

Purchasing power parities – measurement and uses

by Paul Schreyer and Francette Koechlin

How does one compare economic data between countries that is expressed in units of national currency? And in particular, how should measures of production and Gross Domestic Product (GDP) be converted into a common unit? One answer to this question is to use market exchange rates. While straightforward, this turns out to be an unsatisfactory solution for many purposes – primarily because exchange rates reflect so many more influences than the direct price comparisons that are required to make volume comparisons. Purchasing Power Parities (PPPs) provide such a price comparison and this is the rationale for the work of the OECD and other international organisations in this field (see chart 1). The OECD publishes new sets of benchmark PPPs every three years, drawing on detailed international price comparisons. Every time a new set of benchmark PPPs is released, this also gives rise to a new set of international comparisons of levels of GDP and economic welfare.

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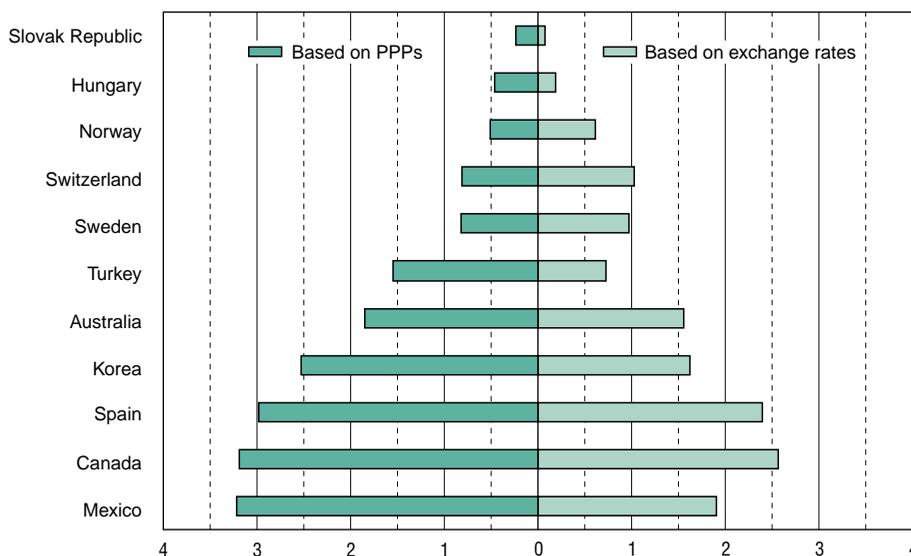
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What are PPPs?

In their simplest form, PPPs are price relatives, which show the ratio of the prices in national currencies of the same good or service in different countries. A well-known example of a one-product comparison is *The Economist's* BigMacCurrency index, presented by the journal as "burgernomics", whereby the BigMac PPP is the conversion rate that would mean hamburgers cost the same in America as abroad.

Chart 1. **Size of economies**

Percentage share of total OECD GDP, 1999, selected countries



Source: OECD, Purchasing power parities 1999 benchmark results, 2002.

The OECD-Eurostat PPPs, however, are not only calculated for individual products, they are also calculated for product groups and for each of the various levels of aggregation up to and including GDP.

The purpose is similar: to obtain rates of currency conversion that eliminate the differences in price levels between countries and so permit volume comparisons.

The calculation of PPPs is undertaken in three stages: first, at the product level, then, at the product group level, where the price relatives are averaged to obtain unweighted PPPs for the group. Finally, at the aggregation levels, the PPPs are weighted and averaged. The weights used in this last stage are the expenditures on the product groups. All this is described in much more detail in the OECD publication *Purchasing Power Parities and Real Expenditures- 1999 Benchmark Year*.

PPP's are spatial price comparisons, and in many ways similar to the better-known price comparisons over time.

Comparisons over time often face the problem of changing products and consumption patterns, especially when the years of comparison are remote. Somewhat similar, a great challenge with spatial comparisons is that volumes or prices of sometimes very different economies have to be compared. Goods and services and their prices that are characteristic in one country may be uncharacteristic in another one, and yet common ground has to be found to make meaningful comparisons.

