PART II

Technical Notes of the 2005 ICP

Data Requirements

There are two basic data requirements for participation in the ICP: Each economy must provide estimates of its GDP compiled in line with the framework described in SNA93, expressed in national currencies, and national annual average prices for a set of well-defined goods and services. This part of the report provides an overview of the data collection and analysis methods used in the ICP. (The treatment of special cases is described in greater detail in appendixes F and G.)

National Accounts Data

For use by the ICP, GDP must be compiled using the expenditure approach, with its components allocated to 155 basic headings. Basic headings are the lowest level of disaggregation for which PPPs are computed. Product specifications are determined for each basic heading. GDP expenditures for each basic heading are used to weight the basic-heading PPPs to higher levels of aggregation and to GDP. (See appendix C for the list of basic headings.)

Expenditure-based estimates of GDP must be consistent between economies. Several classifications are defined in *SNA93*, which enable the national accounts to be categorized in different ways. For ICP purposes, the most important classifications are those relating to expenditures.

In particular, the classification of individual consumption according to purpose (COICOP) provides the framework for dividing individual consumption expenditure by households into its 110 basic headings. Likewise, the classification of the functions of government (COFOG) provides the framework for government expenditures (individual and collective). The remaining significant component of GDP, gross fixed capital formation, is classified by the type of asset on which the expenditures were incurred, such as construction or equipment goods.

Data for some of the required basic-heading levels were not available in all economies; therefore, estimates had to be made by the local national accounts experts. In some cases, particularly in statistically less developed economies, the national accounts were compiled using only the production approach, which meant that the expenditure estimates required for ICP purposes were not available. In such cases, the basic-heading estimates were calculated using alternate data sources (for example, retail sales, household expenditure surveys, or commodity flow data). Occasionally, the weights underlying price indexes, such as the consumer price index (CPI), were used to impute the detailed basic-heading expenditures.

In some economies where expenditure-based GDP was not available, the percentage distribution of an economically

comparable economy from the same region was applied to production-based GDP aggregates to impute the basic-heading details. When necessary, the regional coordinator assisted economies to produce the basic-heading estimates by providing advice or by sending a statistician to work directly with the local national accountants. The regional coordinators and the global office reviewed the basic-heading breakdowns for consistency across economies.

Own-account production can be significant in developing economies, as can the activities of the informal economy. Economies that included own-account production in their national accounts were asked to make adjustments to their average prices at the basic-heading level to reflect its implicit price.

A number of new items introduced in SNA93 (such as mineral exploration, software, and valuables) were not included in some economies' national accounts because they were still being compiled according to the *System of National Accounts, 1968 (SNA68)*. To comply with ICP requirements, those countries updated their national accounts. Therefore, the GDP numbers for some countries will differ from those previously published by the World Bank. (See appendix G for more details.) Given the difficulties in collecting prices for most of these new items, "reference PPPs" (see page 144) were used instead of specifically calculated PPPs (except for computer software, for which prices were specially collected).

Price Data: Household Consumption Expenditure

Purchasing power parities (PPPs) are derived from inter-country comparisons of the national annual average prices for a representative selection of goods and services. Price comparisons are based on the principle of "matching like with like." Therefore, after determining which products to price, it was necessary to carefully define their price-determining characteristics so that comparable items were priced across all economies within each region.

Because of the crucial importance of this part of the work, a new approach was adopted for the 2005 ICP. The first step was to define "product clusters," groups of products with shared broad characteristics (for example, "fresh whole milk"), for which more-specific products needed to be specified. COICOP was used as the starting point because most economies use it (or a compatible variant of it) in compiling their national accounts or their CPI. The product clusters were mapped to the Eurostat-OECD PPP classification to identify products making up each ICP basic heading. Product characteristics were identified using the U.S. Bureau of Labor Statistics checklist from its consumer price index as a starting point to develop a series of structured product descriptions (SPDs), which define the key characteristics of each product to be priced (for example, type, variety, seasonal availability, quantity, packaging, and pricing basis). An SPD identifies those characteristics that are price-determining. For example, the package type or weight of a product will often be price-determining, but the color will not usually affect the price.

Once an SPD was set up for the product cluster, individual products were identified by selecting the specific characteristics of each product included in the pricing list. Each selected product was given a detailed product specification. Each ICP region went through an independent exercise to define the specifications of products to be priced.

The number of products specified under a basic heading varied from one basic heading to another (and even for the same basic heading in different regions) because of the number and diversity of price-determining characteristics. For example, given the centralization of postal services in most economies, it was possible to cover very thoroughly the "postal services" basic heading with only a handful of products. On the other hand, the "bread" basic heading required a wide range of products to be specified because of the diversity of bread types available in different economies.

Developing the final product specifications was a lengthy, iterative process. Chapter 5 of the *ICP 2003–2006 Handbook* describes in detail the preparation of the SPDs and the steps taken to derive product specifications within a region.

A basic concept guiding the price collection is that the prices should be consistent with those underlying each economy's national accounts expenditure estimates. The prices collected should include all nondeductible taxes, as well as tips or gratuities (where significant). And the prices recorded must be annual national average prices consistent with the values recorded in the national accounts. Meet-

ing the latter requirement proved to be difficult in many economies. The special price collections for the ICP were generally run once in each quarter. In some cases, it was necessary for economies to collect prices monthly to prevent biases from price volatility during the quarter. An alternative, adopted by some economies for products whose prices were highly seasonal, was to use price movements from the same product (or product group) in the CPI to adjust the ICP prices that were collected less frequently than those in the CPI. This option was not available in all economies because it requires having a sufficiently detailed and reliable monthly CPI available.

Calculating national average prices consistent with the national accounts proved to be a difficult process, particularly in very large economies. Generally, prices in rural areas are lower than those in urban centers, but collecting prices in rural areas is more difficult and costly than collecting them in towns and cities. Where it was not feasible to collect prices in both urban and rural areas, it was sometimes possible to use price information collected for other purposes. For example, rural and urban adjustment factors were sometimes applied to the prices collected in urban areas to impute rural price levels. The urban and rural prices were then combined (using weights derived from household expenditure surveys or other sources) to obtain a national average price. For many basic headings, the rural sector had little impact on average prices, because the products or services were only available in urban areas.

Representativity and Comparability

The selection of the products to be priced affected the outcome of the comparisons. The products to be priced by each economy needed to meet two criteria: they should be representative of its economy and comparable between economies. Conflicts arise because products that are most representative of a particular type of expenditure in one economy are not necessarily identical to those in another economy.

In practice, there are significant differences in products purchased within the same basic heading in different economies. And, of course, the proportions of total expenditure for each basic heading differ between economies. Therefore, trade-offs were required to ensure that the products priced were representative of the expenditures to which they related, as well as being comparable from one economy to another.

