

Report 2004-032

**International
comparisons of
education expenditure**

International comparisons of education expenditure

Commissioned by the
Norwegian Ministry of
Education and Research

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Executive Summary

Abstract

International comparisons of level and growth in inputs into (resources used on) education per student are sensitive to which exchange rates and price indices that are used in the calculations. The report presents the effects of using Purchasing Power Parities (PPPs) and price indices based on domestic demand components, in addition to those based on Gross Domestic Product (GDP), which has been used in OECD's publication Education at a Glance (EaG). The uncertainty about quality differences between teachers in different countries, makes comparisons of the level of resources used on education difficult, particularly between high-income and low-income countries. When estimating increases in resource use over time, quality differences seem less important. That is an argument in favour of using price indices for education in such calculations. Practical considerations and the availability of data may be arguments for other solutions.

Background

Comparisons of the resources used on education between countries and over time have played an increasing role in the debate over education policy in many countries. In Education at a Glance 2003 (EaG), OECD presents data for expenditure per student converted to US dollars (USD) in 2000 and per cent changes in real (inflation-adjusted) expenditure from 1995 to 2000 in a large number of countries.

In EaG *volume levels* for the resource use per student were calculated by using the Purchasing Power Parity based on Gross Domestic Product (GDP) to convert expenditures in national currency to US dollars (USD). Similarly, estimates of the *change in the volume* of resources per student from 1995 to 2000 in each country were obtained by adjusting the change in education expenditure in current prices with the price index for GDP (the GDP deflator).

In the education policy debate, it has been asked whether the resource indicators in EaG are reliable and robust to alternative specifications and definitions. In particular, the resulting levels of resource use per student might depend on which Purchasing Power Parity (PPP) that is chosen for converting expenditures in local currency to a common currency (e.g. USD). Similarly, the estimates for the change over time in the volume of resources in education might be sensitive to the price index chosen for adjusting for changes in prices over time.

This report, commissioned by the Norwegian Ministry of Education and Research, is an attempt to clarify the consequences of alternative ways of comparing education expenditures over time and between countries.

Problem statement

The main task in the report is to assess the sensitivity of the ranking of countries by level and change in resource use per student to alternative Purchasing Power Parities and price indices. Another question to be analysed is whether the indicators in EaG measure differences in the volumes of resources in the education sector between countries and years.

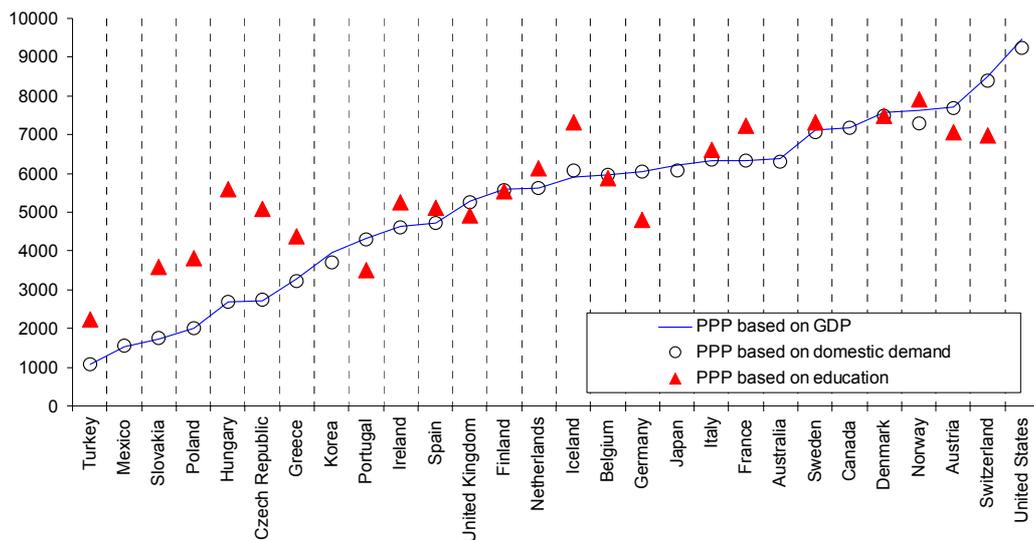
Conclusions

There are potential weaknesses associated with the use of PPPs and price indices based on Gross Domestic Product (GDP) to compare education expenditures between countries and over time. The reason is that a PPP and price index that is based on GDP is sensitive to export prices and import prices. Ideally, the PPP and price index used for these comparisons should reflect price levels and price changes on the resources that are used in the education sector, and not be directly influenced by export or import prices.

Small effects of level estimates using the PPP based on domestic demand

We find that whether one chooses the PPP based on GDP or the PPP based on domestic demand, is of little importance for the ranking of countries by the level of education expenditure per student. Only for three countries is it possible to detect noticeable effects of switching from using the GDP-based PPP to the PPP based on domestic demand. These countries are Korea, Iceland and Norway. The levels of resource use per student using three alternative PPPs for converting to common currency, are shown in Figure A.

Figure A Expenditure on primary through tertiary education in 2000, using different PPPs for converting from national currency to common currency. Euro per student

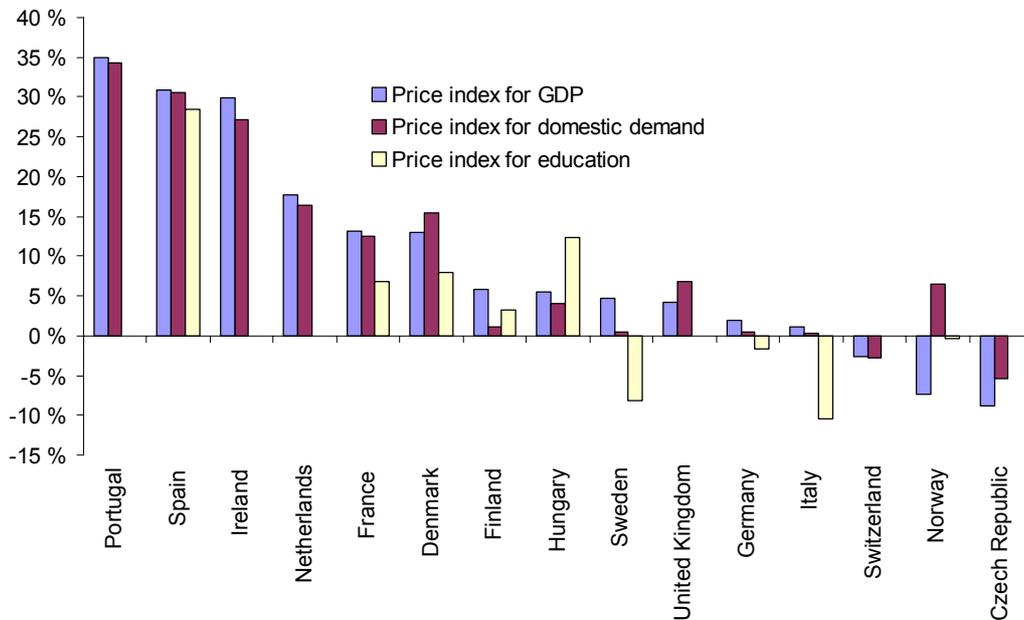


Substantial effects on real growth from switching to the domestic demand deflator

The estimated changes from 1995 to 2000 in the volumes of resources per student changed noticeably when switching from using the GDP deflator (price index) to using the deflator for domestic demand. While estimated change in the volume of

expenditure per student in Norway was -7 per cent using the GDP deflator, it was 6 per cent when the deflator for domestic demand was used. The estimated per cent changes in the volume of education expenditure per student from 1995 to 2000 using alternative price indices (deflators) are shown in Figure B.