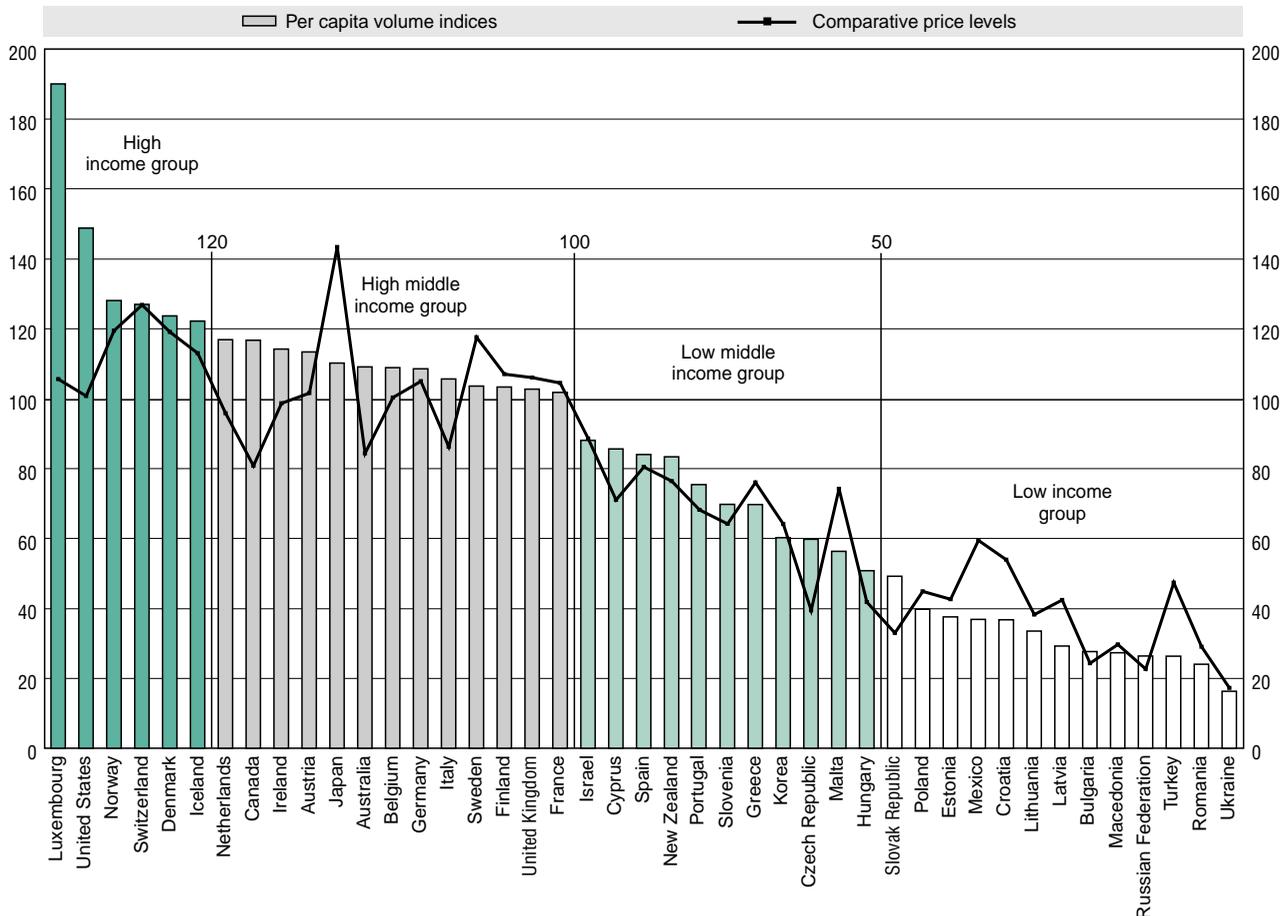
Who uses them?

The main users of PPPs are widely perceived to be the international organisations, such as Eurostat, the International Monetary Fund, the OECD, the United Nations and the World Bank, and this was undoubtedly so when PPPs first became available. Now, however, there is a growing demand for PPPs from a variety of national users.