The representative products of an economy are those that figure prominently in the expenditures within a basic heading. They may therefore be products that are frequently purchased by resident households and are likely to be widely available throughout the economy. They may also be relatively high-value products that may not be bought so frequently, but whose total value is a significant proportion of the total expenditure within a basic heading.

With regard to comparability, products are said to be comparable if their physical and economic characteristics are identical or they are so similar that consumers are hardly concerned about differences between them. In other words, a typical consumer is not prepared to pay more for one than the other. The main way in which comparability was ensured was to prepare detailed specifications for each product to be priced for the ICP in each region. However, another trade-off was involved in this process. On one hand, a product selected for pricing in different economies can be more accurately compared between economies if the specifications are tightly defined. On the other hand, the more tightly defined the product, the less likelihood there is of locating it in many economies.

Product lists were constructed to provide the greatest possible opportunity for economies to identify representative products to price. No economy was expected to price all the products within any particular basic heading. But all economies were expected to price at least some nonrepresentative products so they could be matched with prices collected in other economies.

Price Data: Government Final Consumption Expenditure

Compensation of employees in health, education, and general government is a major input to overall government PPPs. The compensation recorded for PPP purposes included basic salary and allowances before income taxes, in-kind payments (such as employer-subsidized housing), and actual and imputed social security contributions paid by the employer.

Table 3

Commonly Used Reference PPPs

Code	Description	Reference PPP
100000	Gross domestic product	
110000	Final consumption expenditure by households	
110400	Housing, water, electricity, gas, and other fuels	
110440	Water supply and miscellaneous services relating to the dwelling	
110442	Miscellaneous services relating to the dwelling	
110442.1	**Miscellaneous services relating to the dwelling**	**PPPs for actual and imputed rents**
110600	Health	
110630	Hospital services	
110631	Hospital services	
110631.1	Hospital services	PPPs for production of health services by government (without net taxes on production and receipts from sales)
110900	Recreation and culture	
110960	Package holidays	
110961	Package holidays	
110961.1	Package holidays	PPPs for transport services and restaurants and hotels
130000	Individual consumption expenditure by government	
130220	Production of health services	
130222	Intermediate consumption	
130222.1	**Intermediate consumption**	**PPPs for household final consumption expenditure on the domestic market (excluding health and education basic headings and reference PPPs basic headings)**
130223	Gross operating surplus	
130223.1	**Gross operating surplus**	**PPPs for gross fixed capital formation**
130224	Net taxes on production	
130224.1	**Net taxes on production**	**PPPs for production of health services by government (without net taxes on production and receipts from sales)**
130225	Receipts from sales	
130225.1	**Receipts from sales**	**PPPs for production of health services by government (without net taxes on production and receipts from sales)**
160000	Changes in inventories and acquisitions, less disposals of valuables	
160100	Changes in inventories	
160110	Changes in inventories	
160111	Changes in inventories	
160111.1	Changes in inventories	PPPs for consumer goods and equipment goods

Source: ICP Global Office.

Price Data: Gross Fixed Capital Formation

For gross fixed capital formation, the prices recorded include all installation charges and the costs of delivering equipment or materials to the site where they were to be used. For more information on the pricing of construction and machinery and equipment, see the discussion below on comparison resistant areas.

Changes in inventories

PPPs are not directly estimated for changes in inventories. Instead, PPPs are imputed using PPPs for consumer goods and equipment (as described below for reference PPPs).

Balance of exports and imports

Export PPPs could be calculated by comparing the prices of goods and services for export in the participating countries. The same thing could be used for imports. In most cases, the PPPs so obtained would be very close to the exchange rate and would diverge mainly because of differences in freight costs. For ICP 2005 (as in all previous rounds), exchange rates were used as reference PPPs.

Reference PPPs

Reference PPPs are PPPs that are used for basic headings for which no prices were collected. They are based on PPPs from other basic headings. For example, the reference PPP used for changes in inventories was a weighted average of the PPPs for consumer goods and the PPPs for equipment (investment) goods.

Table 3 shows some examples of the most commonly used reference PPPs. It was necessary to use them in cases where one or more economies in a region had been unable to price any products under a particular basic heading. Regional coordinators decided on the most appropriate reference PPPs to use. The reference PPPs used by each region are documented in their regional reports.

Comparison-Resistant Areas

Some components of expenditure on GDP have a long history of being difficult to estimate. In the ICP, these components are often referred to as "comparison-resistant" goods and services. They are found mainly in housing, collective government consumption, health, education, and investment in equipment and construction. Different approaches were used to obtain prices and PPPs for these activities. The global office consulted closely with experts in relevant organizations (such as the World Health Organization) or employed experts on investment in equipment and construction to assist in setting up special pricing lists for the products involved. The requirements regarding the prices recorded were similar to those for the household final consumption products (that is, they had to be national annual average prices consistent with the expenditures recorded in an economy's national accounts).

Housing Rent

Housing rent is an important component of household expenditures and a significant contributor to GDP. Actual rents are recorded in the national accounts along with an imputed component based on the rental value of owner-occupied housing. In effect, the national accounts consider owner-occupiers as renters of their own homes. The reason for this is to avoid a situation in which the value of GDP could be affected by a switch in the proportion of tenants and owner-occupiers in an economy, even if there had been no change in the size or composition of the housing stock. In the past, calculating PPPs for rents has proved to be problematic. The main problem has been that the rental market in some economies is so small that it is difficult to obtain realistic average prices. In addition, the prices reported for calculating PPPs have not always been consistent with those underlying the values of rents in the national accounts. As a result, the real value of housing services computed using PPPs derived from reported rental prices have been different from those derived from unit values estimated from national accounts sources.

The global office developed a questionnaire to obtain detailed data underlying the estimates of dwelling stocks used in the national accounts for both rented dwellings and owner-occupied dwellings (that is, imputed rent). The details of particular interest for ICP purposes were the number of dwellings, number of rooms, and total square footage of each type (detached houses, apartments, and so forth), classified by size, region, locality (urban or rural), and the facilities available (electricity, running water, private toilet, and so forth). The aim was to produce comparisons of the real value of dwelling services between the economies.

In the 2005 round of ICP, regions used one or a combination of three approaches to compute PPPs for housing

rent. The first approach is the quantity method, in which physical measures of the numbers and characteristics of dwellings are used to produce comparable real expenditures on housing. The second approach is the direct rent approach, in which rental data for comparable housing types (apartment, house, and so forth) are used to compute the PPP for the dwelling basic heading. In the absence of detailed rental data and detailed information on the numbers and characteristics of dwellings, Asia-Pacific and Africa used the PPP for individual consumption expenditures by households (excluding rentals for housing) as a reference PPP for housing. This is a neutral approach in the sense that housing has no effect on the overall PPP for individual consumption. South America and CIS used the quantity method. Western Asia and Eurostat-OECD used a combination of the first two methods.

