

CHAPTER 1: INTERNATIONAL COMPARISONS OF GDP

Introduction

- 1.1. The Eurostat-OECD PPP Programme was established in the early 1980s to compare on a regular and timely basis the GDPs of the Member States of the European Union and the Member Countries of the OECD. This remains the purpose of the Programme, although its coverage has been broadened to include countries that are not members of either the European Union or the OECD. These are either countries that have applied to join the European Union or countries of the former Soviet Union and the former Yugoslavia with which Eurostat and the OECD have programmes of technical cooperation in statistics. Annex I gives a brief history of the Programme.
- 1.2. The objective of the Programme is to compare the price and volume levels of GDP and its expenditure components across the countries participating in it. Before such comparisons can be made, it is first necessary to express the GDPs – which are in national currencies and valued at national price levels - in a common currency at a uniform price level. To do this, Eurostat and the OECD use purchasing power parities because, as will be demonstrated later, these, and not exchange rates, are the currency converters that provide the internationally comparable price and volume measures required.
- 1.3. This chapter sets out the background to the international comparisons of GDP organised by Eurostat and the OECD.

Gross domestic product (GDP)

- 1.4. GDP is the sum of the value added generated by producers residing in the economic territory of a country during the accounting period. By comparing a country's GDP over time, it is possible to measure changes in economic growth, overall productivity and, when placed on per capita basis, economic welfare or well-being. But it is a summary measure. For example, it says nothing about the distribution of income within a country. Nor does it show whether growth is the result of increased spending on defence or police or increased spending on education or health. In addition, the coverage of GDP is continually being debated. For instance, should it include housework and other forms of "household production" and should it be reduced because of environment deterioration and the depletion of sub-soil assets.
- 1.5. Still, there tends to be a strong positive correlation between what is measured by the GDP and other measures of economic and social welfare both over time and across socio-economic groups. Wealthier usually means healthier, better educated and a less inequitable income distribution. It is for this reason that GDP continues to receive the attention of

politicians, policy-makers, economists, journalists and the general public. Arguments similar to those in the previous paragraph can be employed to question the usefulness of comparing the GDPs of different countries. Despite these, GDP is still the aggregate used most frequently to represent the economic size of countries and, on a per capita basis, the economic welfare of their residents.

- 1.6. GDP per head has its limitations as a summary measure of economic welfare. Not only does it cover the goods and services that resident households consume to satisfy their individual needs, it also includes services, such as defence, police and fire protection, that government produces to meet the collective requirements of the community, as well as gross capital formation and net exports neither of which constitute final consumption. An alternative measure is the aggregate called "actual individual consumption"¹. This comprises only the goods and services that households actually consume to satisfy their individual needs. It covers all such goods and services irrespective of whether they are purchased by the households themselves or are provided as social transfers in kind by government and non-profit institutions serving households. Eurostat-OECD comparisons are organised so that both the GDP and the actual individual consumption of participating countries can be compared.
- 1.7. GDP can be estimated using three alternative approaches which, in theory, yield the same result. These can broadly be described as: the production approach – which sums all the value added generated by the country's resident institutional sectors² during the accounting period; the expenditure approach – which sums all the final expenditures incurred by the country's resident institutional sectors during the accounting period; and the income approach – which sums all the factor incomes paid by the country's resident institutional sectors engaged in domestic production during the accounting period. Price and volume comparisons of GDP are based on the identity: value = price x volume. The values of income aggregates, unlike the values of production and expenditure aggregates, cannot be split into meaningful price and volume components. Price and volume comparisons of GDP can only be made from the production side or the expenditure side.

Eurostat-OECD approach

- 1.8. Eurostat-OECD comparisons are made from the expenditure side which identifies the components of final demand: consumption, investment and net exports. The reasons for this are: the inherent usefulness of making comparisons from the expenditure or demand side; the difficulties of organising comparisons from the production or supply side which require data for both intermediate consumption and

gross output; and the generally better comparability among countries of their detailed breakdowns of final expenditure on GDP. The disadvantage of the expenditure approach is that, although it enables levels and structures of consumption and investment to be compared, productivity comparisons can be made only at the level of the whole economy. Individual industries are not identified on the expenditure side. To compare productivity at the industry level, international comparisons of GDP have to be made from the production side.³

- 1.9. Values of final expenditure on GDP are made up of two components: price and volume. Comparing the expenditure values of countries will not provide a comparison of the volumes of goods and services purchased in countries unless the price level differences that exist between them have been eliminated. This is exactly the same problem faced in making comparisons over time for a single country where changes in values due to price movements are removed by using a “constant” set of prices. Differences in price levels between countries can be removed either by observing the volumes directly or by deriving them indirectly using a measure of relative prices to place the expenditures of all the countries on the same price level. Prices are easier to observe than volumes and direct measures of relative prices usually have a smaller variability than direct measures of relative volumes. Eurostat-OECD comparisons estimate volumes indirectly.
- 1.10. International volume comparisons of GDP depend on four conditions being met. These are:
- the definition of GDP is the same;
 - the measurement of GDP is the same;
 - the currency unit in which GDP is expressed is the same; and
 - the price level at which GDP is valued is the same.