International organisations, government agencies, universities, research institutes and journalists use PPPs

Chart. 2. Per capita GDP and comparative price levels

1999, OECD 30 = 100



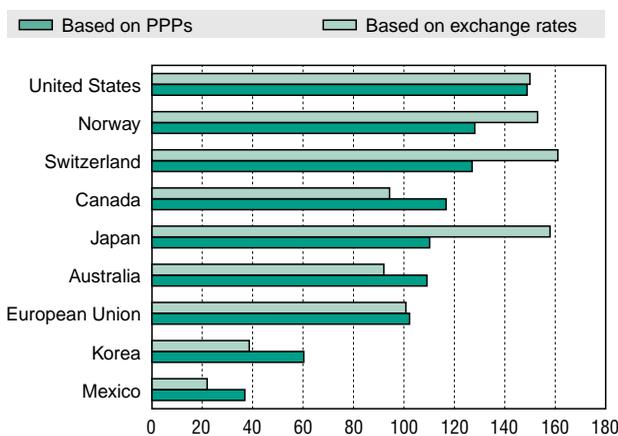
Source: OECD, Purchasing power parities 1999 benchmark results, 2002.

as inputs into economic research and policy analysis requiring comparisons between countries. In such studies, PPPs are employed either as currency converters to generate volume measures with which to compare levels of economic performance, economic growth, overall productivity or as measures of price convergence and competitiveness.

Public enterprises and private firms employ PPPs as currency converters for the purposes of comparative analysis involving prices, sales, market shares and production costs. Banks tend to use PPPs to estimate equilibrium exchange rates, while individuals often use them in salary negotiations when moving from one country to another.

One particularly important usage occurs with the European Commission. Over 25 per cent of its total budget is spent on the Structural Funds, the overall aim of which is to gradually reduce economic disparities between and within EU Member States. The allocation of the bulk of the funds is made on the basis of PPP-converted GDP per capita.

Chart 3. **Two measures of GDP per capita**
1999, OECD 30 = 100



Source: OECD, Purchasing power parities 1999 benchmark results, 2002.

Measuring economic welfare

One of the most frequent uses of PPPs is in the computation of GDP and GDP per capita across countries. Although GDP per capita has often been criticised as an incomplete statistic of economic well-being, it remains a cornerstone indicator of economic performance of individual countries. Policy and analytical interest in this indicator goes a long way to explain the importance of PPPs as a statistical tool.

1. OECD 30 refers to all 30 Member countries of the OECD.
2. Luxembourg remains a somewhat special case due to its large share of transfrontier workers: while contributing to GDP, they do not figure as part of the resident population.

It is to be noted in passing that market exchange rates are particularly ill-suited for comparisons of living standards. This emerges from the fact that exchange rates tend to exhibit large swings over short periods of time, implying rapid shifts of living standards between countries which cannot possibly have occurred. Thus, OECD comparisons of GDP per capita are typically based on PPPs.

To summarise GDP per capita results, OECD often uses four country groups. Using groups instead of a country-by-country ranking avoids possibly misleading interpretations (see box “Ranking may be misleading”) when indices are clustered around a small range of results. For example, the 1999 benchmark comparison yielded the composition of income groups (country indices are based on OECD 30 = 100¹, which corresponds to an average of USD 21 500 per capita) as shown in chart 2.

The 1999 results provide some telling examples for the differences between PPP-based and exchange rate based comparisons (see chart 3). Consider per capita GDP for Japan, Norway or Switzerland relative to the OECD average. When based on exchange rates, income per person would appear to exceed that of the United States. However, when PPPs are used, these countries’ per capita GDP turns out to be lower than that of the United States. This is because price levels are higher in these countries than in the United States. When the price level effect is removed, the volume of goods and services purchased in the United States is higher, on a per capita basis, than in any other country included in the comparison except Luxembourg².

Generally, the gap between high-income and low-income countries narrows when PPPs are used instead of exchange rates. Thus, the per capita indices based on PPPs of Mexico, Greece, Hungary, Poland, Portugal, Turkey and the Russian Federation are closer to those of the United States than are their per capita indices based on exchange rates. Again, this is because the price levels in these countries are low compared to richer countries.

Measuring the size of economies

PPPs are also a tool to measure the relative size of economies. On the basis of each country’s GDP as a percentage of total GDP of all countries considered, the ten largest economies covered by the comparison are the United States, Japan, Germany, France, Italy, United Kingdom, the Russian Federation, Mexico, Canada and Spain. It is also confirmed that the 15 European Union (EU) countries as a group are virtually the same economic size as the United States.

Generally, there is a marked difference in determining the size of economies, depending on whether exchange rates or PPPs are used to compare GDP data: the discrepancy is in particular present in the group of low income countries. For example, on an exchange rate basis, the Russian Federation corresponds to less than one per cent of total GDP in the OECD area. Corrected for differences in the price level, this number rises to 3.5 per cent.