Government

For ICP purposes, government final consumption expenditure was divided into two components: expenditure by general government on collective consumption goods and services and expenditure by general government on individual consumption services. The collective consumption component covers services that are provided to the community as a whole, such as defense, police, and firefighting. The individual component relates to those services provided to specific individuals, such as health and education.

In the ICP, a national accounting aggregate known as "actual individual consumption expenditure" was used for comparison of household consumption. It comprises household final consumption expenditure plus the individual component of government final consumption expenditure and the final consumption expenditure by nonprofit institutions serving households (NPISHs). The reason for using actual individual consumption expenditure is that it is not affected by the extent to which services such as health and education are financed by government or purchased directly by households.

The national accounting convention for measuring nonmarket outputs is the input-cost approach, which means that they are recorded as the sum of the wage costs of the employees involved plus the intermediate consumption of goods and services (materials used, rents, and so forth) and consumption of fixed capital. Collective consumption by government and nonmarket services in health and education produced by government include basic headings for compensation of employees, intermediate consumption, and some other smaller items (as shown in appendix E). PPPs for compensation of employees were compiled by comparing salaries between economies for a number of carefully selected and well-defined jobs that are typical of government expenditures around the world, for both the regional and ring comparisons.

Measuring the compensation of government employees is a difficult area for ICP because labor productivity in government varies widely between economies. For the Eurostat-OECD, CIS, and South America regions, productivity differences were ignored because they were judged to be so small that ignoring them would not affect regional comparisons. However, the participating economies in the Asia-Pacific, Africa, and Western Asia regions are at very different levels of economic development, reflected in government compensation levels. For example, in Asia-Pacific, average compensation (based on exchange rates) in the government health sector of Hong Kong was about 120 times higher than in the Lao People's Democratic Republic (PDR). If no productivity adjustments were made, economies such as Vietnam, Cambodia, or Lao PDR, where government salaries are very low, would be seen as having very high real consumption of government services—and hence very high real GDP—compared with economies such as Hong Kong and Singapore, where government salaries are relatively much higher.

The solution adopted by these regions was to adjust government compensation, and hence government consumption expenditure, for differences in productivity. (Details on the productivity adjustment can be found in appendix D.)

Health

For ICP purposes, basic headings for expenditures on medical products and health services were included under household consumption and individual consumption by government. Government expenditures included additional basic headings for the production of health services. This classification reflects the different ways that health products and services can be purchased:

- Households purchase them directly and pay for them in full.

- Households purchase private insurance, and the insurance company reimburses the purchaser for all or part of the cost of the products.
- They are purchased and paid for in full by government for distribution to households.
- They are purchased and paid for partly by households and partly by government.

The prices used in the ICP should reflect the full price, no matter who is paying for the goods or services. In other words, purchasers' prices are required. In the ICP, the full price was required for products purchased using either of the first two means listed above. For products paid for in full by government (the third way listed above), the full cost of each product to the government was the "price" required. Products and services that are partly paid for by government and partly by households are the most difficult to measure. The price required for ICP purposes was the total of any amounts paid by the consumer plus any contribution to the overall cost made by the government.

The PPP for consumption expenditure on health services included a combination of prices paid by consumers and government contributions measured by the sum of inputs (that is, compensation of employees, plus intermediate consumption, net taxes, and gross operating surplus; less receipts from sales). A reference PPP was used for hospital services because of the difficulties involved in specifying and pricing comparable products across economies, particularly given the huge range of ways in which hospital services are provided and charged in different economies. The reference PPP was the production of health services by government (excluding net taxes on production and receipts from sales).

Construction

Construction investment is a difficult area because of the variety of projects and techniques in different parts of the world, even within the same region. Historically, two methods have been used to price such projects. The first is to price the inputs (wages for the labor; materials used in construction, such as bricks, timber, and steel; and the cost of hiring equipment). The second is based on standard models for different types of construction projects (for example, housing, bridges, roads, and factory buildings) and pricing them by construction experts. The main advantage of the

latter approach is that overheads and productivity differences between economies are taken into account. However, it is much more costly to implement than pricing inputs.

A completely new method was introduced in the 2005 ICP. In practice, it falls in between the input- and model-based approaches. It has been termed the "basket of construction components" (BOCC) approach, and it involves pricing identifiable, complete, installed components (including the materials and labor), plus the cost of hiring any capital equipment used. The product list focused on components (such as a column footing) that were significant in the total cost and then identified the major elements of each. The types of inputs and the mix between labor and equipment differ between economies. The BOCC approach took into account such variations in the mix of inputs. The global office selected 22 components, which represented the principal types of construction activities around the world. Twelve basic construction inputs (such as labor, equipment rental costs, and selected materials) were also priced. These global specifications were priced by all ICP regions. Construction contains three basic headings: residential buildings, nonresidential buildings, and civil engineering projects. Components such as the column footing were first mapped to systems, such as the substructure or superstructure, that make up the construction of a building or project. PPPs were first computed within each system using the cost data for each component within it, the same as if they were product prices. These were then weighted separately to the three construction basic headings. (See the *ICP Handbook*, chapter 9, for more details.)

Machinery and Equipment

Pricing the goods underlying investment expenditures on machinery and equipment was a problematic area in both the regional and the ring comparisons. The approach adopted was similar to the one for consumption goods and services, for which SPDs were used as the starting point. However, for consumption products, each region developed its own specifications. For machinery and equipment, the global office staff prepared the SPDs on a worldwide basis and developed the product specifications. The global office identified at least two manufacturers and two model numbers for most products. National coordinators were asked to provide prices for the first of these two specifications for each product, provided that the model specified was

available and in common use in the economy; otherwise, the second one was to be priced. If more than one model could be priced on this basis, then national coordinators were asked to do so. In those cases for which exact product matches could not be found, each economy had to price a model that broadly met the specifications and was commonly used in the economy.

Data Validation

Data validation was a critical part of the 2005 ICP. Several stages were involved, some requiring an iterative process to clean up the data progressively. The process was time-consuming and required close coordination and goodwill on the part of the regional and national coordinators in each region. A key aim of the very methodical data valida-tion process undertaken in all regions was to ensure that the prices and national accounts data were as comparable as possible between economies so that consistent results would be produced. (Appendix I provides an overview of the software used for the many stages of data collection and validation.)