GDP estimates of countries participating in Eurostat-OECD comparisons generally meet the first condition as they are compiled in line with one of the two complementary international systems of national accounts: the SNA 93⁴ or the ESA 95⁵.

- 1.11. The measurement of GDP is not sufficiently uniform over all participating countries to satisfy the second condition. In particular, the GDPs of countries with large non-observed economies⁶ are underestimated. Obtaining exhaustive estimates of GDP from all participating countries has to be a long-term goal. To this end, Eurostat has worked successfully over the last twenty years with EU Member States to improve the comparability of their GDP estimates. While more recently, the OECD has published a

handbook⁷ that provides national accountants with guidelines on how to measure the non-observed economy. It draws heavily on the experience of Eurostat among others.

- 1.12. The third condition of a common currency unit is not met other than by the twelve countries in the Euro Zone. The GDP estimates of the majority of participating countries are expressed in different national currencies. Nor is the fourth condition met as the GDP estimates of participating countries are valued at national price levels. To meet these last two conditions it is necessary to have conversion rates that both convert to a common currency and equalise the purchasing power of different currencies in the process of conversion. Such conversion rates are called “purchasing power parities” or “PPPs”. Eurostat-OECD comparisons are made using PPPs.

Exchange rates

- 1.13. Exchange rates had to be used to make international comparisons of GDP before PPPs became available. Exchange rates provide GDP estimates that satisfy the third condition of being expressed in the same currency unit. But they do not provide GDP estimates that satisfy the fourth condition of being valued at the same price level.
- 1.14. Exchange rates are determined by the supply and demand for different currencies. And the supply and demand for currencies are influenced by factors such as currency speculation, interest rates, government intervention and capital flows between countries rather than by the currency requirements of international trade. Moreover, many goods and services, such as buildings, all government services and most market services, are not traded internationally. For these reasons, exchange rates do not reflect the relative purchasing powers of currencies in their national markets as has sometimes been postulated in international trade theory.⁸
- 1.15. Consequently, as explained in Box 1.1, GDPs of countries converted to a common currency using exchange rates reflect not only differences in the volumes produced in the countries, but also differences in the price levels of the countries. In other words, though shown in the same currency, they remain valued at national price levels. As such, they are *nominal* measures and measures of value. PPPs, on the other hand, are conversion rates that are both currency converters and price deflators. Therefore, as shown in Box 1.1, GDPs of countries converted to a common currency using PPPs are also valued at a uniform price level. They reflect only differences in the volumes of goods and services produced in countries. As such they are *real* measures and measures of volume.

Box 1.1: Exchange rates or PPPs

1. The ratio of the GDPs of two countries when both GDPs are valued at national price levels and expressed in national currencies has three component ratios:

$$GDP\ ratio = price\ level\ ratio \times volume\ ratio \times currency\ ratio\ (or\ exchange\ rate) \quad (1)$$

2. When converting the GDP ratio in (1) to a common currency using exchange rates – that is, by dividing through by the currency ratio – the resulting GDP_{XR} ratio remains with two component ratios:

$$GDP_{XR}\ ratio = price\ level\ ratio \times volume\ ratio \quad (2)$$

The GDP ratio in (2) is expressed in a common currency, but it reflects both the price level differences and the volume differences between the two countries.

3. A PPP is defined as both a currency converter and a spatial price deflator. It comprises two component ratios:

$$PPP = price\ level\ ratio \times currency\ ratio\ (or\ exchange\ rate) \quad (3)$$

4. When converting the GDP ratio in (1) to a common currency using a PPP – that is, by dividing through by (3) – the resulting GDP_{PPP} ratio has only one component ratio:

$$GDP_{PPP}\ ratio = volume\ ratio \quad (4)$$

The GDP ratio in (4) is expressed in a common currency, is valued at a uniform price level, and reflects only volume differences between the two countries.

5. When the GDPs of two countries are valued at national price levels but expressed in a common currency, as, for example, in the Euro Zone, the GDP ratio still has three component ratios one of which, the currency ratio, equals 1:

$$GDP\ ratio = price\ level\ ratio \times volume\ ratio \times currency\ ratio\ or\ 1$$

Similarly, the PPP still has two component ratios:

$$PPP = price\ level\ ratio \times currency\ ratio\ or\ 1$$

But, as the currency ratio equals 1, the PPP is, in effect, simply a spatial price deflator.