Figure B Per cent change in the volume of expenditure per student in primary and secondary education using alternative price indices. Per cent change 1995-2000. European countries.



The large change of results of using the GDP deflator in Norway arise because the GDP deflator in Norway in the second half of the 1990s was heavily influenced by large increases in the prices of Norway's petroleum exports and therefore raised the GDP deflator. Since volume changes are estimated by dividing numbers in current prices by the price index, the strong increase in the GDP price index produced a negative growth estimate for the volume of inputs in education for Norway in this period. Also for other countries the effect on growth estimates of switching from using the GDP deflator to the domestic demand deflator is noticeable. Among these countries are Denmark, Finland, the United Kingdom and the Czech Republic. It is reasonable to contend that the differences for these countries are influenced by variations in their export prices.

Significant level effects of using the PPP based on education

The PPPs are calculated as the conversion factors which ensure that prices of various goods, services or demand categories are the same in all countries. For government services, including education, there are no markets and the resource unit for which prices are measured, is poorly defined. In practice, wage rates per man-hour or per man-year for education sector employees are the dominant prices on which the PPPs for education are based.

If an average teacher man-hour is of the same quality in all countries, teacher wages should be a good indicator for calculating PPPs to be used for converting national education expenditures to common currency. The effects of switching

from the GDP-based PPP to calculating volume levels for education inputs using PPPs based on education, are sometimes significant, cf. Figure A.

Two tendencies are visible. First, estimated volume levels tend to be higher in low- and medium income countries, for instance several central and east European countries, when switching to the PPP based on education. This change is mainly because teacher real wages are higher in high-income countries, not because teachers in these countries necessarily are more skilled or have more education, but because wages in general are higher in high-income countries. Using PPPs where wages do not constitute the dominant component - such as the GDP-based PPP and the PPP based on domestic demand - high real wages results in high volume estimates for education resource use.

For some other countries, the estimated volume levels are considerably lower when the education PPP is used compared to the results when PPPs are based on GDP or domestic demand. This is the case i.a. for Switzerland, Germany and Austria. This is probably an effect of high relative wages for teachers in these countries. Using the PPP based on education, the ranking of countries by volume level comes close to ranking countries by teacher man-hours per student, since labour is the dominant cost component in education, and because teacher wages are used as proxy for other cost components as well in OECD's and Eurostat's estimates.

Quality differences are hard to measure, especially in education

One important source of uncertainty in international comparisons of the volume of resources used on education is variations in teacher quality. Currently there are no practical methods of adjusting for quality. Using the education-based PPP, implies that teachers in all countries are assumed to be of the same quality. The use of the education-based PPP might thus underestimate the resource use on education in countries where high relative wages for teachers reflect high quality teaching.

Using a GDP-based PPP or a PPP based on domestic demand, one implicitly says that teachers with higher real wages are more productive (or are embedded with more resources) than teachers with lower real wages. Using a GDP-based or domestic demand-based PPP thus gives as result that more resources are used on education in high-income countries because teacher real wages are higher in these countries than in low-income countries, even though the high-income teachers on average may have received exactly the same education and have the same personal skills as the teachers in low-income countries.

It is hard to say which effects are the most important. When comparing high- and low-income countries, there are arguments for using education services PPPs, because it removes the artificial effect on resource use from the fact that all real wages in high-income countries are higher than in low-income countries. When comparing the level of resources between countries at approximately the same income level, average real wages are also approximately the same. In such a comparison, higher teacher real wages in one country than in another country could be seen as indicative of higher qualifications among teachers. This is an argument in favour of using a PPP based on domestic demand or GDP in that situation.

Quality is of little importance when measuring changes over time

EaG reports increase in the volume of resources per student from 1995 to 2000. For each country, this change is calculated as the per cent change in the nominal

expenditure per student, adjusted for the change in the price index. Ideally, this price increase should mirror the change in the average price of the resources that are used in the education sector. If we assume that teachers are the only input and teacher wages are measured per hour, this procedure would result in an estimate of the per cent change in volume equal to the per cent change in teacher man-hours per student. Even though teacher quality might differ between countries, the quality change from year to year within each country, would be marginal. Thus, there are theoretical arguments in favour of using the price index for education services as price index for calculating volume changes of resources in education over time.

Generally lower growth estimates when using the price index for education

The empirical importance of using the education price index when estimating volume changes over time is illustrated in Figure B. In some countries, switching from using the domestic demand price index to the price index for education, raises estimated volume growth (Finland, Hungary). The volume growth estimates are reduced in the majority of countries where data were available (e.g. Sweden, Spain, France, Denmark and Norway).

1 Introduction

Comparisons of the resources used on education between countries and over time have played an increasing role in the debate over education policy in many countries. In *Education at a Glance – EaG* - (OECD, 2003), OECD presents data for expenditure per student converted to US dollars (USD) and per cent changes in real (inflation-adjusted) expenditure from 1995 to 2000.

There are different purposes for these indicators. *One purpose* for the indicators is to compare resources use per student between countries at various levels of education. Policy-makers will thus have information about whether a country uses more real resources than other countries per student. *Another purpose* is to compare the level of resource that a country uses in the education sector with measured educational outcomes. Through the PISA and TIMSS projects quantitative data for student performance in many countries have become available. In Norway, it has been asked whether the moderate performance of Norwegian pupils should lead to changes in educational policy, a question that has been accentuated when taking into account the high levels of educational expenditure per student in Norway. It has, for example, been asked why Norwegian students perform so much poorer than Finnish students, although expenditures per student are much higher in Norway. *A third purpose* is to compare the change in the use of real resources per student over time in different countries, answering questions like: Have per student use of resources in Norway increased more or less than in other European countries? In order to make such comparisons, one must account for inflation by using appropriate price indices.

In the education policy debate in Norway and other countries, it has been asked whether the indicators are reliable and robust to alternative specifications and definitions. This report, commissioned by the Norwegian Ministry of Education and Research, is an attempt to clarify the consequences of alternative ways of comparing education expenditures over time and between countries.

The most used indicator for the *priority* given to education in EaG is expenditure on educational institutions in per cent of GDP (indicator B2) and government expenditure on education in per cent of total government expenditure (indicator B4). GDP is the value of aggregate production (and is close to the national income) in a country. Thus, indicator B2 measures the fraction of the country's aggregate income that is used for education purposes. Indicator B4 measures the priority given to education relative to other government expenditures. It is not a part of the current project to evaluate these indicators.

The most central indicator for *the level of the volume of resources* in EaG 2003 is expenditure per student measured in US dollars, converted from national currency

to US dollar by the purchasing power parity factor for GDP (indicator B1). The aim of the indicator is to reflect country differences in the resources per student that are available in different countries. The indicator should thus reflect differences between countries in the ability to use man-hours, materials and capital (buildings and equipment) in the education sector.