Data Validation: Prices

The first stage of data validation was a price comparison within each economy, shortly after the first quarter price collections were completed. The aim was for each national coordinator to ensure that the products being priced were consistent from one part of the economy to another so that economies in which problems were identified would be able to correct their procedures or better specify the prod-ucts being priced for the remaining three quarters of price collection. The starting point was to compare the average prices collected for a single product in different locations within an economy. The process involved examining the

spread of prices on the assumption that variations in prices for the same product within an economy should not be large. Any extreme observations were examined closely to determine whether they had been correctly recorded, whether appropriate units of measurement were used, or whether there was some inconsistency in the product being priced in different locations. In some cases, quite significant differences in price levels between urban and rural areas occurred legitimately. If this appeared to be the case, price levels were compared between cities and between rural areas. The process revealed different inter-pretations of the product specifications, particularly for the more generically described products, and it also identified a number of cases of inappropriate quantities being priced. This process enabled appropriate corrections to be made to the initial data.

National coordinators supplied prices progressively to the regional coordinators after each quarter's collec-tion, which provided the opportunity for a second check, but with the advantage of being able to compare prices between, as well as within, economies. The primary pur-pose of this review was to ensure that economies priced comparable items. The national coordinators worked closely with the regional coordinators in carrying out this work, which involved checking the average prices of cor-responding products in all economies in the region. At this

stage, a Quaranta validation table could be produced for each basic heading, allowing the regional coordinator to compare characteristics of the prices between economies (for example, their relative levels, variation, and dispersion) after converting them to a common currency, using both exchange rates and PPPs.

Another editing facility used for the first time in the 2005 ICP was the Dikhanov table, which extended the type of analysis provided by the Quaranta table. The main difference between the two is that the Quaranta table concentrates on key features of the data at the basic-heading level while the Dikhanov table presents a broader overview across basic headings.

The feedback from the preliminary editing phase provided a means, early in the price collection cycle, of identifying products that were being incorrectly identified or priced. The data validation was an iterative process: as data problems were identified and corrected, the relationships presented in the tables changed, and therefore several cycles were normally required to complete the data cleaning.

The process was managed by the regional coordinators, who sent queries to the national coordinators. Once the problems identified in the price data were resolved, a second set of Quaranta and Dikhanov tables was produced, and the detailed checking process was repeated. At about this time, most regions held a data validation workshop. The purpose of these workshops was to have price experts from each economy in the region review, as a group, the price data in a "semifinal" state. The aim was to finalize product prices by resolving data queries during the meeting. Inevitably, it was not possible to resolve every problem, and so a major outcome of a data validation workshop was a list of potential problems for which the price statisticians had to find an explanation for apparent anomalies or provide corrected prices.

Once the price data were considered final, national coordinators were asked to formally approve their own economy's prices. Final Quaranta and Dikhanov tables were circulated as part of this process.

Data Validation: National Accounts

A crucial aspect of data validation was to make international comparisons of the contributions of each basic heading to GDP. Any significant differences that could not be readily explained by the regional coordinator's team were referred back to the national coordinators concerned for resolution. The patterns of expenditure between different groupings of economies were also compared. For example, the share of GDP spent on basic needs, such as food, should be relatively high in low-income economies, while the share of expenditure on luxury items, such as motor vehicles, should be higher in the high-income economies. Such checks are fairly subjective, but they identified problems that had to be corrected before each region's comparisons were finalized.

Data Issues and Accuracy

The ICP is a very large statistical program, which uses not only existing data sources (for example, national accounts data) but also data derived from special surveys, particularly to obtain prices not otherwise available. The results are published on an economy basis, so each economy has a stake in the accuracy of its results. Consequently, there is shared responsibility for editing the ICP inputs and outputs, although the global office is ultimately responsible for the quality of the final overall results.

Several steps were taken to improve data accuracy starting with the careful selection and defining of products to be priced via the structured product definitions. The next step was data validation at the regional level, where workshops were convened after each data collection and where economies reviewed the prices submitted to determine whether all priced the same product the same way.

When comparing GDP volumes between economies, it is also necessary to take into account the accuracy of the underlying national accounts estimates. The estimates of GDP in national currencies can have large errors associated with them. For example, substantial revisions have been made to the level of GDP in many economies over the past decade as more and better statistical surveys have become available, particularly in the area of services, and as the nonobserved economy has been covered more comprehensively. Any such shortcomings in the national accounts data affect the international comparisons for those economies, no matter whether PPPs or exchange rates are used.

As is the case with national accounts data in general, the data for some aggregates are more accurate than those for others. Sometimes the quality of the underlying data source

determines the level of accuracy, and sometimes statistical measurement issues (for example, in the methods of estimating the values of nonmarket services) predominate. The same is true of the ICP data, particularly at the basic-heading level. In many cases, the values underlying the basic headings have been obtained by allocating broader national accounts aggregates, using data that may not be completely compatible with the accounts. In such cases, the data are useful as weights to obtain broader aggregates, but they will not necessarily provide an accurate comparison between economies at that level.

Methodology: Calculating PPPs

Overview

Calculating PPP-based expenditure volumes requires high-quality price data and detailed expenditure weights derived from national accounts data for each of the countries for which PPPs are being calculated. After the data collection phase was completed, national average prices for each product were used to derive PPPs for basic headings and higher aggregates. These PPPs were matched to national accounts aggregates, expressed in national currency, to convert them to a common currency at a uniform price level.

Before looking at the methods for calculating PPPs, it is necessary to consider some important requirements of PPPs. One is that the comparison between any pair of economies should not change, no matter which economy is chosen as the numeraire (that is, the base country or economy of reference). This requirement is referred to as "base-country invariance." A second requirement is that the PPPs in a multilateral comparison should be transitive. Transitivity is the property whereby the direct PPP between any two economies (or regions) yields the same result as an indirect comparison via a third economy (or region). In other words, a direct comparison between economy A and economy B gives the same results as an indirect comparison

between economy A and C followed by a comparison of C to B. Transitivity is important because it means that comparisons made between any pair of countries are mutually consistent.

In describing the computational methods used in the 2005 ICP, it is necessary to define the various stages of aggregation required within each region. Three aggregation processes were involved to compute regional PPPs:

- Averaging the individual price observations to form an annual national average price for each product in each country
- Averaging between-country individual product price ratios to obtain PPPs at the basic-heading level between countries within a region
- Averaging basic-heading PPPs to obtain aggregate PPPs for GDP and its major components between countries within a region

For some of the stages, different techniques were used across the regions. (The following sections provide a review of the general methodology. Appendix F provides an overview of how the methods used differed by regions. The *ICP Handbook*, chapters 11–15, provides the most detailed explanations of the methodologies used to calculate PPPs.)

Annual National Average Prices

In principle, the annual national average price for 2005 for an individual product should be its average unit value for 2005 (that is, the value of the product sold during 2005 divided by the quantity sold in 2005). In practice, such detailed data are rarely (if ever) available; therefore, the ICP used an approach similar to that used by national statistical offices in producing price indexes to deflate the national accounts to obtain volume estimates.