Measuring productivity

Although GDP per capita comparisons command significant interest among analysts, they are not the only pertinent statistic based on PPPs. One other useful indicator that also requires PPP-based volume comparisons of output is the level of labour productivity, i.e., output per employed person. Estimates of relative productivity

Ranking may be misleading

When countries are clustered around a very narrow range of outcomes, it may be misleading to use the per capita volume index based on PPPs to establish a strict order of ranking. As is often the case with statistical information, there is a level of uncertainty associated with the data sources and procedures on which PPP computations rely. Relatively minor differences in the measured per capita GDP can result in a different country order that may not be statistically or economically significant.

As an example, consider the table below with GDP per capita indices for the EU countries in 1999, and the corresponding ranking. Suppose there is a 1 per cent rise in the index for one country, say Austria. With all other countries' GDP per capita index unchanged, this would change Austria's

position from rank 5 to rank 4. Or, by the same argument, Germany's position would shift from 7 to 6.

What is important is the observation that as small a difference as 1 per cent in results can yield quite different rankings when countries are as similar as for example the large economies of the EU. In fact, ranks change easily within the group of *high-middle income* countries and it would, for example, be difficult to attribute economic significance to the difference in the ranks of Sweden, Finland, the United Kingdom, Italy, or France. At the same time, those EU countries that are part of the *high-income* group clearly keep their position, as do those EU countries that are part of the *low-middle income* group.

GDP per capita 1999

| EU 15 = 100 | Index | Rank |
|---------------------------|-------|------|
| <i>High income</i> | | |
| Luxembourg | 186 | 1 |
| Denmark | 121 | 2 |
| <i>High-middle income</i> | | |
| Netherlands | 114 | 3 |
| Ireland | 112 | 4 |
| Austria | 111 | 5 |
| Belgium | 107 | 6 |
| Germany | 106 | 7 |
| Italy | 103 | 8 |
| Sweden | 101 | 9 |
| Finland | 101 | 9 |
| United Kingdom | 101 | 9 |
| France | 100 | 12 |
| <i>Low-middle income</i> | | |
| Spain | 82 | 13 |
| Portugal | 74 | 14 |
| Greece | 68 | 15 |

Sources: OECD, *National Accounts of OECD Countries*, 2002.

levels provide insights into the possible scope for further gains in productivity and competitiveness and also place a country's growth experience in the perspective of its current level of income and productivity. For inter-country comparisons of levels of labour productivity, PPPs are indispensable: by definition, a measure of productivity has to put a *volume* measure of output in proportion to a volume measure of inputs. Converting the value of output into a common currency by applying exchange rates would seriously hamper the goal of capturing volume indicators of production.

In the table below, PPPs and volume measures of GDP are used to compare relative labour productivity measures across countries. When these productivity indices are put next to their GDP per capita counterparts (also based on PPPs), considerable differences become apparent. They point to differences in labour utilisation and demographic structures (and possibly statistical issues concerning the measurement of labour input) and have been used extensively in analytical studies, such as the *OECD Growth Project* (see page 8, "*The New Economy: Beyond the Hype*").

Comparing price levels

Another key statistic derived from PPP measures is comparative price levels or the ratio between PPPs and current exchange rates. If PPPs and exchange rates coincide, it can be concluded that, on average, one unit of a currency buys as much in the country under considera-

tion as it does in the reference country. When PPP exceed exchange rates, it can be concluded that one unit of the currency under consideration buys less domestically than on other markets and vice versa.

The price level effect is particularly visible in countries with low income per capita: there, exchange rates often exceed PPP rates by a substantive margin, indicating a comparatively low price level. Partly, this is due to the economic importance of non-traded goods and services that are bought relatively cheaply in low-income countries. It has long been noted that there is a positive correlation between comparative price levels and GDP per capita: the richer a country, the higher its relative price level tends to be, and vice versa. The 1999 results confirm this observation. In Chart 2, the line depicting comparative price levels follows quite closely the sequence of bars that represent GDP per capita indices. Overall, it can be concluded that an exchange rate based comparison will yield widely understated measures for volume GDP and income in international comparison.