In EaG data for the *change in the volume of resources over time* are presented as well. In Chart B1.7 in EaG (2003), per cent changes in real (inflation-adjusted) expenditure per student in tertiary education is displayed. OECD plans to publish similar data in 2004 for primary and secondary education as well. The aim of the indicator in Chart B1.7 is to measure changes over time in the volume of resources available to the tertiary education sector. This is done through deducting changes in expenditures per student that are caused by price increases from the overall increase in per student expenditure. In EaG (2003) this inflation adjustment has been done by using the GDP deflator.

Problem statement

The main task in the report is to assess the sensitivity of the ranking of countries by level and change in resource use per student to alternative Purchasing Power Parities and price indices. Another question to be analysed is whether the indicators in EaG measure differences in the volumes of resources in the education sector between countries and years.

More specifically, the project will describe and discuss:

- What does the PPP conversion factor for GDP as used in EaG actually measure?
- How are the PPP factors constructed?
- Will alternative PPP factors produce other results for countries' real expenditure per student?
- Is the GDP deflator a suitable indicator for the prices of educational inputs?
- Will Norway's extraordinary large petroleum exports make it particularly problematic to use aggregate indicators such as the GDP-based PPP factor or the GDP deflator?
- Will alternative price indices to the GDP deflator yield different results?

In order to answer these questions, we first discuss how some ideal PPP factor and price index should be from a theoretical perspective. *Chapter two* is a theoretical discussion of aims of the PPP factors and price indices used. The chapter also contains a description of the methods used in Eurostat and OECD, that calculate the indicators. *Chapter three* analyses the empirical importance of using alternative PPP conversion factors for the ranking of countries' education expenditures. *Chapter four* analyses the effects of alternative price indices for the estimated volume changes in education expenditures.

2 PPPs and price indices

The task is to compare the volumes of inputs used on educational across countries and over time. These volumes consist of teacher man-hours of different quality (defined for example by educational background of teachers), the numbers of pencils, books, PC's, cars, buildings and other inputs used in education. These volumes are not observed directly. What is observed is educational expenditures at various points in time and in different countries. To compare volumes means finding the appropriate price index (for comparisons over time) and the appropriate exchange rate (for comparisons across countries with different currencies) for the average of all educational inputs.

2.1 Theory

When comparing educational expenditures across borders, one needs an exchange rate for converting expenditures in different currencies (say Euro and kroner) to a common currency. It is widely accepted that for making volume comparisons between countries, the market exchange rates are not suitable, i.a. because of their volatility and because market exchange rates only capture inter-country price differences on tradable goods and services. Inter-country price differences on goods and services that are not subject to trade are not well reflected in market exchange rates. In particular education services are locally produced (use of teacher and other man-hours) and not subject to trade.

The concept of PPP

One way to reduce distortions when comparing volumes between countries is to use a Purchasing Power Parity (PPP). For a particular good or service, the PPP is the currency conversion factor that equalises the price of the same good in different countries. One example of a PPP exchange rate is the Big Mac¹ PPP index, based on the price of a Big Mac Hamburger in different countries. The Big Mac PPP (local currency/US dollar) is the conversion factor that makes the hamburger cost the same in the country in question as in the USA. Using this conversion factor, one can thus convert from expenditures on hamburgers in different countries (local currency) to expenditures in USD. The resulting dollar numbers for each country is the appropriate indicator for the volume of hamburgers purchased in each country.

¹ Published regularly by the journal The Economist (www.economist.com).

It is easy to measure the price of a hamburger. For commodity groups consisting of different goods and where the goods come in different variants and qualities, the computational and conceptual problems may become huge. Eurostat and OECD calculate PPP exchange rates for a large number of commodity and service groups, up to aggregate demand categories as private consumption, public consumption and GDP. How this is done is described later.

We wish to compare the volume of *inputs to the educational system*

The choice of conversion factor depends on what one is interested in comparing. We are interested in deriving a measure of the volume of inputs in education from expenditure data. This implies finding the price of one resource-unit used for education. Let us assume that this smallest resource unit is one man-hour. Thus, the price of one teacher man-hour is the price of this smallest unit.

However, even if the education sector is labour intensive, and inputs to the educational system mainly consist of labour services for students and for supporting services, other input factors must also be accounted for. In addition to labour services, inputs to the educational system are intermediate inputs (pencils and textbooks are trivial examples) and capital services (class-rooms, school libraries, cars etc).

An obvious, but very important point with respect to labour, intermediate inputs and capital services is that they come in different qualities. A teacher with a Ph.D. should be expected to supply a better educational service to high-school students than a teacher without a university education; a headmaster is considered more important than a secretary; a well-equipped science laboratory has higher quality than a poorly equipped one, etc. The main problem in comparing the volume of educational inputs lies in how to account for the quality of educational services. To illustrate, we will first deduct principles for the choice of currency conversion factor (exchange rate) to use between two countries, Norway and Portugal, given that there are no quality difference.

Exchange rate given no quality difference

We want to compare the volume of educational services in Norway and Portugal. The most important component is labour – teaching. If the number of man-hours in education in each country is known (and the average man-hour in teaching is of the same quality in the two countries), we should use the number of man-hours directly as volume indicators.

However, assume that we do not know the number of man-hours. Then we must start from expenditures used on teachers in local currencies, and use the correct exchange rate to derive the volume of teaching input. We proceed as follows²:

Since we know the number of teaching man-years and the expenses on teaching, we find the average wage for teachers in each of Norway and Portugal. Say that it is 300 000 NOK in Norway and 20 000 € in Portugal. Then we know that we find the number we are interested in by dividing expenses in Norway by 300 000 and expenses in Portugal by 20 000. Dividing expenses in Norway by 30 000 and those in Portugal by 2000 will also generate a correct impression of the volume of

² In the example we assume that the number of man-hours per man-year is the same in both countries.

teaching services (only that the resulting number is ten times the number of teachers in both Norway and Portugal.). It is the relative difference between wage levels in Norway and Portugal that matters. So it is also correct to divide expenses in Norway by 15 (or multiply those in Portugal by the same number).

After treating labour we move on to intermediate expenses (pencils, books etc). Say that we are fortunate enough to know, to a reasonable degree of precision, the content of the basket of intermediate expenses in Norway and Portugal. This information is provided by the statistics bureaus in each country and is presented as a fixed-price basket. Equipped with our assumption that there is no quality difference we proceed as before and find the relative exchange rate between Norway and Portugal³. We cannot expect it to be precisely the same as in the case of labour. Say that for intermediate expenses it is 10.

Finally we take on capital services and perform the same operation there: An estimate of the fixed-price bundle in each country, and assuming no quality difference⁴, gives us the tools to estimate the relative exchange rate. Say that in this case it is 17.

Given the assumption of no quality difference the numbers 15, 10 and 17 are all that we need to compute the *volume of educational services* in Norway compared to Portugal. If we benchmark the volume in Portugal to unity, we find the similarly benchmarked volume in Norway by dividing Norwegian labour expenses by 15, intermediate expenses by 10 and capital expenses by 17.

Two things are worth noticing: a) Only the prices of educational goods and services enter into the comparison, and b) actually we will also reach the answer by adding together all educational expenses in Norway and dividing by the weighted average of 15, 10 and 17, using the share of each expenditure category as weights. This weighted average is the purchasing power parity for educational services. Note the two requirements to this PPP: only the right inputs should enter, i.e. educational expenditure inputs, and the weights should refer to educational expenditure, in the same year, adding over those inputs.