Prices were collected throughout 2005 for the products specified in each region of the ICP. Typically, the prices were obtained from a range of different outlets in a sample of cities and towns throughout each economy at least once every quarter. Africa collected prices on a monthly basis, while Asia-Pacific, Latin America, and Western Asia collected prices on a quarterly basis. National average prices were calculated using as weights the quantities sold in different quarters of the year and in different regions of the economy. When data on quantities sold were not available, alternatively, regions used expenditures or population as weights. In cases where weights were not available altogether, the annual national average price was calculated as a simple arithmetic mean of the prices observed during the year, provided that there were no significant seasonal variations in the prices.

Once the national annual average prices were computed, aggregation methods, such as CPD and EKS, were applied to derive the PPPs at the basic-heading level. (An outline of these methods follows. Full details, including examples, are presented in chapter 11 of the *ICP 2003–2006 Handbook*.)

Calculating PPPs at the Basic-Heading Level

The following sections provide an overview of the methods used to compute PPPs at the basic-heading level. The ICP regions used the CPD method; the Eurostat-OECD-CIS regions used the EKS* (see below for explanation of difference between EKS and EKS* methods) methodology.

The CPD Method

The country-product-dummy (CPD) method is a multilateral approach in which the PPPs are estimated simultaneously for all products and for all countries within a region, with simultaneous estimation of prices for all products. A very important property of the PPPs generated by this model is that they are transitive.

In the 2005 ICP, the starting point of the CPD approach was a matrix of prices (in national currencies) for products priced within each country in the region concerned. There were gaps in the matrix because it was not possible (and neither necessary nor generally desirable) for all countries to price every product in the list. The CPD method is a regression technique. The underlying model is multiplicative (but additive in logarithms). It assumes that prices vary by product within countries at the same rate across all countries, and that prices vary between countries at the same rate across all products. In practice, one country has to be chosen as a base, and all other product/country combinations are measured in terms of their variation from this base. An error term (also multiplicative in this case) is required to handle differences in the observed country/product prices from those generated by the model.

The multiplicative CPD model can be illustrated by a general example. Let us assume that there are m countries and that their product list contains n products. Then, for each product in each country, the observed price is p_{ij} for i = 1, 2, . . . , m and for j = 1, 2, . . . , n. Note that the prices pij are expressed in each country's national currencies. The multiplicative CPD model is expressed in equation (1) as

$$p_{ij} = \alpha_i \beta_j \upsilon_{ij}, \tag{1}$$

where υ_{ij} is the error term.

The CPD model is converted from a multiplicative one to an additive one by expressing the terms in the model as logarithms in equation (2):

$$\log(p_{ij}) = \log(\alpha_i \beta_j \upsilon_{ij}) = \log(\alpha_i) + \log(\beta_j) + \log(\upsilon_{ij}) \tag{2}$$

The observed price data are in national currencies. Dummy variables with values of 1 or 0 are used to represent each country (i) and product (j). The regression coefficients are estimated by ordinary least squares. The interdependent country factors (α_i) are the PPPs relative to the base country, and the product factors (β_j) are average prices in the base country. If we assume that the base country is country 1, then $\alpha_i = 1$. Any other country can be made the base country simply by dividing every country's PPP by the new base country's PPP.

Another useful output from the CPD model is a set of estimated prices in PPP terms, $\alpha_i \beta_j$, for each product in each country. Differences between observed prices and the modeled prices provide an indication of possible problems with the prices provided by a country. Large differences indicate that prices for the same product vary significantly between countries or that the product is misspecified or not representative of the economy. The distribution of these differences provides the underlying basis for the Dikhanov table as an editing tool. The distributions can be graphed to provide a simple means of identifying potential problem prices, for a product across countries or for a set of products within a country.

The EKS and EKS* Methods

The EKS formula (named after its developers Éltetö, Köves, and Szulc) was first used to produce transitive PPPs from a set of nontransitive bilateral parities that were obtained as simple geometric averages from individual price ratios for a pair of countries. The EKS method differs from the CPD method in several important respects. First, it is based on a binary approach rather than a multilateral one. The binary PPPs of all pairs of countries do not automatically produce transitive estimates, and hence an extra step is required to convert the binary comparisons into multilateral, transitive ones. The EKS method treats participating countries as a set of independent units, each with an equal weight. The binary PPPs are made transitive by a procedure that minimizes the differences between them and the multilateral PPPs it produces. For each pair of countries, the EKS method provides PPPs that are similar to the PPPs that would be obtained if each pair of countries had been compared separately.

The EKS formula is used to produce transitive PPPs from a set of bilateral PPPs. If there are n countries in a region, transitive PPPs are obtained as the nth root of the product of the direct bilateral PPP with weight 2 and (n–2) indirect PPPs, each with weight 1.

For example, if there are three countries, A, B, and C, the transitive PPP for countries A and B is shown in equation (3):

$$\left[\left(\frac{P^A}{P^B} \right)^2 \times \left(\frac{1}{P^B \big/ P^A} \right) \times \left(\left(\frac{P^C}{P^B} \right) \times \left(\frac{P^A}{P^C} \right) \right) \right]^{\frac{1}{3}} \tag{3}$$

For the EKS formula to work, it is necessary for PPPs to be available for all countries for each basic heading. Occasionally, some PPPs for some countries were missing because of data collection problems or data consistency issues. In such cases, PPPs had to be imputed either by using the PPP of a similar basic heading or from a broader (but related) aggregate.

The EKS method can be seen as a procedure that minimizes the differences between multilateral binary PPPs and bilateral binary PPPs. In its most general form, it can be presented in equation (4) as

$$PPP_{j,k} = \left(\prod_l PPP_{j,l} \big/ PPP_{k,l} \right)^{1/m} \tag{4}$$

where $PPP_{j,k}$ is the multilateral index for country j and country k and m is the number of all countries.

The EKS* method is an extension of the original EKS method; the asterisk (*) refers to the way in which the Eurostat-OECD and the CIS denote representative products in their PPP price collections. Each product deemed by a country to be representative of its expenditures is assigned an asterisk in a representativity field. Any products that do not have an asterisk in that field are treated as nonrepresentative.

The starting point for EKS* is a comparison between each pair of countries in a region. The issue of representative/nonrepresentative products comes into play at this stage. Three bilateral PPPs at the basic-heading level are calculated for each pair of countries. A bilateral PPP is

calculated by first taking all the representative products within one country and matching them with the products priced by a second country, no matter whether the products in the second country were classified as representative. The ratio of prices in the first country to those in the second is calculated for each of the matched products, and a geometric mean is taken of all the price ratios.

The process is repeated by matching all representative products in the second country with as many products as possible from the first country, no matter whether they are classified as representative in the first country. The price ratios are calculated for all matched products, but this time the ratios are those between the second country and the first country. Once again, the geometric mean is calculated for the price ratios of all the matched products. The final bilateral PPP for the basic heading is obtained as the geometric mean of the two geometric means obtained from these first two steps. At this point, the PPPs for each basic heading have been calculated as unweighted (more correctly, equally weighted) averages of the prices. No weights are available below the basic-heading level because, by definition, the basic heading is the most detailed level for which national accounts expenditures are required for the ICP (although the distinction between representative and nonrepresentative products can be seen as a form of weighting).