Inter-temporal comparisons: using current or constant PPPs

So far, PPPs have been discussed as currency conversion rates *for a given point in time* – they provide a snapshot of relative prices. Expenditure on GDP data converted by PPPs provide a snapshot of relative volumes in that particular year. For many analytical purposes, it is

From GDP per Inhabitant to Labour Productivity
Selected OECD countries, 1999, expressed at 1999 benchmark PPPs

| Country | GDP per capita | GDP per person employed |
|----------------|----------------|-------------------------|
| USA = 100 | | |
| Australia | 73 | 78 |
| Canada | 78 | 81 |
| France | 68 | 87 |
| Germany | 73 | 81 |
| Italy | 71 | 97 |
| Japan | 74 | 72 |
| Mexico | 25 | 32 |
| United Kingdom | 69 | 74 |
| United States | 100 | 100 |

Source: OECD, *National Accounts of OECD countries*, 2002; OECD, *Labour Force Statistics*, 2001.

Current and constant PPPs: what the OECD publishes and recommends

The OECD has followed a two-way strategy concerning the choice between benchmark and extrapolation results for international comparisons.

First, in *National Accounts of OECD Countries, Volume 1*, the OECD publishes time series based on both current and constant PPPs. The accompanying text recommends GDP per capita data based on constant prices and PPPs for comparisons over time. Thus, these data answer a question such as: *'How has the relative position of a country's GDP per capita changed, given its measured growth performance?'*

Current (benchmark) PPPs are put forward as the appropriate tool to compare GDP levels for the latest period available, as they reflect the most recent and most relevant price structure. These data respond to the question: *'What is a country's position in terms of GDP (per capita), given the most recent set of international prices?'*

Second, the OECD has to deal with the fact that benchmark PPPs are available for the European OECD countries on an annual basis – provided by Eurostat - but on a three-yearly basis only for other OECD countries. There is thus a choice of presenting benchmark PPPs only at three-year intervals and thereby losing valuable information for many

European countries or of producing estimates for intermediate years for non-European countries. The OECD has followed the latter option. Estimates on intermediate years are one-year extrapolations backwards or forward to benchmark years. Of course, these estimates are only necessary for those countries that are not covered by Eurostat's annual benchmark exercise. Currently, the PPP comparisons published in the *OECD Main Economic Indicators* reflect this method.

Further, the OECD has to decide how to update the latest benchmark results. To date, the latest available benchmark year for all countries is 1999. PPP series for 2000 and 2001 are obtained by extrapolating on the basis of relative price indices for GDP. From a conceptual point of view, extrapolating PPPs from 1999 onwards and applying them to GDP data is tantamount to expressing this GDP data in 1999 constant prices and constant PPPs.

Lastly, it should be noted that there is full consistency of current PPPs between the data published by Eurostat and by the OECD for European countries. Differences may occur when publication dates are different or due to small differences in GDP or population data.

of interest to observe the evolution of volume GDP between countries *and* over time. There are at least two ways of setting up such a comparison, each with its specific interpretation and use.

The first possibility of combining spatial and temporal observations is by using a sequence of current or 'benchmark' PPPs, i.e., a new set of price data compiled in Member countries, weighted and aggregated to yield rates of currency conversion for total GDP and its expenditure components. This means that prices and price structures are allowed to vary over time. Comparable volume levels of GDP are obtained by applying these current PPPs to GDP measures at current national prices. Within a given year, (spatial) comparisons between countries are straightforward – volumes are measured with the same price structure. Comparisons over time, however, incorporate several effects: relative volume changes, changes in relative prices between countries and, possi-

bly, changes in definitions and methodologies. One can also say that by carrying out this calculation for every period, GDP comparisons across countries are based on *current international prices*.

A second approach to generate time series of PPPs is to fix a 'base' year and to extrapolate PPPs for other years. Extrapolation is done by applying the relative rates of inflation observed in different countries to the base year PPPs. Consider a simple two-country example and suppose that PPPs in year 1 are equal to 1: one currency unit of country A buys, on average, the same amount of goods and services as one currency unit in country B. Now assume that, between the two periods, the price level of GDP in country A rises by 20% whereas, on average, prices in country B remain unchanged. PPPs are then extrapolated by applying a ratio of $120/100=1,2$ to the initial PPP. Thus, extrapolated PPPs for year 2 are $PPP \text{ of year } 1 * 1,2 = 1,2$.

GDP series in national currency and at current prices can now be converted with these PPPs to yield volume measures that are comparable across countries. The resulting measures of GDP comparisons are volume indices at *constant prices and PPPs*. The same result would have been achieved by applying volume growth rates of GDP to the comparative GDP levels of the base year.