In practice we can't measure quality differences

Especially in services such as teaching, there may be substantial differences in the quality of education personnel between countries. One important source of different quality is that the education requirements for teachers may be different in different countries. One possible source of quality measurement would be to correct for the number of years of teacher education. But it is still open what the adjust-

³ Note that in this case we not only assume that the quality of pencils, computers etc. is the same in both countries, but also that both countries purchase the same number of pencils and computers to their schools. Otherwise, in case Norway only purchases pencils and Portugal only purchases computers there would be a quality difference. It might not be realistic that Norway only purchases pencils and Portugal only computers, but one reason for expecting systematic differences between countries is the fact that some expenses are privately paid in some countries and publicly paid in others.

⁴ Again, it is not only the case of a classroom being a classroom in both countries, but also a case of whether the same amount of classrooms, swimming pools, science labs etc enter into the baskets of each country. In fact, the same issue is present in the case of labour: it is not only the case of headmasters being of the same quality in each country, but also the case of whether the same amount of headmasters, assistants etc. enter into the labour "basket".

ment should be, and in practice the PPP researchers have not arrived at any viable method to adjust for quality along these lines, cf. e.g. Dean (2002).

Another approach would be to assume that differences in teacher quality is reflected in the market through the wages needed to recruit teachers. If a country wants high-quality teachers and wants to impose long education requirements and high personal skills from teachers, it has to offer high wages. There is obviously a difference of a teacher with one year of education and a teacher with five years' education. If labour is mobile, i.e. employees can move costlessly to the regions with higher wages, wage differences would be a good indicator for quality differences among employees, including teachers. But labour is not perfectly mobile, and less so in a large region as the EU or OECD. Differences in teacher wages in different countries are probably more the result of inter-country variations in GDP per capita than the result of variations in the educational background or other quality differences between teachers in different countries.

In practice, then, there are currently few or no practical ways to adjust for quality differences of teacher man-hours between countries.

Different types of PPPs

There is an important difference between PPPs based on domestic use (from small commodity (or service) groups to aggregate domestic demand) and PPPs that are based on GDP.

The PPPs and price indices for GDP include export and import prices, which surely should not be part of any price index when one wants to compare volumes of expenditures on education or any other component of domestic demand. A sharp rise in export prices for a country will raise the GDP deflator. This will affect the PPP estimate for the country. The extent to which there are market spill-overs from export prices to domestic prices will be measured by the appropriate price indices in domestic demand. Thus, theory says that when education expenditures should be compared across space and over time, the GDP-based PPPs and price indices are in principle inferior to price indices based on domestic demand or narrower commodity or service groups.

OECD has in the EaG (2003) chosen to use GDP-based PPPs and price indices to convert per student expenditures on education from national currencies to common currency and to compute volume changes in per student expenditure over time. This need not be a problem in practice if the empirical importance of using GDP-based PPPs and price indices compared with using indices that from a theoretical point of view seem more appropriate, is small. Whether this is the case, will be illuminated in the next chapter.

Price comparisons across time

The principles for comparing volumes of education inputs over time, using expenditure data, are the same as the principles for comparing volumes across space.

If we neglect potential changes in the quality of inputs in the form of teacher man-hours, PC's etc, price comparisons over time should be performed by dividing expenditures of various components by the price index of this component. For instance, the volume change of teacher man-hours will be calculated by the difference between expenditure divided by the hourly wage index (base year = 1) and

the expenditure in the base year, and similarly for the other components in education expenditure.

This procedure ensures that higher real wages will not be registered as changes in volumes, but in price. A general increase in real wages in a country would usually be accompanied by a rise in teacher wages as well, even though average teacher quality has not changed. The procedure of dividing with the wage index captures that effect. If a country raises teacher quality by raising educational requirements, part of such a policy would probably be to raise wages as well. The extent that teacher quality actually increases by such a policy is not captured by dividing by the wage index. In practice, our contention is that it is more important to correct for the trend towards higher overall, and teacher, wages than to capture potential (put uncertain and non-immediate) effects on quality of higher real teacher wages.

2.2 Calculations of PPPs

Purchasing power parities (PPPs) are estimated by Eurostat and OECD in cooperation to enable *volume* comparisons of GDP, aggregate demand components and product groups across countries. Both national institutions and OECD/Eurostat publish price indices in national currency for the same commodity/service groups and demand components up to GDP.

Eurostat makes the calculations for the 15 EU countries, the 3 EFTA countries (Iceland, Norway and Switzerland), the 10 accession countries in Central and Eastern Europe, in addition to Bulgaria, Romania and Turkey. OECD also calculates PPPs for the 6 OECD countries not part of EU and EFTA (Australia, New Zealand, Japan, Korea, Canada, Mexico and the United States).

The PPPs are calculated for various commodity groups (e.g. food), demand groups (e.g. aggregate private consumption or aggregate government consumption) or the entire GDP. The ICP (International Comparison Programme) and the ECP (European Comparison Programme) have established a methodology for country reporting based on national accounts, and established procedures for comprehensive and detailed PPP calculations by Eurostat and OECD jointly.

Often the PPPs are presented as a vector of PPS' (Purchasing Power Standards), which instead of enabling the conversion of any country's GDP into any other country's currency and price structure enables the conversion of all countries' GDPs into one common currency and price structure. For Eurostat, the Euro and the average price structure in EU(15) is used, whereas for OECD, the US dollar and the US price structure is used for this purpose⁵.

2.2.1 Products and aggregation levels

Figure 2.1 shows how the aggregation levels are constructed and named for the calculation of PPPs.

⁵ Because the PPP matrix is transitive, this has no bearing on the relative differences between countries, only on the actual levels.

Prices on around 2.700 similar products and services⁶ are compared between countries every three years, and PPPs are produced, first at the individual product level⁷, then at increasingly aggregated levels, up to the GDP level.

A product level PPP, or price relative, between two countries is the price deflator that allows us to compare e.g. the number of skateboards sold in the two countries rather than the money spent on skateboards. These product level PPPs are not published, since generally Eurostat/OECD consider data at this detailed level as too uncertain.

The full set of GDP-based PPPs, on the other hand, is published and widely used. It is a matrix of indices that converts any a unit of one country's GDP into any other country's currency and price structure.

In theory, one could use the PPPs at any level of aggregation to compare different countries' expenditure on that product, product group, expenditure category or main aggregate. It is also possible to construct different aggregates that combine product groups in a way that better reflect the expenditure to be compared.