Products classified as nonrepresentative by both countries are excluded from the bilateral price ratio calculations, even if both countries price them; however, prices for these products are not discarded. They can be used in other bilateral comparisons if some other countries classified them as representative and in the EKS procedure to make the PPPs transitive, and so they can have some influence on the final PPP calculations.

PPPs for GDP and its Major Aggregates within a Region

The EKS method

Using the EKS method, the aggregation of basic-heading PPPs is undertaken at each level of expenditure up to the level of GDP by using the following steps.

For each pair of countries, the basic-heading PPPs are weighted, summed, and averaged by using the basic-heading expenditure weights of the first country, and then computing another weighted average using the second country's weights. Because the basic-heading expenditures are in each country's national currency, they are converted to shares for the weighting process. This step provides two weighted PPPs at each level of aggregation, each reflecting the weight distribution of each of the pair of countries being compared. The geometric mean of these two PPPs gives a single PPP between the two countries.

The outcome of this process is a matrix of PPPs for each pair of countries, for each aggregate for which PPPs were required, up to the level of GDP. Each matrix consisted of nontransitive PPPs, which were then made transitive by applying the EKS method. This was done to obtain transitive PPPs that remain as close as possible to the nontransitive PPPs calculated in the initial step.

The result is that the real final expenditures are not additive to higher aggregate levels or to GDP. However, the EKS method avoids the Gerschenkron effect (described in the next section), which occurs when additive indexing methods are used. EKS PPPs and real final expenditures based on them are better suited for comparisons across countries. Results from the GK method (described below) are better suited for the analysis of price and volume structures across countries (for example, real food expenditures as a percentage of the GDP).

The transitive EKS PPPs were used as deflators to convert aggregates expressed in national currency into volumes expressed in a common currency. It is important to note that because the volumes are not additive, it is not possible to obtain volumes for any aggregates for which PPPs have not been calculated directly through the above process.

The Geary-Khamis (GK) and the Iklé Methods

The GK method was used to derive aggregate PPPs in previous rounds of the ICP before 1993. Conceptually, the GK method calculates volumes in a numeraire currency by valuing the quantities in each country using a common vector of average prices. The price vector has to be as typical as possible of the region as a whole, and so a quantity-weighted average of the prices for the entire region would be the ideal price vector. To obtain this price vector, prices in national currency have to be converted to a numeraire currency using the PPPs. Therefore, average common prices and PPPs are interdependent variables in the GK linear

system. Major advantages of using a single price vector are that the process is a straightforward multilateral one and no second stage of processing is required because the volumes are transitive; they are also additive, which is a useful attribute for some analyses.

The disadvantage of the GK method is that the average prices in the price vector are weighted using quantity weights from all countries in the region. The result is that the prices of larger countries and countries that have a relatively high level of expenditure will have a greater weight than those of the smaller countries. In other words, the prices observed in the smaller and lower-income countries tend to deviate more from the average prices of the region (that is, those in the price vector) than those of larger and of higher-income countries, which have a greater influence on the average prices calculated. One consequence of this weighting pattern is that the volumes estimated for lower-income countries tend to be higher than would have been the case if a weighting pattern were used that more closely matched the actual price structure in the lower-income countries. This bias is referred to as the "Gerschenkron effect."

To reduce the extent of the bias caused by the Gerschenkron effect, the approach used in the Africa region was a variation of the GK approach known as the "Iklé method." The Iklé weights are based on country expenditure shares, rather than on country quantity weights. As a result, the weights are more evenly distributed among countries and are not so heavily dependent on the higher-income and larger countries as in the GK method. The Iklé method minimizes the Gerschenkron effect, although it does not eliminate it completely. More important, it provides additivity.

Eurostat-OECD has used the EKS method since 1990. In the 2005 ICP, Africa used the Iklé method, while all the other regions used an EKS approach. Africa preferred an additive method, which was considered important in their analysis.

Combining Regional Results with a Global Comparison: The Ring Comparison

The 2005 ICP was organized on a regional basis, partly for operational reasons and partly because economies within a geographic region are more likely to be similar to each other than to economies in other parts of the world. The latter point means that more robust results are likely within a region than would be the case if all economies in the world were combined in a single, worldwide comparison. For example, within a regional comparison, the product lists can be focused on a smaller range of products, enabling economies to price a large proportion of them. At the same time, the characteristics of the products can be more tightly specified, so quality differences are likely to be less significant.

To produce global estimates, regional results must be matched with each other. Two alternative methods were considered for linking regions in the ICP. One was to nominate "core" or "bridge" countries, which would have to participate in two regional comparisons, providing a link between that pair of regions. The other was to select a group of countries, a few from each region, that would participate in a separate and parallel worldwide comparison organized specifically to provide a link between regions.

With one exception, the second alternative was adopted for the 2005 ICP. This has become known as the "ring comparison" because of the way in which it worked to determine the PPPs between different global regions. The ring comparison was a much-reduced global ICP comparison in which transitive PPP relationships, at the basic-heading level and above, were established between regions rather than between individual economies in each region. In total, 18 ring countries conducted special price collections using a global product list to enable these relativities to be calculated.

The ICP's Technical Advisory Group (TAG) recommended the ring comparison approach because it felt that it would provide the most robust links between regions. The ICP global office was responsible for leading the ring comparison work. It was developed in such a way that products could be matched between ring countries in any pair of regions, thereby maximizing the usefulness of the data collected.

Whichever linking technique was used (that is, bridge countries or the ring comparison), it would have been possible to use either a single country or several countries from each region to link the regions together. It was not necessary to include the same number of countries in each region, although obviously at least one country must be involved from each region. The bridge country approach would have been simpler to implement, and it is less

Table 4

Countries Included in the Ring Comparison

Africa	Asia-Pacific	Latin America	Western Asia	Eurostat-OECD
Cameroon	Hong Kong, China	Brazil	Jordan	Estonia
Egypt, Arab Rep.	Malaysia	Chile	Oman	Japan
Kenya	Philippines			Slovenia
Senegal	Sri Lanka			United Kingdom
South Africa				
Zambia				

Source: ICP 2003–2006 Handbook.

data-intensive and less resource-demanding than the ring comparison. However, experience in previous rounds of the ICP showed that the results from using a single country within each region to link the regions were too dependent on the economic structure of the bridge country. This was a particular concern with so many new techniques being used for the first time in the 2005 ICP. Any problems that arose with a bridge country's results would be reflected in the relationship between all countries in that region and hence those in all other regions. The ring comparison was developed as a means of providing more robust links possible between regions.