Whichever way they are calculated, these time series have a very convenient property: they replicate exactly the relative movements of volume GDP growth of each country. While such a characteristic facilitates the use and interpretation of PPPs over time, it shares an important drawback with other indices that use a fixed base: the assumption that price *structures* do not change over time. Economic reality has it, however, that *relative* prices do change over time and it is well known that ignoring these shifts over longer periods can generate a biased picture of economic developments. Another consequence of fixing price structures at a base year is the dependence of results on the choice of the base year.

The key conceptual difference between using current and constant PPPs is that the former capture changes in volume as well as changes in relative prices, whereas the latter only capture volume changes. Even if the volumes of goods and services remain identical over time, a GDP comparison based on current PPPs may change over time if prices and price structures shift. This factor comes into play when some countries are large producers and exporters of products with marked price changes, as has been the case for Norway as an important exporter of oil.

Another source of differences between the two approaches is methodological changes between successive rounds of

price collection. For example, the introduction of the 1993 *System of National Accounts* brought with it changes in product classification that affected PPP computations. While such changes help to improve comparability across countries once they are put in place, they also reduce comparability with observations before their introduction and a break in series occurs. Sometimes, simple changes in price collection methodologies have similar effects and reduce inter-temporal comparability. The OECD is currently analysing the impact of certain breaks in series on overall results.

There may also be differences in the ways in which statistical offices construct implicit price indices for their GDP series. Such differences will directly influence the extrapolated PPP measures and so account for some of the observed differences between GDP based on current and constant PPPs.

Even when there is no change in methods, systematic methodological differences exist. For example, price changes of exports and imports in the national accounts are based on import and export price indices. For PPP evaluations, export and import price ratios between countries are simply measured as bilateral exchange rates. Also, price comparisons in the PPP programme treat products as identical even when they are sold at different locations or at different types of outlets. National accounts principles foresee that products delivered in different locations should be treated as different qualities even if they are otherwise physically identical. Lastly, simple measurement errors can enter the picture. Such measurement errors may be due to small samples and due to the difficulty of comparing like with like across countries.

Glossary

Comparative price levels: These are defined as the ratios of PPPs to exchange rates. They provide a measure of the differences in price levels between countries by indicating for a given product group the number of units of the common currency needed to buy the same volume of the product group in each country. For example, in 1999, a given volume of GDP costs on average 106 dollars in the United Kingdom, 68 dollars in Portugal and 143 dollars in Japan. In other words, the general price level of Japan is higher than that of the United Kingdom and of Portugal.

Equilibrium exchange rate: Long-term exchange rate that equals the PPP of a currency in a world where all goods are traded and where markets are fully efficient. Such convergence, proposed by the 'PPP theory of exchange rates' would imply that the same price levels should be observed across countries.

Gross domestic product – Expenditure based: Total final expenditures at purchasers' prices (including the f.o.b. value of exports of goods and services), less the f.o.b. value of imports of goods and services.

OECD PPPs

- **PURCHASING POWER PARITIES AND REAL EXPENDITURES – 1999 BENCHMARK YEAR**, OECD (forthcoming 2002). The detailed results for purchasing power parities and real expenditures contained in this paper publication cover 43 countries including the 30 OECD Member countries, the 13 European Union candidate countries, Israel and the Russian Federation. They are based on price and expenditure data for 1999 and have been calculated using the EKS aggregation method. International comparisons of price levels and real GDP can be made using the price and volume measures presented in this publication.
- Main Economic Indicators (monthly), “Purchasing power parities, Comparative price levels”, OECD. Available on paper and electronically (CD-ROM and on line at www.SourceOECD.org).
- National Accounts of OECD Countries, volume 1: Main Aggregates, “Comparative tables based on PPPs”. Available on paper and electronically (CD-ROM and on line at www.SourceOECD.org).

Data and more information on PPPs are also available free of charge at: www.oecd.org/std/ppp.

Further information

- R. Dornbusch (1987), “Purchasing Power Parity”; in Eatwell et al. (eds.), *The New Palgrave: A Dictionary of Economics*.
- OECD (2001), “The New Economy: Beyond the Hype”, Paris.
- D. Pilat and P. Schreyer (2002), “Measuring Productivity”, OECD Economic Studies No 33, 2001/2 for a discussion.

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