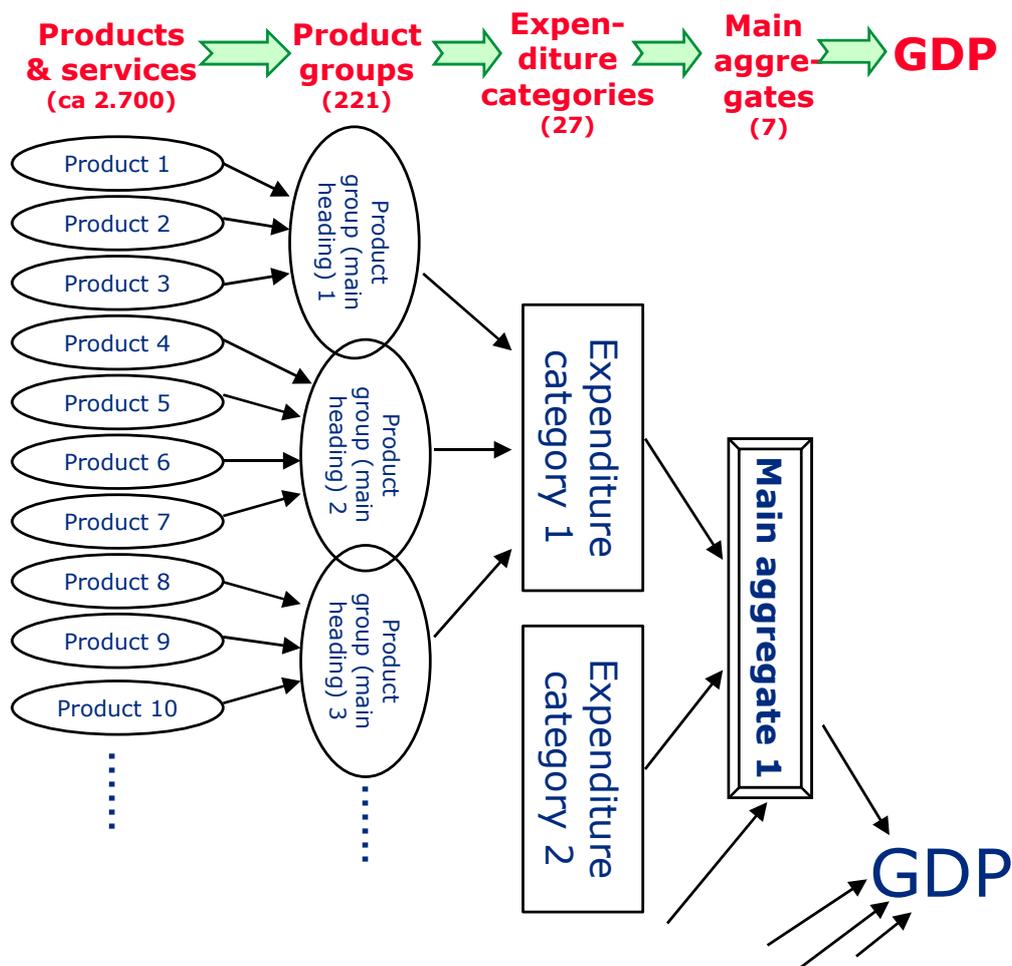
The International Comparison Project has developed a structure for the break-down of GDP that is both convenient when comparing countries with widely different economies and compatible with the 1993 SNA and 1995 ESA national accounts break-down.

Because certain sectors of the economy are very differently financed in different countries, a break down of the expenditure depending on "who pays", is not convenient. The ICP has therefore developed a break down based on "who consumes". In this way, total education expenditure can be compared between countries, irrespective of whether students are financed directly by their parents or indirectly by their parents' tax bills (or pay themselves).

⁶ In addition to the prices of about 2.500 goods and services this includes the salary level of 34 different occupations, 186 types of equipment goods and 20 hypothetical construction projects

⁷ At that level, they are called price relatives rather than PPP's

Figure 2.1 Aggregation of price relatives and PPP's



Expenditure data in the national accounts are structured around the 1993 SNA or the 1995 ESA standards. In the production of PPPs, expenditure data from each country's national accounts are needed to construct the weights that are attributed to the different prices. If fruit constitutes 5% of “Food and non-alcoholic beverages” sold in Norway, then the price of fruit should weigh 5% in constructing the price level to represent “Food and non-alcoholic beverages” in Norway.

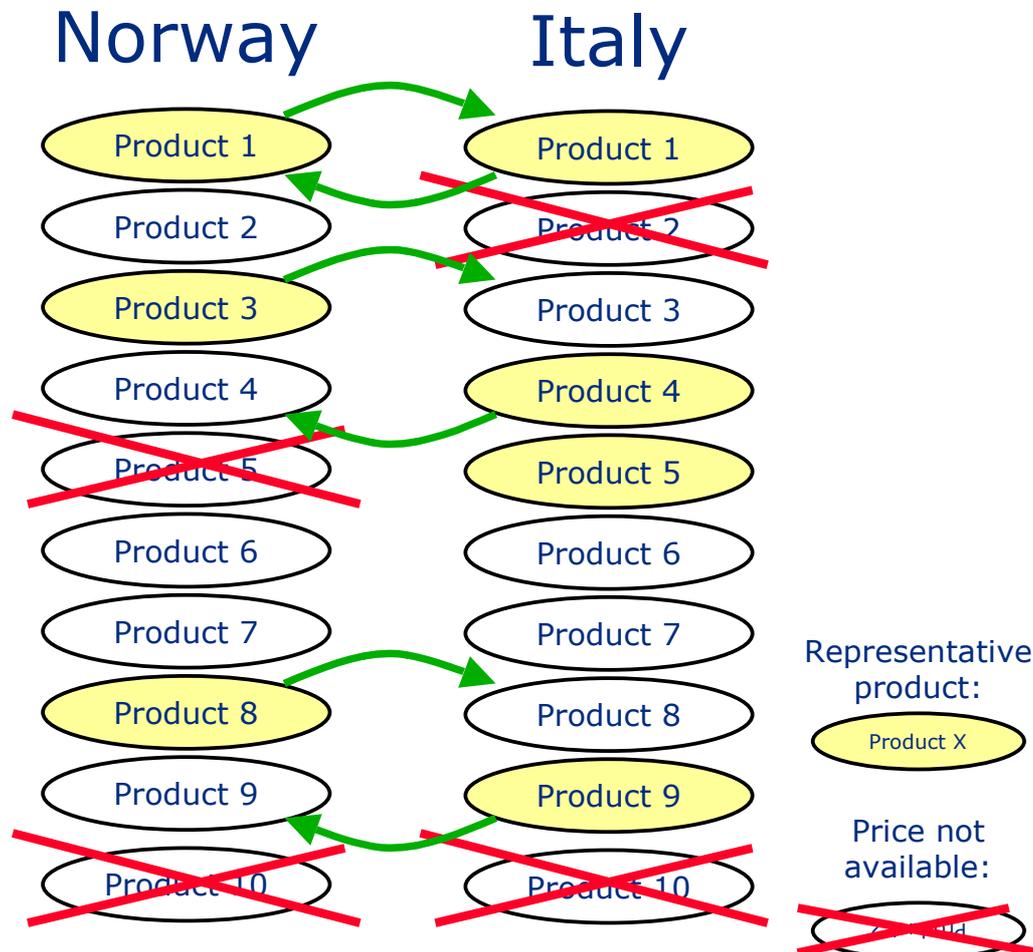
However, expenditure data are not available at the most detailed product level. Therefore, we cannot use the budget shares of apples and other fruits within the product group “Fruit” to measure the relative importance of each type of fruit in each product group in each country. The method used is instead that each country signals for each product in the product group whether the product is representative for that product group in that country or not. The selection of products and services for which prices are collected, is set up in such a way as to assure that all countries have at least one representative product in each product group.

2.2.2 The actual calculation

Purchasing power parities are first calculated bilaterally at the product group level. Each product group contains between 5 and 50 products and/or services, but a country will generally not collect prices for all the products in the product group, simply because some products are so unimportant even non-existent in that

country. Furthermore, each country has labelled a certain number of the products in each product group as representative products.