1.16. Box 1.2 gives a clear example of why PPPs rather than exchange rates should be used for international comparisons of volume. It shows the GDPs of the United States and Japan expressed as a percentage of the GDP for the fifteen countries that were members of the European Union prior to 2004 – the “EU 15” – for the benchmark years 1985, 1990, 1993, 1996 and 1999. There are two sets of percentages: one based on exchange rate converted data, the other based on PPP converted data. It also gives the average annual volume growth rates for five periods: 1985-99, 1985-90, 1990-93, 1993-96 and 1996-99.

1.17. It appears from the exchange rate converted data that in 1985 the GDP of the United States was 44 per cent larger than that of the EU 15, whereas the PPP converted data indicate that the two economies were of comparable size. When comparing Japan and the EU 15, the exchange rate converted data suggest that the GDP of Japan was almost half that of the EU 15, while the PPP converted data show it to be just over a third. Similar large and mainly contrary differences between the two sets of percentages also exist for 1990, 1993, 1996 and 1999. Exchange rate converted data are generally misleading on the relative sizes of economies.

Box 1.2: GDPs of the United States and Japan as a percentage of the GDP of the EU 15 in 1985, 1990, 1993, 1996 and 1999; average annual volume growth rates for 1985-99, 1985-90, 1990-93, 1993-96 and 1996-99

Percentage with exchange rate converted GDPs	1985	1990	1993	1996	1999
- EU 15	100	100	100	100	100
- United States	144	84	93	88	108
- Japan	47	44	62	53	53
Percentage with PPP converted GDPs	1985	1990	1993	1996	1999
- EU 15	100	100	100	100	100
- United States	102	100	102	103	105
- Japan	36	39	41	41	36
Average annual volume growth rates	1985-99	1985-90	1990-93	1993-96	1996-99
- EU 15	2.3	3.1	0.7	2.2	2.7
- United States	3.2	3.2	1.7	3.5	4.3
- Japan	2.6	4.9	1.5	2.0	0.4

Exchange rates overstate the size of economies with relatively high price levels and understate the size of economies with relatively low price levels. This is demonstrated in Box 1.3.

- 1.18. The average annual volume growth rates for the period 1985-99 show that the economy of the United States grew faster than that of the EU 15. Yet from the exchange rate converted data, it appears that the GDP of the United States fell from being 44 per cent larger than that of the EU 15 in 1985 to being only 8 per cent larger in 1999. The PPP converted data show a change in the relative sizes of the two economies that broadly reflects their differing growth rates. For the period 1993-96, the average annual volume growth rates for Japan and the EU 15 were much the same. Yet the exchange rate converted data show Japan's GDP relative to that of the EU 15 as having fallen from 62 per cent to 53 per cent. The PPP converted data reflect the fact that the GDPs of Japan and the EU 15 grew at similar rates. The changes in the relative sizes of the three economies over the five periods as measured by exchange rate converted data are not consistent with their relative growths for the same periods, whereas the changes as measured by PPP converted data are.
- 1.19. An additional problem with exchange rates is that they are often subject to violent fluctuations. This

means that countries may appear to become suddenly "richer" or "poorer" even though in reality there has been little or no change in the relative volumes of goods and services produced. It is the volatility of exchange rates, and not the fact that they do not correct for difference in price levels between countries, that is sometimes perceived as their weakness when making international comparisons of GDP. Fluctuations are avoided by using moving averages of exchange rates to convert GDP to a common currency.⁹

- 1.20. Box 1.4 illustrates that the use of moving averages will not provide a more credible picture. Like Box 1.2, it shows the GDPs of the United States and Japan expressed as a percentage of the GDP of the EU 15 for the benchmark years 1985, 1990, 1993, 1996 and 1999. There are two sets of percentages, both based on GDPs converted using moving averages of exchange rates – three-year moving averages and five-year moving averages. When compared with the average annual volume growth rates in Box 1.2, neither set seems any more economically plausible than the set of percentages derived using the exchange rates for a single year that is shown in Box 1.2. Averaging exchange rates over several years dampens their fluctuations, but does not bring them any closer to PPPs.

Box 1.3: Comparative price levels and indices of nominal and real GDP 1999

Country	Comparative price levels	Nominal GDP (%)	Real GDP (%)	Nominal GDP per head	Real GDP per head
Denmark	120	2.1	1.7	146	122
Sweden	119	2.9	2.4	121	102
Finland	108	1.5	1.4	110	101
Luxembourg	107	0.2	0.2	199	186
United Kingdom	107	17.1	15.9	108	101
Germany	106	24.6	23.1	113	107
France	105	16.8	15.9	105	100
Austria	103	2.4	2.4	114	111
Belgium	101	2.9	2.9	108	107
Ireland	100	1.1	1.1	112	112
Netherlands	97	4.7	4.8	111	115
Italy	87	13.8	15.8	90	104
Spain	81	7.1	8.6	67	82
Greece	77	1.5	1.9	52	69
Portugal	69	1.4	1.9	50	74
EU 15	100	100	100	100	100

