

## RECENT ADVANCES IN PURCHASING POWER PARITIES

*Review of Purchasing Power Parities of Countries: Recent Advances in Methods and Applications*, edited by D. S. Prasada Rao (Edward Elgar, Cheltenham, UK and Northampton, MA, USA, 2009)

Purchasing power parities (PPPs) are price indices that enable, through deflation, inter-regional, inter-country, inter-area comparisons of goods and services volumes (or even asset stocks) for economic aggregates of policy and research interest.<sup>1</sup> Not surprisingly, the economic aggregate of greatest historical focus in this regard has been gross domestic product (GDP) compiled from the expenditure approach. The long-running International Comparisons Program (ICP) has compiled PPPs to compare GDP volumes between countries for periodic benchmark years starting in 1970.<sup>2</sup> These data, for both total and per capita GDP, are important wherever international comparisons of economic size are relevant, such as evaluating countries' systemic importance in the world economy and, on a per capita basis, making cross-country comparisons of the standard of living. PPPs also have recently acquired significant administrative and operational as well as analytical uses. For example, GDP volume at purchasing power parity now is included in the quota formula used as a guide for assessing member countries' relative position in quota reviews and at the time a member joins the International Monetary Fund.<sup>3</sup>

The ICP has steadily improved in country coverage, and the most recent, 2005 round, has shown a demonstrable improvement not only in coverage, but also in methodological rigor and survey design. The upcoming, 2011 round will incorporate further lessons learned from the 2005 round, building momentum in a virtuous cycle, improving coverage with an expected 160 participating countries, as well as implementing further methodological refinements.

*Note:* The views expressed herein are those of the author and should not be attributed to the IMF, its Executive Board, or its management.

<sup>1</sup>Notwithstanding their usefulness, PPPs are often misunderstood as exchange rates (alternatives to market exchange rates, the observed prices of *currencies* in terms of one another) rather than as *price deflators* for bilateral international ratios of GDP in national currency. This confusion, or at least imprecise terminology, may arise because PPPs have the same dimension as exchange rates (currency A per currency B), but also may be a result of the purchasing power parity *theory*. This theory, dating from 16th-century Spain, posits that exchange rates will adjust to equate the prices of goods and services as a result of international trade. Empirical tests of this theoretical convergence result remain mixed, however, and PPPs are best seen as having a conceptual identity distinct from exchange rates (see, e.g. Rogoff, 1996). The Balassa–Samuelson effect is one explanation for deviations between exchange rates and PPPs (see, e.g. Zalduendo, 2008).

<sup>2</sup>See <http://go.worldbank.org/WLPETUYSO0> for a short history of the ICP.

<sup>3</sup>See pp. 2–4 and box 1 in *Reform of Quota and Voice in the International Monetary Fund: Draft Report of the Executive Board to the Board of Governors* (<http://www.imf.org/external/pp/longres.aspx?id=4235>) for a description of the IMF quota formula.

Acknowledging this progress, the problems and issues in international comparisons are still far from fully understood. *Purchasing Power Parities of Countries*, edited by Prasada Rao, brings the reader to the frontiers of PPP methodology, neatly codifying some significant advances achieved over the last decade or so. The first in this volume of carefully researched and argued papers is the editor's overview, followed by David Roberts' thorough introduction to the survey and computational methodology of the OECD and Eurostat PPP program, one of the five regional components of the ICP and perhaps the longest running continuous regional program. The paper provides a solid grounding in the practical and operational issues facing PPP compilers and the statistical protocols developed to handle them.

The second section covers system approaches to PPP computation. Bert Balk considers the problem of choosing among the several options for PPP computation, first by the number of a set of mathematical axioms or index number "tests" they satisfy, and second by their ability to approximate economic index numbers based on cost-minimizing economic agents. Balk also considers PPP alternatives in the context of the "spanning tree" approach, the spatial analog to index chaining through observed patterns of Hicks and Leontief aggregation for temporal price and volume statistics.<sup>4</sup> He concludes that the often used, non-additive GEKS<sup>5</sup>-Törnqvist and GEKS-Fisher methods "have better credentials than others." Although additive methods fare poorer than non-additive methods because they are subject to the Gerschenkron effect, a type of substitution bias, he judges the venerable Geary Khamis (GK) method least susceptible to this bias. Prasada-Rao's paper analyzes the properties of weighted versions of the GEKS and "country-product dummy" (CPD) methods, including weights determined by the "proximity" indicators underlying the spanning tree methodology. Steve Dowrick's paper uses Afriat's non-parametric (but homothetic) economic index number analysis<sup>6</sup> to assess purchasing power parity bias in exchange rates, as well as the bias of the GK and EKS PPP methods. He concludes that GEKS displays relatively low levels of bias, but that the non-parametric methods are nevertheless computationally feasible for production statistics and thus should be preferred for their rich theoretical interpretation. Itsuo Sakuma, Prasada Rao, and Yoshimasa Kurabayashi offer a new additive method to the inventory of PPP methodologies, based on the existing Kurabayashi-Sakuma method. James Cuthbert takes an angle on the spanning tree approaches by considering the dataset structure of spatial prices and quantities using distance or proximity measures, focusing on two additive classes of PPP methods: generalized GK (with variants: the ordinary GK and the Iklé) and Van Ijzeren (with variants: the ordinary Van Ijzeren, the Standardized Structure [later in the same volume], and the Sakuma-Rao-Kurabayashi [noted above]). Based on the 1985 ICP round, he assesses the differences between

<sup>4</sup>In the temporal context, see, e.g. Allen and Diewert (1981).