Figure 2.2 Illustration of initial PPP calculation between Norway and another country (e.g. Italy) for any given product group



PPPs are then calculated, on the basis of the reference products for each of the two countries. Figure 2.2 illustrates the calculation of PPPs between Norway and Italy for a product group that contains 10 products. Product 1, 3 and 8 are labelled Norwegian representative products, whereas product 1, 4, 5 and 9 are Italian representative products. Furthermore, there are no Norwegian prices available for product 5 and 10 and no Italian prices available for product 2 and 10.

First the PPP for the Norwegian representative products is calculated as the average of the price relatives for products 1, 3 and 8. Then the same is done for Italy's representative products, only excluding product 5 since no Norwegian price is available. Then the average of the two price ratios give us the bilateral PPP between Norway and Italy for this product group.

This exercise is repeated for each pair of countries. For some pairs of countries, certain product group PPPs may not be possible to calculate because of lacking prices in one country for the other country's representative products. In that case, indirect PPPs are calculated using other countries as "bridges". At the end of the exercise, we have produced 221 matrices of bilateral PPP's, one for each product group (so-called "main headings").

2.2.3 Transitivity and the fixity convention

The method described up to now gives us all possible bilateral PPPs that correctly reflect relevant price differences between two countries. However, in a larger multinational comparison, they are not consistent because the PPP matrices are not transitive. That is to say, the ratio of the PPP between countries A and B and the PPP between countries B and C is not the same as the PPP between countries A and C. In order to ensure transitivity, Eurostat and OECD uses the so-called EKS method⁸ that minimizes the changes in the bilateral PPP's from their values in the first step.

The EKS method makes the PPP estimates sensitive to the size and composition of the group of countries included in the adjustment. Since Eurostat performs the adjustment every year for the 31 countries within their responsibility, while OECD only does it every three years for the other countries, Eurostat and OECD has agreed upon a “fixity convention”. By this convention, Eurostat's resulting matrices for their 31 countries are taken as a given (as fixed) by OECD, and so when OECD makes the EKS adjustment for the full set of countries, they impose the condition that the 31 Eurostat-countries' internal PPPs are fixed, and so adjust the rest to obtain correct price level ratios on that basis.

When all the transitive PPP matrices are available at the product group level, any aggregation will be calculated using national expenditure on the product group level as weights. Similar to the product group level, at any aggregation level two PPP's are calculated, one using the first country's expenditure as weight, the other using the second country's expenditure as weights. The geometric average of the two PPPs are then taken as the bilateral (un-transitive) PPP at that aggregation level. The EKS method is then applied to assure transitivity and thus multilateral consistency.

2.2.4 Updating of PPP estimates

While all prices are collected with 3 year laps in both institutions, Eurostat and the OECD use different methods for updating the PPP calculations for the countries they are responsible for.

Eurostat collects one third of the prices each year, and makes detailed estimates for all prices that are not updated based on different national price indices. On this basis, the full and detailed PPP calculation is performed every year.

OECD on the other hand, collects all prices every third year (1996, 1999, 2002), and only perform detailed PPP calculations for those years. PPP's for intermediate years are estimated by extrapolation, but only at the aggregated level (GDP level), and are not published until the next 3-year calculation is completed. The OECD uses global extrapolation and estimates PPPs and real expenditures at the level of GDP only. With this method, the PPPs for GDP for the latest benchmark year are extrapolated by the relative rates of inflation in different countries as measured by the implicit price deflators for GDP.

⁸ By the Elteto-Köves-Szulc method, transitivity is achieved by replacing the direct PPP between each pair of countries by the geometric mean of itself squared and all the corresponding indirect PPP's between the pair obtained using the other countries as a bridge.

2.2.5 Prices of non-market services (NMS)

Non-market services (NMS) is the name given to sectors of the economy for which there are no markets. These services have for years proved problematic for national accountants and statisticians that are estimating PPPs, since there are no obvious way of measuring the volume of these services. These sectors have been deemed “comparison resistant” (see e.g. Sergueev, 1998) in terms of expenditure comparisons, and are even said to constitute a problem for any PPP or volume comparison that contains these sectors, including total GDP (ref. OECD, 2002, p 21). The problem is that we must use indirect methods for estimating the price levels, the price relatives between countries and thus PPPs, since no output prices are directly observable.

Input price method

The so-called *input price method* is chosen for these estimations. Total expenditure on non-market services, e.g. education by government, is composed of i) compensation of employees, ii) intermediate consumption and iii) consumption of fixed capital. Expenditure on each of these three elements are available from national accounts.

Prices are calculated by two different methods. For compensation of employees, each country’s salary levels for selected staff categories in the sector (see Table 2.1) are used, whereas for intermediate consumption and consumption of fixed capital, so-called “reference PPPs” are used in the place of direct price comparisons. The reason is that for these product groups (basic headings) no price information was available. The PPPs selected as reference PPPs are either for highly aggregated expenditure components, such as household final consumption expenditure, or for goods and services that are similar to the goods and services for which no prices were collected.

Table 2.1 34 occupations in government, education and health services

| | |
|--|--|
| Cleaner | Executive official II (with university degree) |
| Caretaker | Kindergarten teacher |
| Labourer | Primary school teacher |
| Messenger | Secondary school teacher |
| Maintenance electrician | Head teacher |
| Switchboard operator | Hospital cook |
| Secretary | Typist |
| Draughtsman | Hospital administrator |
| Bookkeeping clerk | Laboratory assistant |
| Computer operator | Physiotherapist |
| Policeman | Nursing auxiliary |
| Social worker | Nurse I |
| Civil engineer | Nurse II (operating theatre) |
| Sanitary engineer | Nurse III (head of department) |
| Public health nurse | Doctor I |
| Public health physician | Doctor II (assistant head of department) |
| Executive official I (without university degree) | Doctor III (head of hospital department) |

Source: OECD (2002)

Experimental methods for quality adjustment

In the past three decades, several alternative methods have been proposed in order to estimate PPPs for non-market services. On experimental and basis there have been attempts at

- making various productivity adjustments to the salary levels so as to account for differences in quality between countries and
- using reference PPP's also for the 'compensation of employees'-component.

Among proposed productivity adjustments has been to construct indicators based on the average number of years of teacher's education and work experience. Another adjustment that has been proposed is to adjust for the reasonable assumption that the amount of educational services reaching each student is less in large classes than in small classes. This option is clearly not suited to the problem in this report, since this adjustment is already made in national currency.

Different adjustment approaches have been discussed in (Dean, 2003). Several analysts of PPPs claim that the current solution is chosen more out of political reasons and to obtain consistency between countries than because of its superiority (see Franz and Sergueev, 2003). John Astin (2001), Head of Price Comparison Unit at Eurostat admits that the currently used method is "widely recognised as inadequate if not inappropriate" (p. 6). In fact, most authors seem to maintain that the best solution would be to either directly measure some sort of volume output from the sectors or to perform some kind of a productivity adjustment to the salary levels in the input price approach (see e.g. Dean, 2003). However, one should bear in mind that the discussion in the community of statisticians developing the measurement methods in the field of PPPs may be focussed on solving slightly different problems than the ones in this report.