- Comparative price levels are the PPPs divided by exchange rates. The indices of nominal GDP and nominal GDP per capita are based on exchange rate converted data. The indices of real GDP and real GDP per capita are based on PPP converted data.
- When the comparative price level is above 100, the indices of nominal GDP and nominal GDP per capita are higher than the indices of real GDP and real GDP per capita. When the comparative price level is below 100, the indices of nominal GDP and nominal GDP per capita are lower than the indices of real GDP and real GDP per capita. The indices of nominal GDP are especially misleading on the relative sizes of the economies of the United Kingdom, France and Italy.
- The differences between the per capita indices of nominal and real GDP are even more marked. There are changes in ranking - some quite significant as in the case of Sweden and Italy. The relative difference between countries also changes. The gap between high income countries and low income countries is much smaller with the per capita indices of real GDP.

Box 1.4: GDPs of the United States and Japan as a percentage of the GDP of the EU 15 in 1985, 1990, 1993, 1996 and 1999

Percentage when three-year moving averages of exchange rates are used to convert the GDPs	1985	1990	1993	1996	1999
- EU 15	100	100	100	100	100
- United States	132	88	89	91	111
- Japan	48	49	58	56	53
Percentage when five-year moving averages of exchange rates are used to convert GDPs	1985	1990	1993	1996	1999
- EU 15	100	100	100	100	100
- United States	123	88	88	93	113
- Japan	47	50	57	55	53

Purchasing power parities (PPPs)

1.21. In their simplest form PPPs are nothing more than price relatives that show the ratio of the prices in national currencies of the same good or service in different countries.¹⁰ For example, if the price of a hamburger in France is 2.84 euros and in the United States it is 2.20 dollars, the PPP for hamburgers between France and the United States is 2.84 euros to 2.20 dollars or 1.29 euros to the dollar. In other words, for every dollar spent on hamburgers in the United States, 1.29 euros would have to be spent in France to obtain the same quantity and quality – or volume - of hamburgers.¹¹ To compare the volumes of hamburgers purchased in the two countries, either the expenditure on hamburgers in France can be converted to dollars by dividing it by 1.29 or the expenditure on hamburgers in the United States can be converted to euros by multiplying it by 1.29.

1.22. PPPs are not only calculated for individual goods and services, they are also calculated for product groups and for each of the various levels of aggregation up to and including GDP.¹² The calculation is made in three stages. The first is at the product level, where price relatives are calculated for individual goods and services. The second is at the product group level, where the price relatives calculated for the products in the group are averaged to obtain unweighted PPPs for the group. And the third is at the aggregation levels, where the PPPs for the product groups covered by the aggregation level are weighted and averaged to obtain weighted PPPs for the aggregation level. The weights used to aggregate the PPPs in the third stage are the expenditures on the product groups. In principle, it would be desirable to weight the price relatives within product groups, but the expenditure data required to do this are not available generally.

1.23. PPPs are still price relatives whether they refer to a product group, an aggregation level or to GDP. It is just that in moving up the hierarchy of aggregation the price relatives refer to increasingly complex assortments of goods and services. Thus, if the PPP for GDP between France and the United States is 0.97 euros to the dollar, it can be inferred that for every dollar spent on the GDP in the United States, 0.97 euros would have to be spent in

France to purchase the same volume of goods and services. Purchasing the “same volume of goods and services” does not mean that identical baskets of goods and services will be purchased in both countries. The composition of the baskets will vary between countries and reflect differences in tastes, cultures, climates, price structures, product availability and income levels, but both baskets will, in principle, provide equivalent satisfaction or utility.

1.24. PPPs are defined throughout this manual as being both currency converters and spatial price deflators as this is the definition that applies for the majority of countries participating in Eurostat-OECD comparisons. When countries share a common currency, as do the twelve countries of the Euro Zone, there is no need to convert to a common currency and, as explained in Box 1.1, PPPs can be defined simply as spatial price deflators. This definition also applies to PPPs calculated for regions within a country. It is important to recognise that having the same currency does not necessarily mean having the same price level. PPPs are still required. Whether or not they actually effect a currency conversion is secondary to their expressing expenditures of different countries (or different regions) at a uniform price level.

Price and volume measures

1.25. PPPs are used to convert national final expenditures¹³ on product groups, aggregates and GDP of different countries into real final expenditures. The final expenditures are called “real” because, as explained earlier, in the process of being converted to a common currency, they are valued at a *uniform price level* and so reflect only differences in the volumes purchased in countries. They are the spatial equivalent of a time series of GDP for a single country expressed in *constant prices*. PPPs and real final expenditures provide the price and volume measures required for international comparisons. The PPPs and real final expenditures for GDP are undoubtedly the most important, but the PPPs and real final expenditures below the level of GDP are also useful in their own right. With them international comparisons of price and volume levels can be made for product groups and aggregates as well as for GDP

1.26. Box 1.5 shows estimates of final expenditure on GDP at national price levels in national currencies for the EU 15¹⁴, the United States and Japan in 1999. It also shows the estimates after they have been converted to real final expenditures and the PPPs used to convert them.