<sup>5</sup>Gini-Eltető-Köves-Szulc. The GEKS method makes a set of bilateral parities transitive, meaning that a PPP comparison of two countries through any third country is the same as a direct comparison between the two. GEKS-Törnqvist applies the GEKS technique to a set of Törnqvist bilateral parities, while GEKS-Fisher applies the GEKS technique to a set of Fisher bilateral parities. In general, sets of empirical bilateral parities using superlative index formulas such as Törnqvist and Fisher are not transitive, necessitating a method such as GEKS to impose transitivity.

<sup>6</sup>See Afriat (1981).

these alternative PPP methods using principal components analysis, relating the results to proximity groupings of countries for prices and quantities. He concludes that 93 percent of the difference among the alternative approaches is explained by the first principal component, which he interprets as the Gerschenkron (substitution bias) effect.

The third section focuses on spanning tree methods of PPP computation. Erwin Diewert considers the options for the distance or proximity measures that are essential to the spanning tree approach. After considering a wide array of alternatives against a set of axioms or tests, he settles on what he terms the “asymptotically linear” and “asymptotically quadratic” absolute proximity measures for prices, and weighted versions of the same for quantities. Robert Hill, the originator of the spanning tree approach, examines methods for increasing the stability or robustness of the country by country paths or spanning trees through successive cross-sections of data. He concludes that restrictions can be applied to stabilize spanning trees without seriously compromising the advantages of the approach. Bettina Aten and Alan Heston critique the spanning tree approach, suggesting that in the operational context of the ICP, this approach to PPPs “is not obviously the wave of the future” for global PPP estimates. They grant that spatial chaining may have a role within the regional comparisons into which the global effort naturally organizes, but even so “it may be some time before an acceptable method of chaining within regions is developed.” On the other hand, they see a near term role for chaining (actually, as a single link or limited chain) in adding countries with limited data to a regional comparison and in linking regional comparisons together. Sergey Sergeev closes the section by considering methods for (1) determining a single vector of international prices through which volume comparisons can be made between countries, a variant on the GK approach, and (2) determining a single international share vector that weights quantity comparisons between countries.<sup>7</sup> Both approaches result in additive methods, with (2), the “standardized share” (SS) method, producing results based on 2002 Eurostat data similar to the official GEKS results, but also carrying an additive property the GEKS estimates do not have.

The last section contains three papers dealing with applications of PPP methodology. Michael Ward’s paper considers how PPPs are used for decision making in a wide variety of policy contexts. These contexts are grouped into four areas: national, international, global aggregates, and other uses. The paper by Bart van Ark and Marcel Timmer applies PPP methodology to GDP by production rather than by expenditure to examine differences in total factor productivity between countries, summarizing a rich literature in this field. Finally, Larry Dwyer, Peter Forsyth, and Prasada Rao’s innovative paper uses detailed ICP data to compare the price competitiveness of international tourism destinations.

In closing, the Cuthbert paper makes a useful contribution, aside from its central theme, in taking note of the groupings of related PPP methods, particularly

<sup>7</sup>It can be shown that a system of bilateral Törnqvist parities is transitive if and only if they are constructed by comparing each country’s prices to an international price vector *and* averaging each country’s expenditure shares with an international share vector. The general result, based on functional equations, is in Kokoski *et al.* (1999). For a specific instance of this general result, see Caves *et al.* (1982).

the generalized GK and Van Ijzeren classes. Commenting more broadly on the state of play reflected in selected papers from all of these sections, it is remarkable how much emphasis continues to be placed on additive results in spatial price and volume index comparisons in the wake of the superlative index number developments of the last 35 years.<sup>8</sup> Superlative non-linear index numbers such as the Törnqvist and Fisher are susceptible to contribution-to-change analysis, explaining variations in their levels in terms of variations in their components, without resorting to constraining the underlying aggregator to be additive.

This new collection of papers will be an important reference for economists and statisticians working in the international price comparisons field for some time to come.

Kimberly D. Zieschang  
Chief, Real Sector Division,  
Statistics Department, International Monetary Fund,  
700 19th Street, NW, Washington, DC 20431, USA  
(kzieschang@imf.org).

#### REFERENCES

- Afriat, Sydney N., "On the Constructability of Consistent Price Indices between Several Periods Simultaneously," in Angus S. Deaton (ed.), *Essays in the Theory and Measurement of Consumer Behavior in Honour of Sir Richard Stone*, Cambridge University Press, Cambridge, 133–61, 1981.
- Allen, Robert C. and W. Erwin Diewert, "Direct versus Implicit Superlative Index Formulae," *Review of Economics and Statistics*, 63, 430–5, 1981.
- Caves, Douglas W., Laurits R. Christensen, and W. Erwin Diewert, "Multilateral Comparisons of Output, Input, and Productivity using Superlative Index Numbers," *Economic Journal*, 92(365), 73–86, 1982.
- Kokoski, Mary, Brent R. Moulton, and Kimberly D. Zieschang, "Interarea Price Comparisons for Heterogeneous Goods and Several Levels of Commodity Aggregation," in Alan Heston and Robert E. Lipsey (eds), *International and Interarea Comparisons of Income, Output, and Prices*, National Bureau of Economic Research, 123–69, 1999.
- Rogoff, Kenneth, "The Purchasing Power Parity Puzzle," *Journal of Economic Literature*, 34, 647–68, 1996.
- Zalduendo, Juan, *Bivariate Assessments of Real Exchange Rates using PPP Data*, IMF Working Paper 08/153, available at: <http://www.imf.org/external/pubs/cat/longres.cfm?sk=22064.0>, 2008.

<sup>8</sup>Granted, there exist superlative index numbers that have limited additive features, but additivity in both price and quantity indices remains a severe restriction.