ECONOMIC STATISTICS

REFLECTIONS ON PURCHASING POWER PARITIES AND REAL VALUES

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SUMMARY

The article investigates the nature of purchasing power parities and real values in the framework of multilateral international comparisons. It discusses the modification in the definition of these terms in the conditions of multilateral exercises. The relevant properties of these calculations, transitivity and base country invariance are also displayed.

On the basis of these properties, discussion focuses on the term 'numeraire'. Various versions of this 'artificial monetary unit' is presented, that differ in terms of two characteristics: to what extent exchange rates be used and which currency be chosen to derive the numeraire.

KEYWORDS: International comparisons; Purchasing power parities.

In this article special issues of international comparisons in terms of Purchasing Power Parities (PPP) are discussed. These comparisons are often labelled as ICP (International Comparison Project) or ECP (European Comparison Programme). Methods in general of those exercises do not belong to the scope of present investigations as they have been discussed to large extent in the reports of actual comparisons as well as in special studies. The focus of the analysis below is the economic and statistical interpretation of the results.

From among the rich set of numerical information provided by the comparison, two are being considered:

1. purchasing power parities of currencies,
2. real values, i.e. major economic magnitudes, as GDP, expressed in real terms (i.e. in a common currency).

Speaking in general terms, Purchasing Power Parities convert data of national currency into real value. In case of country *J*

$$NATIONAL\ VALUE\ (J)\ \text{x}\ PPP = REAL\ VALUE\ (J) \qquad /1/$$

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Country-to-country (spatial) volume ratios of any two countries (J and K), referred to as volume indices, equal the ratio of the respective real values

$$\frac{REAL\ VALUE\ (J)}{REAL\ VALUE\ (K)} = VOLUME\ INDEX\ (J/K) \qquad\qquad /2/$$

In this paper, however, less attention is paid to volume indices, as their interpretation is not exposed to the ambiguities discussed in connection to PPP and real value.

1. Basic and modified interpretation

A generally accepted interpretation of Purchasing Power Parity is the following: a given sum of money, when converted into a different currency at PPP rate, will buy the same basket of commodities in one country as in another one. This simple and transparent interpretation, however, undergoes some modifications in multilateral comparison systems, especially in those carried out in the framework of international groupings (e.g. EU, OECD). In these systems a set of consistency criteria are set against multilateral aggregation schemes. Authors as well as actual exercises differ in number and composition of the desired properties, in the present context it is sufficient to mention two of them: transitivity and base country invariance.

Transitivity requires that each index, whether a price or quantity one, should be a number on a continuous scale, one that will meet comparisons between the indexes of members of any group of countries:

$$INDEX\ (J/K) = INDEX\ (J/L)\ /\ INDEX\ (K/L) \qquad\qquad /3/$$

Base country invariance means that it makes no difference for the volume ratios which country is chosen as the base. It makes the system *neutral* in the sense that none of the countries get any privilege in the calculations.

Transitivity requirement is met if the same price system is used all throughout the comparison. To satisfy base country invariance, it is necessary to introduce an international average price system. This (in most cases implicit) price system means that the weighting pattern of the volume indices corresponds to an average of all participating countries. In this way PPP is no longer a parity between two currencies, but parity between a currency and the international average.

This is the reason why the initial interpretation of PPP as given above shall be modified in the following way: when the expenditure of different countries is converted into a common currency by means of PPP, it is expressed in the same set of international prices.

There are a considerable number of aggregation schemes that meet the two criteria, transitivity and base country invariance. From among them *Geary-Khamis* (*GK*) and *Éltető-Köves-Szulc* (*EKS*) formulae are of the broadest (almost exclusive) use. Both have been discussed in comparison reports and other studies, it is therefore sufficient to give a short reminder here. The *GK* method consists of a linear equation system with $N+M$ variables and equations, N being the number of items, M the number of participating countries. Its most relevant variable in the present context is $PPP_{GK}(J)$, the parity between national currency of country J and the international price system. *EKS* is a compound

average parity $PPP_{EKS}(J/K)$, that makes the parity of two countries J and K depend – in addition to direct binary ratio – also on all indirect ratios through all participating countries ($J/L : K/L$, with $L=1,...,M$).

2. Numeraire

International average prices, discussed in the previous section, need a numeraire, i.e. an actually existing currency. Due to base country invariance the choice of the numeraire does not effect the relative position of the countries in terms of volume ratios, but PPPs, real values and their interpretation depend on the choice. Several variants of choice or creation of numeraire have been in use so far. They can be presented in terms of two characteristics.

– Do exchange rates have to do with the numeraire or not?
– Is the currency of a participating country used or not?

By the combination of these characteristics, three variants can be described.

1. No exchange rate – country numeraire. In this variant the numeraire country and base country are the same. This has been the case in 'European Comparison Programme – Group 2' with Austria as base country and the Schilling as numeraire. PPPs can be understood as real parities between national currencies and the numeraire (e.g. Bulgarian Leva to Austrian Schilling). But this Schilling constitutes the unit of an international price system expressed in Schilling.

A substantial property of this scheme is the following: the overall GDP of the base country is the same in national currency as in international price system. Let us label this property as 'Equality of Totals' (ET). It is valid for the overall figure, but not necessarily for the positions of the breakdown (consumption, capital formation etc.).[2]

Real values of participating countries – in accordance with formula /1/ – are expressed in the currency of the base country (in our example Schilling), but in terms of international price system. As in formula /2/ the ratio of these real values for any two countries produces volume index.

