9] | $CGDP_{jt}$ | Real gross domestic product *per capita* (current international prices) |
| [10] | $cc_{jt}$ | Consumption share (current international prices) |
| [11] | $ci_{jt}$ | Investment share (current international prices) |
| [12] | $cg_{jt}$ | Government share (current international prices) |

[20] The short-cut benchmark residual factors for 1980 are given in Appendix B.

| | | |
|---|---|---|
| [13] | $P_{jt} = (PPP_{jt}/XR_{jt}) \cdot 100$ | Price level of gross domestic product, expressed as a percentage (Purchasing power parity over GDP ÷ Exchange rate) |
| [14] | $PC_{jt} = (PPP_{jt}^{C}/XR_{jt}) \cdot 100$ | Price level of consumption, expressed as a percentage (Purchasing power parity over Consumption ÷ Exchange rate) |
| [15] | $PI_{jt} = (PPP_{jt}^{I}/XR_{jt}) \cdot 100$ | Price level of gross domestic investment, expressed as a percentage (Purchasing power parity over gross domestic investment ÷ Exchange rate) |
| [16] | $PG_{jt} = (PPP_{jt}^{G}/XR_{jt}) \cdot 100$ | Price level of government, expressed as a percentage (Purchasing power parity over government ÷ Exchange rate) |
| [17] | $XR_{jt}$ | Exchange rate |

### Centrally Planned Economics

| | | |
|---|---|---|
| [1] | $RGNP_{jt}$ | Real gross domestic product *per capita* (1980 international prices) |
| [2] | $POP_{jt}$ | Population |

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