2.3 Choice of PPP indicator: Theory and practice

2.3.1 Today's practice

Eurostat and OECD calculate PPPs for aggregate components of domestic demand such as private consumption, public consumption and public investment, as well as for GDP. Also PPPs for education services are calculated.

The PPPs for education services consist of three components – wage costs, prices of intermediate inputs and capital costs.

The indicator for teacher wages is the average wage per man-year for each category of staff, cf. Table 2.1. There are no quality adjustments of teacher wages in the calculations, apart from the distinction between primary school teacher, secondary school teacher and head teacher. The possibility that the educational requirements or other factors that produce differences in the average quality of teachers between countries is thus not accounted for in the PPPs.

For intermediate consumption, there is no primary price data, so a reference PPP is used. The reference PPP used for intermediate inputs is the education sector wage PPP. Neither is there for capital consumption any reliable primary price data for the education sector, thus a reference PPP is used. The reference PPP for capital costs in the education sector is the PPP for average capital costs.

In EaG, it was chosen to use a reference PPP based on GDP instead of the education sector PPP, or any other PPPs based on aggregates in domestic demand. For calculation of changes in volumes between 1995 and 2000, the GDP deflator was used.

2.3.2 PPPs: Pros and contras

Regarding the pros and contras for choosing between the other PPPs and price indices, both the quality of data underlying the various components of aggregate demand, and theoretical considerations are important.

What is evident is that the quality of the primary price material is best for consumer goods. Here the quality differences of commodities between countries are smallest, since the majority of consumer goods are tradable goods. Thus, the PPPs for most consumer goods must be considered very reliable. The PPPs and price indices for aggregate private consumption should of the same reason be considered reliable.

The PPPs for aggregate investment are based on price level information on capital goods, such as buildings, machines and equipment of various specifications. It can be contended that the number of product variants is larger for investment goods than for consumption goods. One reason for this contention is that buildings and machinery are very often produced by order, tailored for the customers' needs. Thus, direct price level comparisons between countries becomes more difficult for investment goods than for consumer goods. We thus believe that PPPs for investment demand are somewhat more uncertain than PPPs for private consumption.

Government consumption, which for the largest part is non-market services, is full of computational problems, as discussed at length above. The price levels are based on the input price method, so that potential quality differences between countries are neglected. This introduces uncertainty in the PPPs for public consumption and also for education services. However, the quality of the primary data, most notably wage rates, need not be inferior at all. For Norway, and probably for a number of other countries as well, the wage rates that are the most important primary data for the PPP for education services are taken from government registers and thus very reliable.

PPPs - Control questions

The discussion of the appropriateness of various PPPs can be illuminated posing a number of control questions, and seeing how the different indicators measure the changes.

PPP-aggregate demand components

One alternative to today's practice of using PPPs based on GDP. The PPP for domestic demand is to use PPPs for total domestic demand. The PPP for domestic demand is an average of the PPPs for private consumption, government consumption and total investment. Higher overall real wages as part of a general process of economic growth will imply higher teacher real wages as well. This will be registered as higher volumes in education, even though the difference in teacher wages between a low-income and a high-income country has not necessarily anything to do with teacher quality, but only with the overall income level in the country. This is not a desirable property of the PPP indicator. Use of total domestic demand (or private consumption) based PPP will bias the volume levels of education expenditure per student upwards in high-income countries. This effect has been labelled the "Baumol's disease". When comparing volume levels between countries at approximately the same level of real income, this problem will not be important for a price-based PPP, however.

PPP-Gross domestic product

The PPP based on GDP captures the price differences for domestic demand, but is also sensitive to the prices of exports and imports. In small open economies exports of raw materials are important. Raw materials' prices usually vary much more than manufactured goods prices. Thus, in some situations for some countries the GDP-based PPP may deviate substantially from the PPP for domestic demand and the PPP for education services. It seems to us that the GDP-based PPP is inferior to alternative aggregate PPPs since it includes prices that have no justification for influencing the PPP we are interested in. The only justification may be that it is easy to calculate, but our contention is that it would be as easy, if not easier, to make crude calculations of PPPs for domestic demand as for GDP.

PPP-education

Higher real wages (for teachers and others) in one country than another will not in itself lead to higher volumes if one uses the PPP based on education services, where teachers' wages dominates. The differences in volumes will mainly reflect the differences in man-hours. This is a desirable property and an argument in favour of using a PPP based on education services. In particular it helps avoiding

artificially high volume estimates in high-income countries compared to low-income countries. However, the indicator is exposed to uncertainty because of possible quality differences of teacher man-hours between countries.

If the country increases the number of teacher man-hours per student, this is measured as a volume increase, which is a desired property of the indicator. Higher export prices (or lower import prices) does not affect this PPP and thus not the measured volumes, which is again a desirable property.

Price indices-control questions

The answers on the control questions are similar, but not identical when it comes to evaluating the appropriateness of the various price indices for calculating volume changes over time.

First, it should be noted that the volume change calculations do not involve currency conversions at all; all calculations are done in national currency.

Since we are occupied with changes in volumes between two years that are not very far from each other, quality differences is a much less important issue than when comparing across space. This is an argument in favour of using a price index for education, which to a large extent reflects the real wage developments of teachers and other employees in the education sector. Higher real wages for teachers (in tandem with an overall real wage increase) will not be registered as an volume increase. Only an increase in man-hours per student will be measured as volume increases. This is probably a desirable property.

Similarly to the GDP-based PPP, the GDP deflator is affected by exogenous fluctuations in export and import prices. This makes the GDP deflator a potentially unreliable price index for deflating changes in nominal expenditures over time.

An alternative to the GDP price index is to use the aggregate price index for domestic demand as deflator for calculating volume changes over time in education expenditures per student. Higher man-hours will, correctly, be registered as volume changes. However, higher real wages in the economy, including higher teacher real wages, will be registered as higher volumes, even though neither the number of teacher man-hours nor the average human capital of teachers need have been changed. This price index will thus over-estimate volume changes in education in countries where real wages increases are high, relative to countries where real wage changes are lower.

3 Expenditure levels 2000 using alternative PPP's

In this chapter, we consider the results of applying different sets of PPPs to the expenditure data.

We have used table B1.1 from EaG as basis. This table shows expenditure per student for 10 different levels and aggregation of levels of education, all converted into US\$ and US prices by the GDP PPP for 2000. We converted the expenditure data back to local currencies by using the GDP PPP as reported in the same data set and chose to look at the following five levels of education:

- Primary education
- Lower secondary education
- Upper secondary education
- Tertiary education
- Primary through tertiary education.

We then assembled alternative PPP data received from Eurostat and OECD. These were:

- Eurostat: ICP-matrix and SNA-matrix for year 2000 for the 31 Eurostat countries, and a specially constructed PPP for "Domestic Demand"
- OECD: PPP data corresponding to the Eurostat PPP data on Domestic Demand and Actual Individual Consumption for the relevant countries outside the Eurostat countries. The GDP PPP was available to us for these countries as well.

We then chose six different PPP's to map out the different possibilities:

- **GDP:** Gross Domestic Product. Most commonly used PPP, also used in EaG for 2000.
- **Domestic Demand:** Sum of private and government consumption and total investment.
- **Actual Individual Consumption:** All consumption by individuals, irrespective of who finances the consumption (households, government or NGOs).
- **Education:** Consumption of education, irrespective of who finances it. (Only data from Eurostat).
- **Final Consumption by Households:** Only the part of individual consumption actually financed by the household. (Only data from Eurostat).