1.27. Three sets of indices have been derived using these data, the population data and the exchange rates, namely:

- *Indices of real final expenditure:* These are measures of volume. They reflect the relative magnitudes of the product groups or aggregates being compared. At the level of GDP they are used to compare the economic size of countries.
- *Indices of real final expenditure per head:* These are standardised measures of volume. They reflect the relative levels of the product groups or aggregates being compared after adjusting for differences in the size of populations between countries. At the level of GDP they are often used to compare the economic well-being of populations.
- *Comparative price levels:* These are 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 or aggregate the number of units of common currency needed to buy the same volume of the product group or aggregate in each country.¹⁵ At the level of GDP they provide a measure of the differences in the general price levels of countries.

1.28. The indices have the EU 15 as reference or base country - that is, the EU 15 = 100. But they are not affected by the choice of reference country and can be rebased on the United States or on Japan. The method used by Eurostat and the OECD to calculate and aggregate PPPs provides PPPs that are invariant to the country, or group of countries, chosen as base country. The base country serves

as a point of reference only. The PPPs are also transitive. Transitivity is the property where the direct PPP between each pair of countries is equal to the indirect PPP derived via any third country. For example, in the case of the three countries A, B and C, the ratio of the PPP between A and B and the PPP between C and B is equal to the PPP between A and C – or, $PPP_{A/B} / PPP_{C/B} = PPP_{A/C}$.

Nominal value measures

1.29. If exchange rates are used instead of PPPs, the estimates of final expenditure on GDP at national price levels in national currencies from Box 1.5 for the EU 15, the United States and Japan are converted to the nominal final expenditures in Box 1.6.

1.30. Although these nominal final expenditures are expressed in a common currency, the euro, they are still valued at *national price levels* and continue to reflect the differences in price levels between the EU 15, the United States and Japan. They are the spatial equivalent of a time series of GDP for a single country expressed in *current prices*. Nominal final expenditures give rise to two sets of indices, namely: *indices of nominal final expenditure* and *indices of nominal final expenditure per head*. The indices are measures of value. They are not measures of volume and should not be used as such.¹⁶

Users and uses of PPPs

1.31. 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. This was undoubtedly so when PPPs first became available. But now there is a growing demand for PPPs from a variety of national users. These include government agencies, universities, research institutes, public enterprises, private firms, banks, journalists and individuals.

Box 1.5: Price and volume measures for the EU 15, the United States and Japan, GDP, 1999

	EU 15	United States	Japan
Final expenditure on GDP at national price levels in national currencies (billions)	8018.5	9206.9	512530
Population (millions)	376.9	273.0	126.7
Exchange rate (1 euro = units of national currency)	1.00	1.07	121
PPPs for GDP (1 euro = units of national currency)	1.00	1.09	177
Real final expenditure on GDP at a uniform price level in euros (billions)	8018.5	8446.7	2895.7
Indices of real final expenditure on GDP (EU 15 = 100)	100	105	36
Real final expenditure per head on GDP at a uniform price level in euros	21275	30940	22855
Indices of real final expenditure per head on GDP (EU 15 = 100)	100	145	107
Comparative price levels of GDP (EU 15 = 100)	100	102	146

Figures have been rounded.

1.32. International organisations, government agencies, universities and research institutes use PPPs 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 welfare, consumption, investment, economic growth, overall productivity and government expenditure on defence, police, health, education, etc., or as price measures with which to compare price levels, price structures, price convergence and competitiveness. Journalists used PPPs in both these ways in their commentaries on economic and social policy.

1.33. Public enterprises apply PPPs when comparing their prices and operating costs with those of similar public enterprises in other countries. Private firms operating in different countries apply PPPs for the purposes of comparative analysis involving prices, sales, market shares and production costs. Banks employ PPPs in economic analysis and in the monitoring of exchange rates. Individuals often refer to PPPs in salary negotiations when moving from one country to another (as do the personnel managers with whom they are negotiating).

1.34. International organisations also use the real final expenditures generated by PPPs for statistical purposes. The real final expenditures on GDP and its component expenditures are aggregated across countries to provide totals for groups of countries, such as the Euro Zone, the European Union and the OECD. Country shares in these totals are used as weights when non-additive economic indicators, such as price indices or growth rates, are combined to obtain averages for groups of countries.

1.35. With one exception, PPPs are not used by international organisations to calculate member countries' contributions or to assess their eligibility for aid grants or access to loans on favourable terms. The exception is the European Commission. Some 30 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 regional GDP per capita.¹⁷

Limitations of price and volume measures

1.36. GDP and GDP per head are often used to rank countries by economic size and economic welfare. But neither the indices of real final expenditure on GDP nor the indices of real final expenditure per head on GDP should be used to establish a strict ranking of countries. Instead, they are best used to assign countries to groups with similar GDP per head as, for example, those in Box 1.7. Likewise, comparative price level indices can be used to rank countries by their general level of prices, but here too countries with similar price levels should be grouped together, as they are in Box 1.7, rather than ranked strictly.

