

# PURCHASING POWER PARITIES IN INTERNATIONAL COMPARISONS: QUANTITY vs. PRICE COMPARISONS

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Just as intertemporal price indices have two functions, to measure price changes and to deflate current values to constant values, this is true also for interspatial price indices, purchasing power parities (PPPs). In practice these two functions of PPPs, for conversion and for comparing price levels, are not always distinguished, and this may have some disadvantages since in a number of cases the differences between the two PPPs might be considerable. The authors review the differences in content of the two types of PPPs, and make some suggestions for making the distinction more explicitly.

## A. THE TWO FUNCTIONS OF PRICE INDICES

Prices are tools (weights) for quantity comparisons, and quantities are tools (weights) for price comparisons. In the classical theory of index numbers this interconnection was reflected in the factor reversal principle, the requirement that the product of the quantity and price indices should equal the ratio of the values. The implicit assumption behind the acceptance of this principle is that actual prices, and only actual prices, are used as weights for quantity indices, and actual quantities, and only actual quantities, as weights for price indices.

As recent experience has shown, this assumption is not always justified. For intertemporal measurements a number of authors, and also some international recommendations, have introduced a distinction between deflator price indices and analytical price indices, the first being a tool for quantity measurement, that is for deflation into constant prices, and the second being an aim in itself. However, relatively little attention has been devoted to this kind of distinction in the field of interspatial measurement. Most international comparison studies compile only one price index or purchasing power parity (hereafter PPP), which is used both for the conversion of national aggregates to another currency and as a measure of purchasing power or price level differences.

The authors of the present paper contend that this distinction between price indices as tools for quantity comparisons and price indices with their own analytical value is important and worthwhile for interspatial as well as intertemporal comparisons. The first type of index will be referred to as a convertor PPP, the second as an analytic PPP.

## B. THE PROPERTIES OF CONVERTOR PPPs

The United Nations International Comparison Project (ICP) presents only one set of price indices; these indices are, in our terminology, convertor PPPs.

The method of computation of these indices is entirely subordinated to the requirements of quantity comparisons. It is not in the least our intention to contest the usefulness of these indices; they are very good tools for the conversion of value data expressed in national currency to another currency. What we do want to say is that the same indices are not necessarily the best means of expressing the differences in purchasing power of the currencies being compared. There are several reasons for this.

(i) The field covered by convertor PPPs includes non-market transactions such as consumption from own production and owner-occupied housing; for analytical uses it seems to us that it would be preferable to restrict the coverage of the computation to market transactions only.

(ii) The prices on which the convertor PPPs are based are those used for the valuation of the national aggregates, but they are not necessarily actual prices. For example, in countries where housing is greatly subsidized consumption of dwelling services is valued not by the rents actually paid but by current cost plus consumption of fixed capital, or to put it another way, an imputed price is used. This is the right procedure for quantity comparison, since otherwise the very low rent would lead to a relative understatement of the importance of the quantity of housing. However, imputed prices have no place in an analytical PPP, where the aim is to express the differences between real existing prices and not between those used by statisticians as weights for quantity comparisons.

The difference between convertor PPPs and analytical PPPs is often large. For instance, in the Austria/Poland comparison the zloty/schilling PPPs differed as shown in Table 1.

TABLE 1  
ZLOTY/SCHILLING ANALYTICAL AND CONVERTOR PPPs IN 1975  
FISHER INDICES, ZLOTYS AS A PERCENT OF SCHILLINGS

Commodity Groups	PPP's		Ratio of PPP's: Convertor/ Analytical
	Analytical	Convertor	
Food, beverages and tobacco	119.67	118.39	98.9
Nonfood items, total	103.64	94.51	91.2
Of which:			
Rents	33.17	85.52	257.8
Education	64.96	48.48	74.6
Health care services	101.05	62.33	61.7
Total consumption	109.18	101.80	93.2

(iii) The formula used for convertor PPPs, the value ratio divided by Geary-Khamis quantity indices, was also subordinated to the requirements of quantity comparisons. The quality of these PPPs is not as good as the quantity indices of the ICP; they do not satisfy the additive consistency requirement, and they may even violate the so-called average test, i.e., it may happen that the index for a group may be higher or lower than any of the component subgroup indices. Two examples to illustrate this phenomenon, taken from the ICP Phase II Report [1], are shown in Table 2.

TABLE 2  
EXAMPLES OF THE AVERAGE TEST VIOLATION

1. Netherlands/United States PPPs, 1973		
	Items	PPPs
Government compensation	149-152	2.87
Government commodities	152	3.18
Government total	149-153	3.23
2. India/United States PPPs, 1970		
Clothing	40-47	3.21
Footwear	48-51	3.17
Clothing and footwear	40-51	3.16

### C. GENERAL PROBLEMS OF THE COMPUTATION OF ANALYTICAL PPPs

From what has been said above, the conclusion can be drawn that if purchasing power comparison is the main objective or one of the main objectives of the study, analytical PPPs different from the convertor PPPs are also needed. If convertor PPPs are already available, the computation of analytical PPPs does not require much additional work. What needs to be done is the following:

(a) All non-market transactions need to be deleted from the coverage. For instance, if consumption is the aggregate for which PPPs are to be computed, consumption from own production, owner-occupied dwellings, and various goods and services provided free of charge should all be omitted.