The single exception was the Commonwealth of Independent States (CIS), whose regional results were linked to the Eurostat-OECD region using Russia as a bridge country. Russia priced both the CIS and the Eurostat-OECD product lists to provide the link. The ring comparison was used to combine the results for the other five regions. The CIS countries' results were then linked to those for the other regions using the relationship between Russia and the Eurostat-OECD region. In effect, the CIS results were linked into the rest of the world in a two-stage process. The first was using Russia as a bridge country. The second was a link to the other four regions using the relationships established by the Eurostat-OECD countries that participated in the ring comparison. The main reason for using Russia as a bridge country was that this process was consistent with

what had been used in recent rounds conducted by Eurostat-OECD, and the conceptual expertise and the practical experience required to enable this method to work were available in the region.

The following criteria were used to select ring countries:

- Having developed markets and an open economy
- Having a wide range of goods and services that were likely to be found in ring countries in other regions
- Able to participate in the full GDP comparison
- Having acceptable price data and expenditure weights
- Able to derive annual, national average prices
- Willingness to act as a ring country

Developing the product list for ring countries was complicated because it involved several different phases. The most time-consuming part was preparing the product list for consumer products. The starting point was to examine the combined product lists across the regions and check off the products that each ring country had priced in the regional comparisons. Any products not priced by a ring country were discarded, while the remaining products were retained as potential products to be included in the ring list. The next stage was to check the structured product descriptions (SPDs) for each of these products. The usefulness of the worldwide SPD approach was evident in this

Table 5

Number of products priced by region and for the ring comparison

Category	Africa	Asia-Pacific	CIS	OECD–Eurostat	Latin America	W. Asia	Ring
Food and nonalcoholic beverages	356	223	198	422	147	353	281
Alcoholic beverages and tobacco	41	19	20	72	8	21	30
Clothing and footwear	128	78	104	319	136	162	132
Housing and utilities	21	17	22	64	18	12	35
Furnishings and household equipment	95	85	91	460	77	83	124
Health	144	112	75	244	51	69	162
Transportation	55	65	47	365	33	29	96
Communication	19	19	16	81	8	12	28
Recreation and culture	49	70	79	336	54	59	96
Education	7	7	7	5	10	11	7
Restaurants and hotels	51	25	45	117	14	20	60
Miscellaneous goods and services	34	56	36	136	22	31	44
Total consumption	**1,000**	**776**	**740**	**2,621**	**578**	**862**	**1,095**
General government	**50**	**50**			**50**	**50**	**50**
Construction	**34**	**34**			**34**	**34**	**34**
Equipment	108	108			108	108	108

Source: ICP Global Office.

phase. Even though the final product specifications differed from one region to another, the regional SPDs were used to identify those products that were most likely to be comparable between regions. In consultation with the ring countries, the global office prepared the final product list for the household consumption products.

As was the case with the regional comparisons, products that were not covered by this process were housing, government consumption, health, and capital goods. Global specifications were prepared for these items and priced by all countries, except those in the CIS, OECD, and Eurostat regions. That meant that the same data were used for both the regional and ring comparisons for Africa, Asia-Pacific, South America, and Western Asia. Ring countries in the Eurostat-OECD region priced the ICP global specifications for the ring comparison.

The number of products specified for the ring comparison and the number actually priced in each region are shown in table 5. (A more detailed description of the ring methodology can be found in chapters 13–15 of the *ICP 2003–2006 Handbook*.)

The following steps were used to compute the global PPPs:

- Basic-heading ring prices for each ring country within a region were converted to a regional price using the regional PPPs. This resulted in five sets of regional prices in each basic heading.
- The CPD method was used to compute five between-region PPPs for each basic heading.
- The between-region PPPs served as scale factors that converted each country's regional PPPs to global, basic-heading PPPs referenced to the U.S. dollar.

Because a single scalar applied to all economies within a region at each level of aggregation, all basic-heading relative comparisons of economies in each region remain the same as they were in the regional calculations.

The next step was to average the global basic-heading PPPs to GDP and major aggregates. The volumes for each basic heading were summed up across all economies within a region to obtain regional total volumes in the numeraire currency. The between-region basic-heading PPPs were aggregated to higher levels using regional relative volumes as weights by the EKS method.

The outcomes were PPPs (and volumes calculated from them) at the basic-heading and aggregate levels that preserved fixity within each region (see below) and could be compared between any pair of economies in the world. (See appendix H, which provides a worked example.)

How Regional Results Compare with the Global Levels

The following two tables provide an example showing how the regional PPPs and all other related measures are calibrated to the global level. Table 6 shows the regional price level indexes (PLIs) (United States = 100) for the published aggregates of the GDP. They are a weighted average of the economy price levels. The regional PLI for each aggregate is the ratio of regional total nominal expenditures (US$) to the regional PPP or real expenditures.

The global PLI at each level of aggregation for each economy within a region is the regional PLI multiplied times each economy's PLI (region = 100), as shown in their respective regional reports. The table shows that the regional PLIs vary considerably across the major aggregates.

Table 7 shows how the regional price level indexes for Asia-Pacific are calibrated to the global level. Note that the PLI for Asia-Pacific's GDP is 41. Table 7 shows the PLIs

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Table 6

Regional price level indexes for each level of aggregation

PRICE LEVEL INDEX U.S. = 100	Africa	Asia-Pacific	CIS	Eurostat-OECD	South America	Western Asia
GDP	46	41	43	99	52	51
Actual individual consumption	46	39	36	98	52	49
Food and nonalcoholic beverages	83	60	55	111	69	62
Alcoholic beverages, tobacco, & narcotics	64	65	37	93	37	49
Clothing and footwear	65	56	91	111	82	60
Housing, water, electricity, gas, & other fuels	30	39	17	92	48	60
Furnishings, household equipment, & maintenance	57	62	67	107	72	54
Health	22	9	15	76	27	19
Transport	89	70	72	123	89	55
Communication	92	35	61	98	58	93
Recreation & culture	77	48	51	107	79	76
Education	15	11	8	67	28	21
Restaurants & hotels	78	73	66	124	71	118
Miscellaneous goods & services	48	46	45	102	54	44

Source: ICP Global Office.

from the Asia-Pacific regional report along with the PLIs at the global level for all economies.

The global PLI for every economy in Asia-Pacific is its regional PLI multiplied by 0.41, which is the overall PLI for the Asia-Pacific region in the global comparison. Similar tables could be generated for every aggregate of the PPP, with PLIs for economies in the regional comparison differing from those in the global report by the scalar shown in table 6. This process ensured that the relative relationship between economies within the region were the same for both the global and regional levels.