1.37. PPPs are statistical constructs rather than precise measures. While they provide the best available estimate of the size of a country's economy, of the economic well-being of its residents and of its general price level in relation to the other countries in the comparison, they are, like all statistics, point estimates lying within a range of estimates – the "error margin" – that includes the true value. The error margins surrounding PPPs depend on the reliability of the expenditure weights and the price data as well as to the extent to which the particular goods and services selected for pricing by participating countries actually represent the price levels in each country. As with national accounts data generally, it is not possible to calculate precise error margins for PPPs or for the real final expenditure levels and comparative price levels derived from them.

1.38. At the level of GDP, a broad - and arbitrary - rule of thumb is that differences between countries in their indices of real final expenditure, real final expenditure per head and comparative price levels need to be at least five percentage points to be considered as statistically significant. At the level of the main aggregates, error margins are larger and differences in indices of real final expenditure, real final

Box 1.6: Measures of nominal value for the EU 15, the United States and Japan, GDP, 1999

	EU 15	United States	Japan
Final expenditure on GDP at national price levels in national currencies (billions)	8018.5	9206.9	512530
Population (millions)	376.9	273.0	126.7
Exchange rate (1 euro = units of national currency)	1.00	1.07	121
Nominal final expenditure on GDP at national price levels in euros (billions)	8018.5	8604.6	4235.8
Indices of nominal final expenditure on GDP (EU 15 = 100)	100	107	53
Nominal final expenditure per head on GDP at national price levels in euros	21275	31519	33432
Indices of nominal final expenditure per head on GDP (EU 15 = 100)	100	148	157

Figures have been rounded.

expenditure per head and comparative price levels will also need to be larger to be statistically significant. Below the level of the main aggregates, error margins are compounded by differences in the national classifications used by participating countries in their national accounts. Because the margins of error increase as the level of aggregation gets lower, neither Eurostat nor the OECD publish results of their comparisons below a certain level of detail.

- 1.39. Comparative price levels at the level of GDP allow the general price levels of countries to be compared with that of a reference country. A value over 100 indicates a higher general price level, a value under 100 indicates a lower general price level. Comparative price levels at the level of GDP also indicate the degree to which a country's exchange rate reflects its general price level in relation to the general price level of the reference country. A value over 100 indicates that the exchange rate understates the general price level, a value under 100 indicates that the exchange rate overstates the general price level. This is not the same as saying a currency is undervalued or overvalued.
- 1.40. Although PPPs appear in international trade theory in the context of equilibrium exchange rates - that is, the underlying rates of exchange to which actual exchange rates are assumed to converge in the long term¹⁸, the PPPs discussed here are not relevant for this purpose as they do not refer solely to domestically-produced tradable goods and services valued at export prices. They have been calculated specifically to enable international price and volume comparisons to be made for GDP and its component expenditures. As such, they refer to the entire range of *final* goods and services which make up

GDP as a whole including many items, such as buildings and government services, that are not traded internationally. In addition, except for net foreign trade, they are valued at *domestic* market prices and are calculated using expenditure weights that reflect *domestic* demand.

- 1.41. Indices of real final expenditure on GDP provide a "snapshot" of the relative volume levels of GDP among participating countries for a given point in time or reference year. When placed side by side, the indices of consecutive reference years appear to provide a "moving picture" of relative GDP volume levels over the years. This apparent time series of volume measures is actually a current price time series showing the combined effect of changes in relative price levels and changes in relative volume levels. Within each reference year, the indices are at a uniform price level, but the level of the uniform price level changes from reference year to reference year. As a result, the rates of relative growth derived from the indices are not consistent with those obtained from the constant price estimates of GDP of countries.
- 1.42. To trace the evolution of relative GDP volume levels between countries over time, it is necessary to select one of the reference years as a base year and to extrapolate its relative GDP volume levels over the other years. Extrapolation is done by applying the relative rates of GDP volume growth observed in the different countries. This provides a time series of volume indices at a constant uniform price level that replicates exactly the relative movements of GDP volume growth of each country. Underlying this method is the assumption that price structures do not change over time. But it is an economic fact of life that relative prices do change

Box 1.7: Summary results for the 43 countries covered in the 1999 Eurostat-OECD comparison