(b) Imputed prices should be replaced by actual prices, wherever imputed prices have been used in the valuation of the aggregates compared. For example, where dwelling consumption was valued at cost for the purposes of the quantity comparison, it should be replaced by rents actually paid.

(c) The quantity-comparison oriented formula should be replaced by a price-comparison oriented formula.

There may be cases where this last adjustment is not needed. In a simple binary comparison using the Fisher formula, there is no need to change the aggregation method since this formula is equally appropriate for price and quantity comparison. However, a typical quantity-comparison-oriented method like the Geary-Khamis formula used in ICP or the Gerardi formula used in the EEC comparisons, or generally speaking any method based on some sort of average prices, must be replaced to serve the requirements of analytic PPP comparisons.

Several price-comparison-oriented aggregation methods are possible. To preserve the transitivity and the additive consistency properties, the natural way to construct price-comparison-oriented PPPs is to use some sort of average quantities as weights for compiling the price indices.

One possibility is to use world or regional average quantities as weights. World total quantities would of course give the same result. This method is in a sense analogous to the Geary-Khamis quantity-measurement-oriented

formula, having the same properties with respect to price-oriented measurement. Thus, this solution might not be considered sufficiently 'neutral', or in the terms of some authors it would be biased, the final results being closer to the results obtained by weighting with the quantities of the large countries than to those obtained by weighting with the quantities of the small countries.

Another possibility would be to use as weights not total quantities but average per capita quantities. This would avoid the large country/small country bias, but not the rich country/poor country bias.

There are, of course, methods that are more neutral and can avoid both of these kinds of bias. One possibility would be the following: As a first step, determine Gerardi-type unweighted geometric average prices for each commodity; next value the quantities in each country by these average prices; then determine the percentage distribution of the value weights obtained for each commodity in each country; and finally average these percentage distributions to obtain a world or regional percentage distribution that can be used as a common weighting system for the PPPs. The averaging would of course be unweighted, as in the quantity-comparison-oriented Gerardi formula.

#### D. SOME SPECIAL PROBLEMS IN THE COMPUTATION OF ANALYTICAL PPPs

##### 1. *The Treatment of Items that are Free in One of the Countries Compared*

Some goods and services have market prices in some countries but are provided free of charge in others. This may cause special methodological problems in analytical PPP comparisons. (In convertor PPP comparisons there are no items with zero prices.) For the sake of simplicity, these problems will be considered here in the context of binary comparisons only.

The first problem is a small technical one, but nevertheless worth mentioning. Where one of the prices is zero, individual price ratios cannot be computed. Formally, of course, it is possible to divide zero by a positive number, giving zero, or a positive number by zero, giving infinity, but these results are not operational and cannot be used for further processing or aggregation. Thus where zero prices exist the usual technical procedure of international comparisons, calculating group PPPs as unweighted averages of the individual price ratios, cannot be used. There is no technical problem, however, if the group indices are calculated using the classical form of index computation as the ratio of  $\sum qp_B$  and  $\sum qp_A$  values. Thus, where there are zero or nearly zero prices, a different technical procedure based on different assumptions is needed, for instance using imputed quantity data.

The second problem is of a more conceptual character. The question can be raised as to whether the items that have zero or almost zero prices will not receive an unduly small weight in the overall index. To clarify this problem, it is useful to consider the problem first in the context of quantity comparisons.

Let us take a very simple example. Two countries, A and B, are to be compared. The total aggregate consists of only two items, housing and furniture. We have both  $q$  and  $p$  data for the two items in the two countries. Housing is

subsidized in both countries, rents covering only one-fourth of total cost, and total cost is considered to be the imputed price. Furniture is not subsidized. The basic data are as follows:

Items	Quantities		Actual Price		Imputed Prices (Costs)	
	Cty. A	Cty. B	Cty. A	Cty. B	Cty. A	Cty. B
Housing	2	1	5	6	20	24
Furniture	1	2	10	5	n.a.	n.a.

Thus, in country A twice as much housing is consumed as in country B, and in Country B twice as much furniture is consumed as in country A. Our task is now to determine in which country *total* consumption is higher. The answer, from a logical point of view, seems to us obvious: if housing has a larger relative importance, then in country A; if furniture has a larger relative importance, then in country B.