Fixity

The relative ranking of economies by GDP, GDP per capita, or any other aggregate depends on the composition of the group of economies being compared, because the inclusion of different economies in the comparison affects the underlying weighting patterns. "Fixity" is the term given to the convention whereby the price and volume comparisons between a group of economies that were established in a comparison covering just that group of economies remain unchanged, or fixed, when the economies of the group are included in comparisons with a wider group of economies.

Fixity is an issue in the 2005 ICP because of the process of regionalization that was adopted for operational purposes. Regionalizing the ICP meant that different product lists were used in each region and that the data-editing processes were carried out independently in each region. Each of the regional coordinating agencies became responsible for producing the results for their respective regions, and each agreed to publish their own results. The rate of progress in different regions varied because of the different types of problems encountered along the way. Applying fixity to the PPPs and expenditure volume estimates for each region has enabled each coordinating agency to publish the results for its region as they became available, knowing that the relative positions of economies in the region would not change as they were combined with the results for other regions around the world. In addition, the fixity of the PPP results is an obligatory requirement for the EU, where PPP-based indicators are used to set and administer policies, which should depend exclusively on the data of EU economies.

TABLE 7

GDP PLI FOR ASIA-PACIFIC

GDP PLI	Global PLIs (United States = 100)	Regional PLIs (Asia-Pacific = 100)
Bangladesh	35	86
Bhutan	36	88
Brunei Darussalam	54	133
Cambodia	31	77
China	42	103
Hong Kong, China	73	180
Macao, China	66	162
Taiwan, China	60	148
Fiji	85	208
India	33	82
Indonesia	41	100
Iran, Islamic Rep.	30	73
Lao PDR	28	69
Malaysia	46	112
Maldives	64	156
Mongolia	35	85
Nepal	32	78
Pakistan	32	79
Philippines	39	97
Singapore	65	159
Sri Lanka	35	86
Thailand	40	97
Vietnam	30	73
Asia-Pacific	41	100

Source: ICP Global Office.

Data Access and Confidentiality

At the request of the ICP Executive Board, the World Bank has developed a policy governing access to detailed ICP data (that is, at the level of basic headings and below). The policy respects the access rules of all participating economies, while at the same time facilitating public access as far as possible. Aggregate results published in paper publications

(such as this one) will also be available electronically; more detailed results will be available only electronically. Access to certain data, such as basic-heading data and below, will be restricted to bona fide researchers. (The full details of the access policy will be provided on the World Bank Web site: www.worldbank.org/data/icp.)

Estimation of PPPs for Nonbenchmark Economies

This section provides estimates of PPP-based GDP per capita for economies not included in the 2005 benchmark surveys. ICP 2005 included 146 economies; at least another 65 economies or territories did not participate for a variety of reasons, including lack of resources or no national interest. Although these nonbenchmark economies account for only a small share of the global economy and population, it is important to include as many of them as possible in a comprehensive database.

Each year, the World Bank includes estimates of PPPs for nonbenchmark economies in its *World Development Indicators* publication and database, relying on an estimating equation using information from the benchmark economies. The following estimating equation (5) was used to impute values for missing economies from the previous round (1993–96) of the ICP:

$$Ln(GDP/cap) = 0.3402 + 0.5851*Ln(GNI/cap) + \quad (5)$$
$$0.2941*Ln(SGER),$$

where GDP/cap is the ICP benchmark estimate of GDP per capita (PPP),

GNI/cap is gross national income (GNI) per capita in US$ estimated by the World Bank Atlas method,

and SGER is the secondary (school) gross enrollment rate.

All three variables are indexed to the corresponding values for the United States (United States = 100). This model was first estimated using the benchmark results from earlier rounds and reestimated when the 1993–96 results became available.

Using the preliminary results from ICP 2005, the model or equation (5) was reestimated to be model or equation (6):

$$Ln(GDP/cap) = .3553 + 0.6994*Ln(GNI/cap) + \quad (6)$$
$$0.2292*Ln(SGER)$$

The fit of the model might be improved by including additional independent variables correlated with factor productivity and wage differentials because of imperfect labor mobility between economies and between trading sectors and nontrading sectors. However, full exploration of various model specifications is beyond the scope of this preliminary exercise, which is intended to replicate the existing method so that other methods can be compared with it.

The above model is used to impute for nonbenchmark economies (the results are shown in table 8). For a small number of economies whose Atlas GNI per capita of 2005 are not available, the model or equation (6) is adjusted to replace GNI/cap with GDP per capita in US$ and is reestimated with all available data in model or equation (7):

$$Ln(GDP/cap\ PPP) = 0.1987 + \quad (7)$$
$$0.7147*Ln(GDP/cap\ US\$) + 0.2422*Ln(SGER)$$

The input data and the reference GDP per capita in US$ are mainly taken from the *World Development Indicators* database (April 2008).

TABLE 8

Estimates of 2005 PPP GDP per Capita for Nonbenchmark Economies

Economy	Estimated GDP per capita (PPP)	Reference GDP per capita (US$)	Economy	Estimated GDP per capita (PPP)	Reference GDP per capita (US$)
Afghanistan	874	291	Myanmar[a,b]	831	220
Algeria	6,011	3,098	Nicaragua	2,611	889
Antigua and Barbuda	14,579	10,481	Palau	13,012	7,197
Bahamas, The[a,b]	23,021	18,421	Panama	8,399	4,791
Barbados[a]	15,837	10,427	Papua New Guinea	1,747	815
Belize	7,290	3,820	Samoa	4,872	2,197
Costa Rica	8,661	4,616	San Marino	41,590	50,008
Dominica	8,576	4,170	Seychelles	14,202	8,717
Dominican Republic	5,173	3,115	Solomon Islands	1,712	635
El Salvador	5,403	2,560	St. Kitts and Nevis	13,677	8,932
Eritrea	685	214	St. Lucia	9,279	5,355
Grenada	9,128	4,772	St. Vincent	6,752	3,242
Guatemala	4,897	2,496	Suriname	7,234	3,928
Guyana	3,232	1,073	Timor-Leste	2,203	359
Haiti	1,175	464	Tonga	5,135	2,162
Honduras	3,266	1,214	Trinidad and Tobago	15,352	11,399
Jamaica	7,132	3,660	Turkmenistan[a]	4,247	1,676
Kiribati	3,377	670	United Arab Emirates[a]	33,487	31,601
Libya	10,804	7,040	Uzbekistan	1,975	558
Marshall Islands	6,206	2,282	Vanuatu	3,477	1,709
Micronesia, Federated States	5,508	2,153	West Bank and Gaza	3,542	1,107

Source: GDP per capita (US$) and GNI per capita (Atlas method) are from the *World Development Indicators* database (April 2008)

a. GDP per capita (PPP) is estimated with model or equation (7). All others are estimated with model or equation (6).

b. GDP per capita (US$) is from *World Economic Outlook* (April 2008). All others are from the *World Development Indicators* database (April 2008).