Indices of real GDP per head (EU 15 = 100)	
High income group (120 and above)	Denmark, Iceland, Luxembourg, Norway, Switzerland and United States
High middle-income group (100 - 119)	Australia, Austria, Belgium, Canada, Finland, France, Germany, Ireland, Italy, Japan, Netherlands, Sweden and United Kingdom
Low middle-income group (50 - 99)	Cyprus, Czech Republic, Greece, Hungary, Korea, Israel, Malta, New Zealand, Portugal, Slovak Republic, Slovenia, Spain
Low income group (less than 50)	Bulgaria, Croatia, Estonia, Latvia, Lithuania, FYROM, Mexico, Poland, Romania, Russian Federation, Ukraine and Turkey
Comparative price levels (EU 15 = 100)	
High price level group (110 and above)	Denmark, Iceland, Japan, Norway, Sweden and Switzerland
Medium-high price level group (90 - 109)	Austria, Belgium, Finland, France, Germany, Ireland, Luxembourg, Netherlands, United Kingdom and United States
Medium-low price level group (60 - 89)	Australia, Canada, Cyprus, Greece, Israel, Italy, Korea, Malta, Mexico, New Zealand, Portugal, Slovenia and Spain
Low price level group (less than 60)	Bulgaria, Croatia, Czech Republic, Estonia, Hungary, Latvia, Lithuania, FYROM, Poland, Slovak Republic, Romania, Russian Federation, Turkey and Ukraine

over time and, if such changes are ignored over long periods, a biased picture of the relative economic developments of countries can result. The choice of base year can also influence the picture that emerges.

1.43. Price convergence among EU Member States is of special interest to the European Commission in the context of competition policy and consumer protection. Comparative price levels provide a means of observing the movement of price levels over time, but they have to be used with caution. First, except within the Euro Zone, they are influenced by exchange rate fluctuations. Second, independently of exchange rates, they are volatile. This is generally so at lower levels of aggregation where sample sizes are small. Usually such volatility diminishes, if not disappears, with aggregation. Volatility particularly arises when the basket of goods and services to be priced changes from one benchmark survey to another in order to accommodate market developments. For example, in this respect, the basket for food and non-alcoholic beverages is relatively stable, while that for clothing and footwear is altered substantially each time it is surveyed. Volatility of this type also diminishes with aggregation. Even so, comparative price levels for even higher level aggregates can still appear to jump when there is a change in benchmark prices. For these reasons, comparative price level indices should be used to monitor price convergence only at higher levels of aggregation and, then, only over periods

covering at least two survey cycles – that is, six or more years¹⁹.

1.44. The comparative price levels of household final consumption expenditure are sometimes used to measure the differences in the cost of living between countries. This is correct to the extent that they indicate whether the overall price level for consumer goods and services faced by the average household in one country is higher or lower than the overall price level for consumer goods and services faced by the average household in another country. Households or individuals considering moving from one country to another for reasons of employment, retirement or even a holiday should exercise caution when attempting to infer from these measures of overall price levels how the change of country will affect their cost of living. The comparative price levels of household final consumption expenditure reflect the expenditure pattern of the average household which in all likelihood is very different from that of the household or individual contemplating the move. Also, the comparative price levels are national averages and they do not reflect differences in the cost of living between specific locations such as London and Paris or the Côte d'Azur and the Costa del Sol.

1.45. The “dos and don’ts” with regard to the use of the PPPs, comparative price level indices and volume indices generated by Eurostat-OECD comparisons are summarised in Box 1.8.

Box 1.8: Using the results of Eurostat-OECD comparisons

Recommended uses	<ul style="list-style-type: none"> To make spatial volume comparisons of GDP (size of economies), GDP per head (economic welfare), GDP per hour worked (labour productivity); To make spatial comparisons of comparative price levels; To group countries by their volume index of GDP per head and/or their comparative price levels of GDP.
Uses with limitations	<ul style="list-style-type: none"> To analyse changes over time in relative GDP per capita and relative prices; To analyse price convergence; To make spatial comparisons of cost of living; To use PPPs calculated for GDP and its component expenditures as deflators for other values as, for example, household income.
Not recommended uses	<ul style="list-style-type: none"> As precise measures to establish strict rankings of countries; As a means of constructing national growth rates; As measures to generate output and productivity comparisons by industry; As measures to undertake price level comparisons at low levels of aggregation; As indicators of the undervaluation or overvaluation of currencies; As equilibrium exchange rates.