If the quantity index computation is made on the basis of actual prices, then country B comes out higher. Let us look at the indices:

$$\frac{\sum q_B p_A}{\sum q_A p_A} = \frac{(1 \times 5) + (2 \times 10)}{(2 \times 5) + (1 \times 10)} = \frac{25}{20} = 1.25$$

$$\frac{\sum q_B p_B}{\sum q_A p_B} = \frac{(1 \times 6) + (2 \times 5)}{(2 \times 6) + (1 \times 5)} = \frac{16}{17} = 0.94$$

$$\text{Fisher formula: } \sqrt{1.25 \times 0.94} = 1.08$$

Thus, total consumption is 8 percent higher in country B than in country A.

This conclusion, however, seems to contradict common sense. Housing has a larger relative importance than furniture, since the society is spending, in terms of costs, much more on it. And if this is true, country A has to come out as having a higher level of total consumption.

This is why, in practice, the ICP and a number of other comparisons value some subsidized items at cost. Using these imputed prices for the quantity index computation, we get the following results:

$$\frac{\sum q_B p_A}{\sum q_A p_A} = \frac{(1 \times 20) + (2 \times 10)}{(2 \times 20) + (1 \times 10)} = \frac{40}{50} = 0.8$$

$$\frac{\sum q_B p_B}{\sum q_A p_B} = \frac{(1 \times 24) + (2 \times 5)}{(2 \times 24) + (1 \times 5)} = \frac{34}{53} = 0.64$$

$$\text{Fisher formula} = \sqrt{0.8 \times 0.64} = 0.72$$

Thus, total consumption is lower by 28 percent in country B than in country A.

So far this problem has been discussed in the context of quantity comparisons. But what about the context of analytical PPP comparisons? Let us consider this on the basis of the same numerical example.

Actual prices in country B are 1.2 times those of country A for housing, but 0.5 times as high for furniture. We know in advance that the overall PPP will be somewhere between 1.2 and 0.5. Which of these it will be closer to depends on the relative importance of housing and furniture. Carrying out the computation in the classical way of price index computation we get the following results:

$$\frac{\sum q_{AB} p_B}{\sum q_{AB} p_A} = \frac{(2 \times 6) + (1 \times 5)}{(2 \times 5) + (1 \times 10)} = \frac{17}{20} = 0.85$$

$$\frac{\sum q_{BA} p_B}{\sum q_{BA} p_A} = \frac{(1 \times 6) + (2 \times 5)}{(1 \times 5) + (2 \times 10)} = \frac{16}{25} = 0.64$$

$$\text{Fisher formula: } = \sqrt{0.85 \times 0.64} = 0.74$$

This result, 0.74, is obviously closer to 0.5 than to 1.2, which shows that in the computation furniture had more relative importance than housing. Should we not reject this result in the same way as in the quantity comparison, saying that housing has a larger relative importance and this should be reflected in the weighting?

We think that we should not do this. We have to accept 0.74 as the right result. The quantity index computations and the price index computations are not completely symmetrical. In the price comparison we are interested in the purchasing power of the currencies, and from this point of view it is irrelevant how much cost is behind the price of a given commodity. It is reality that in country A one can buy two housing units for the price of one furniture unit, and this should be reflected in the computation. To say it another way, from the point of view of purchasing power comparison it is not true that housing has a larger relative importance than furniture in this example.

## 2. *The Distinction Between Transfer Flows and Price Elements*

What the actual price is in the context of (analytic) PPP comparison is not always easy to determine. Let us first take a very simple example: a commodity is entirely free in country A; anyone can obtain this commodity without any payment. In country B, on the other hand, one has to pay for the same commodity let us say five units of 'b' currency. This situation is entirely clear. For PPP comparison the zero price in country A should be compared with 5 in country B.

There are, however, situations that are less clear. Suppose the consumer of country A has to pay a certain amount for the commodity in question—let us assume 3 units of 'a' currency—but then he is entirely reimbursed. Is the price in country A in this case zero, or is it 3? Alternatively, suppose some consumers get the commodity free of charge, while others have to pay for it. For those who have to pay for the commodity, it is clear what the price is, but what is the price for those who get it free of charge? Is it zero, or is it the same as for those who have to pay for it? The share of the population that get the commodity free of charge may be large (for example, only foreigners may have to pay) or it may be small (for example, only disabled or retired persons may get it free).

It is not easy to answer all these questions, not only because the possible variations are very numerous but also because, as it turns out, the concept of purchasing power parity is not unambiguously clear. In fact, PPPs may be used for various purposes, and some of them may require different interpretations from others.

The authors do not go further at present than to draw attention to these open problems. In view of the importance of PPP comparisons, it seems worthwhile to devote further study to this group of questions.

#### REFERENCE

- [1] Kravis, I. B., Heston, A., and Summers, R., *International Comparisons of Real Product and Purchasing Power*, Johns Hopkins University Press, Baltimore, Md., 1978, pp. 107, 92.