2. Exchange rate – international numeraire. In this scheme no base country is chosen. The function of a base country is transferred to the total and the average of the participating countries. Such a procedure fits to comparisons carried out in the framework of a community. It is, indeed, the European Union practice where this method is used.

Instead of a base country, the numeraire is a sort of combination of the currencies. In the case of EU this the ECU. Since however the purchasing power of this currency exists only as the combination of the purchasing power of other currencies, the only way to get an international numeraire is by the use of exchange rates. The ECU in real terms is called Purchasing Power Standards (PPS).

In other words, parities are expressed in an arbitrary unit, the Purchasing Power Standard. PPS is defined in such a way that for each individual aggregate the EU total (EU15)

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[2] In the case of *EKS* yes, in the case of *GK* not.

– obtained from converting the values in national currencies with the PPP – is equal to
the EU total for that individual aggregates in ECU.

Consequently, ET property is met at the level of countries' total and average, so that
the EU15 figures are the same in terms of nominal values (national currencies converted
by exchange rates) and in real values (converted by PPP).

$$EU15^{ECU} = EU15^{PPS} \text{, but } COUNTRY\ J^{ECU} \neq COUNTRY\ J^{PPS} \qquad\qquad /4/$$

As an illustration, the following examples of the 1996 EU comparison demonstrate
equalities and inequalities relating to per capita GDP:

EU15	18 113 ECU, (18 113 PPS)
Denmark	26 185 ECU, (21 342 PPS)
Spain	11 736 ECU, (14 068 PPS)

In this version the use of exchange rate seems to be unavoidable, nevertheless it does
not fit the philosophy of the comparison project, the basic idea of which is getting rid of the
exchange rates. (This drawback becomes more explicit in connection with the next variant.)
Fortunately this use of exchange rates does not affect the comparison of volumes.

3. Exchange rate - country numeraire. The third type is a kind of a hybrid of the two
variants discussed above. Similarly to the second one, no base country, rather the total
and average of all the countries serve as basis. However, the currency of one of the
countries is chosen as numeraire. This has been the procedure of the comparison carried
out by OECD, with US dollar as numeraire.

The procedure starts by converting all price and expenditure data to US dollars in
terms of exchange rates and further calculations are made with these converted figures.
OECD total is obtained by the sum of exchange rate converted national data. ET property
is valid at countries' total, as in the previous version, i.e. (not in terms of US and USD).

The dissociation of base and numeraire leads to a sort of ambiguity. There is a set of
real values expressed in international prices, the numeraire of which is dollar, but the
data differs from USD. It is rather hard to find a proper label for this peculiar interna-
tional currency. It could be 'dollar', as its numeraire is USD. But the overall purchasing
power of this 'dollar' differs from the purchasing power of the numeraire. It could be
'international currency', as it actually is, but such a label does not express the magnitude
of the numeraire. 'International dollar' seems to be closer to the properties of this unit,
but it is still misleading. My choice is therefore 'OECD dollar', as a working term and an
analogy to PPS in the EU practice. (Despite the fact that it has never been called so by
OECD.) So in the following formulae

– USDN shall indicate nominal values in dollars, calculated with the help of ex-
change rates (in the case of US the national currency),
– USDR shall mean real values in US dollars,
– OED shall label real values in OECD dollars as defined above.

$$OECD28^{USDN} = OECD28^{OED} \neq OECD28^{USDR}$$
$$USA^{USDN} = USA^{USDR} \neq USA^{OED} \qquad\qquad /5/$$
$$COUNTRY\ J^{USDN} \neq COUNTRY\ J^{USDR} \neq COUNTRY\ J^{OED}$$

Some illustrative examples taken from the 1996 OECD comparison:

	GDP per capita			Ratio (USDR/OED)
	USDN	USDR*	OED	
OECD28	21 903	19 900	21 903	0.907
USA	27 831	27 831	30 694	0.907
Denmark	33 229	23 100	25 521	0.907
Spain	14 892	15 300	16 822	0.907
Hungary	4 431	9 300	10 281	0.907

* Rounded to 100 $, except for the US.

So the drawback of this procedure is the difficulty in interpreting the ten percent difference between the purchasing power of the international currency (OED) and the purchasing power of the numeraire (both being 'dollar'). The ratio USD/International price is the same for each country, but different by headings for example:

	USDR/OED
GDP	0.907
Private final consumption	0.870
Government final consumption	1.135
Gross fixed capital formation	0.875

3. Concluding review of the variants

Three variants of numeraire, real value and purchasing power parity have been put forward. The following table provides an overview on their differences and similarities in terms of the following characteristics.

1. Actual comparison in 1996.
2. The numeraire.
3. The base country or group of countries, at the level of which the 'Equality of totals' property is met.

	Exchange rate *no*	Exchange rate *yes*
Country numeraire	1. European 'Group 2' 2. ATS 3. Austria	1. OECD 2. USD 3. OECD total (OECD28)
International numeraire		1. EU 2. ECU (PPS) 3. EU total (EU15)

The lower left box is empty. Symmetry would require filling it, but – for the time being – there is no exercise with international numeraire where an exchange rate is not used. Perhaps when EURO enters the comparison systems?