- ¹ This concept, or its equivalent, has been used in international comparisons of GDP based on PPPs since the 1950s. It was not until the 1990s that it was adopted by national accountants and included in the international system of national accounts.
- ² These are non-financial corporations, financial corporations, general government, households and non-profit institutions serving households.
- ³ Paragraph I.3 of Annex I provides further information about international comparisons of GDP made from the production side.
- ⁴ *System of National Accounts 1993*, Commission of the European Communities, International Monetary Fund, Organisation for Economic Co-operation and Development, United Nations, World Bank, 1993.
- ⁵ *European System of Accounts 1995*, Eurostat, Luxembourg, 1996.
- ⁶ The non-observed economy comprises activities that are hidden because they are illegal or because they are legal but carried out clandestinely or because they are undertaken by households for their own use. It also covers activities that are missed because of deficiencies in the statistical system. Such deficiencies include out-of-date survey registers, surveys having too high reporting thresholds or high rates of non-response, poor survey editing procedures, no surveying of informal activities such as street trading, etc.
- ⁷ *Measuring the Non-Observed Economy – A Handbook*, Organisation for Economic Co-operation and Development, International Labour Organisation, International Monetary Fund, Statistical Committee of the Commonwealth of Independent States, Paris, 2002.
- ⁸ The theory of purchasing power parity in international economics, at least in its simplest form, suggests that national price levels converted to a common currency using exchange rates should be equal. Arbitrage will ensure that the price of an individual good will be the same in all countries in which it is traded – the law of one price. Hence, when the individual goods are taken together, there will be high correlation in general price levels – at least in the medium and long term. Underlying the theory are the assumptions that all goods are internationally tradable; that the goods sold in one country, if not identical, are at least acceptable substitutes for the goods sold in other countries; that tariffs, VAT, transport costs, trade margins and the like do not create price differences between countries; and that the demand and supply for currency is driven entirely by international trade in goods.
- ⁹ The “World Bank Atlas method” consists of converting the gross national income (GNI) of countries to US dollars with a three-year average of exchange rates adjusted for inflation. As well as showing GNIs per capita converted to US dollars with exchange rates, the Atlas also shows GNIs per capita converted to US dollars with PPPs. It states that “PPP are most appropriate for comparing levels of welfare, which is why they are used in measuring global poverty. Valuations based on exchange rates better measure the tradable value of a country’s output and a country’s relative importance in the global economy.” *World Bank Atlas*, 36th edition, World Bank, Washington, 2004.
- ¹⁰ A well-known example of a one product PPP is that underlying the BigMacCurrency index of *The Economist*. Presented by the journal as “burgernomics”, the BigMac PPP is defined as “the exchange rate that would mean hamburgers cost the same in America as abroad”. The PPPs calculated by Eurostat and the OECD include hamburgers but also the prices of several hundred other goods and services. As might be expected, “burgernomics” provides a poor guide to overall price levels as measured by the Eurostat-OECD PPP Programme.
- ¹¹ The link between quantity, quality and volume is explained in paragraphs 16.11 and 16.12 of the 1993 SNA.
- ¹² For example, from *hamburgers to restaurant services*, from *restaurant services to catering services*, from *catering services to catering and accommodation services*, from *catering and accommodation services to individual consumption expenditure by households* and from *individual consumption expenditure by households to GDP*.
- ¹³ Final expenditures valued at national price levels and expressed in national currencies.
- ¹⁴ By convention the euro is the “national” currency for the EU 15. As only twelve Member States use the euro as their national currency, the GDPs of Denmark, Sweden and the United Kingdom, which are in kroner, kronor and pounds sterling respectively, have first to be converted into euros using exchange rates before being added to the GDPs of the other twelve countries to obtain GDP for the EU 15 in euros.
- ¹⁵ From the PPPs in Box 1.5, it can be seen that if a given volume of GDP costs 100 euros in the EU 15, it costs 109 US dollars in the United States and 17,700 yen in Japan. To compare these prices, it is first necessary to express them in a common currency by converting them to euros using the exchange rates in Box 1.5. The comparative price levels so derived show that if a given volume of GDP costs 100 euros in the EU 15, it costs 102 euros in the United States and 146 euros in Japan. In other words, the general price level of the EU 15 is only marginally lower than that of the United States, but considerably lower than that of Japan.
- ¹⁶ But still they are. Analysts, who, if comparing the GDP of a country in different time periods, would have no hesitation in first adjusting for price movements between the two periods before making the comparison, still persist in assuming that the GDPs of different countries converted at exchange rates provide volume measures directly without the need to make adjustments for price level differences between countries. Yet price level differences between countries can be considerably larger than changes in price levels between different time periods in the same country (as the comparative price levels in Box 1.7 indicate) and lead to flawed analysis and inappropriate policy recommendations. See, for example, “The IPCC Emission Scenarios: An Economic-Statistical Critique”, I. Castles and D. Henderson, *Energy and Environment*, Vol. 14 No. 2 & 3, 2003.
- ¹⁷ A three-year average is used to limit the impact of single years.
- ¹⁸ “As long as anything like free movement of merchandise and a somewhat comprehensive trade between two countries take place, the actual rate of exchange cannot deviate very much from the purchasing power parity.” Gustav Cassels in “Abnormal deviations in international exchanges”, *Economic Journal* 28, 1918. Equilibrium exchange rates are also referred to as “absolute PPPs”. See *International Economics: Theory and Policy*, Paul Krugman and Maurice Obstfeld, Pearson Higher Education, 2000.
- ¹⁹ As explained in Chapter 2, data collection for Eurostat-OECD comparisons takes place over a three-year survey cycle.