- **Final Consumption by Government:** All consumption (individual and collective) financed by the government. (Only data from Eurostat).

We then calculated six sets of expenditure per student based on the six PPPs for each of the five levels of education for all countries involved. There are 28 countries in all, but not all could be calculated for every level because of missing expenditure data for some countries and because there were missing PPPs for the six non-Eurostat countries (Australia, Canada, Japan, Korea, Mexico and the United States) for the three last PPPs.

3.1 PPP estimates

Table 3.1 shows how the estimates of the five alternative PPPs compare to the GDP-based PPP that is being used in EaG. The absolute currency conversion rates are shown in Appendix table 1.

Table 3.1 Importance of different definitions of PPPs. PPP based on various demand components in per cent of PPP based on GDP. Local currency per Euro. Data for 2000

| | Domestic demand | Actual individual consumption | Education | Final consumption by households | Final consumption by government |
|----------------|-----------------|-------------------------------|-----------|---------------------------------|---------------------------------|
| Austria | 100,1 | 99,7 | 109,2 | 98,6 | 104,0 |
| Belgium | 100,1 | 101,1 | 101,7 | 101,5 | 101,2 |
| Czech Rep. | 99,5 | 93,2 | 53,5 | 104,3 | 64,9 |
| Denmark | 101,1 | 100,6 | 100,9 | 100,2 | 102,9 |
| Finland | 100,5 | 108,1 | 100,8 | 111,0 | 99,0 |
| France | 100,0 | 99,9 | 87,6 | 103,3 | 91,4 |
| Germany | 100,2 | 98,3 | 126,2 | 95,1 | 112,9 |
| Greece | 101,9 | 101,1 | 75,0 | 107,1 | 78,1 |
| Hungary | 99,1 | 90,4 | 47,8 | 103,7 | 60,5 |
| Iceland | 97,6 | 101,3 | 80,8 | 105,1 | 89,7 |
| Ireland | 100,3 | 101,5 | 88,2 | 103,5 | 96,0 |
| Italy | 99,8 | 102,5 | 95,9 | 102,8 | 103,0 |
| Netherlands | 100,1 | 97,4 | 92,0 | 99,6 | 94,9 |
| Norway | 104,8 | 105,0 | 96,7 | 106,3 | 100,2 |
| Poland | 100,1 | 96,6 | 53,0 | 109,3 | 63,4 |
| Portugal | 101,1 | 100,5 | 123,9 | 99,7 | 101,0 |
| Slovakia | 99,7 | 92,7 | 48,5 | 103,7 | 59,2 |
| Spain | 99,9 | 99,4 | 92,2 | 101,2 | 93,5 |
| Sweden | 100,9 | 101,1 | 97,2 | 102,9 | 99,1 |
| Switzerland | 101,5 | 104,0 | 121,9 | 102,3 | 110,7 |
| Turkey | 100,6 | 101,9 | 48,3 | 113,6 | 58,7 |
| United Kingdom | 100,2 | 99,6 | 107,1 | 99,8 | 97,4 |
| Australia | 101,1 | 102,0 | | | |
| Canada | 100,0 | 102,4 | | | |
| Japan | 102,6 | 109,0 | | | |
| Korea | 107,4 | 103,0 | | | |
| Mexico | 99,3 | 97,4 | | | |
| United States | 102,2 | 102,6 | | | |

Source: OECD, Eurostat, ECON.

We see that there are noticeable differences for some countries. For most of the categories the changes compared with the GDP-based PPP are not large, except for the PPP based on the prices of education services. Moving from GDP to domestic demand, only for Iceland and Norway there is a discrepancy of more than one per cent. For all other countries, the PPP based on domestic demand is less than one per cent different (in either direction) from the PPP based on GDP, as used in EaG. The particularly large effects on the PPP exchange rate by moving from the GDP-based PPP to the domestic demand-based PPP may be related to Norway's large petroleum exports and Iceland's reliance on fish exports.

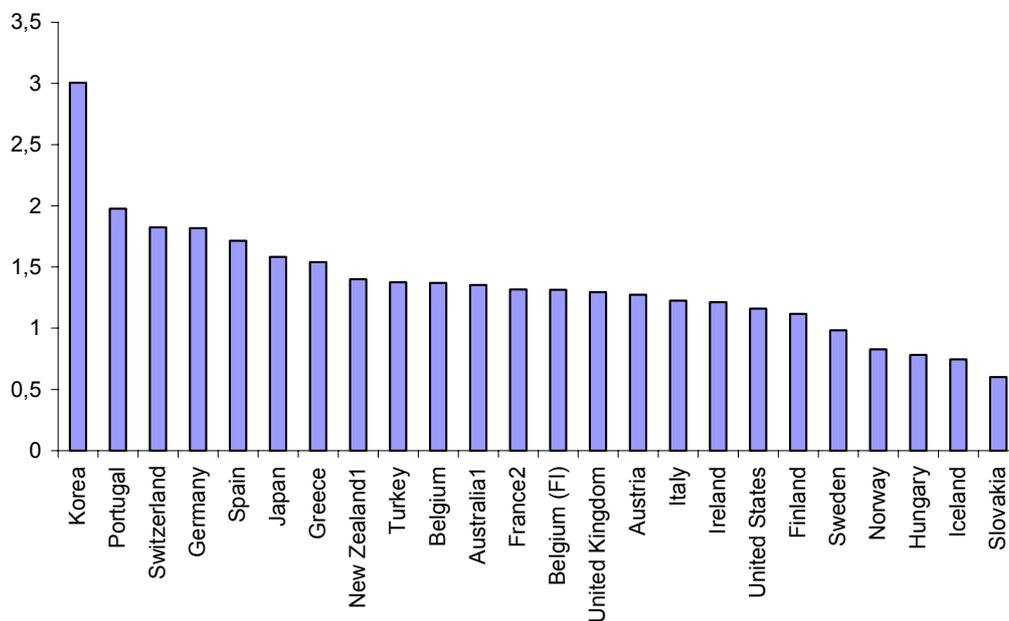
For the PPPs based on actual individual consumption and final consumption by households, there are somewhat larger differences in the calculated PPPs.

It is the PPPs where non-market services are dominating that differ most from the GDP-based PPPs. It is a general tendency that the PPPs based on these demand components are much lower than the GDP-based PPPs for low- and medium income countries such as Turkey, Slovakia, Poland and Hungary. This must be seen in the lower aggregate real income levels in these countries. Lower real income levels, means lower real wages (overall and probably also for teachers), which produces large effects on the resulting PPPs.

It is also interesting to notice the much higher PPP based on education than using the GDP-based PPP for Germany, Portugal and Switzerland. The difference is more than 20 per cent. It is reasonable to suspect that this has to do with the fact that teacher wages are high relative to the average wage level in these countries.

In EaG there are only published rudimentary data for teacher wages. EaG reports teacher wages in primary and secondary education for teachers in their first job, teachers with 15 years experience and teachers at the top of the wage schedule. To get an impression of teacher wages in each country, we took the unweighted average of all the reported wage rates in each country, and related this average wage to GDP per capita. This ratio is indicative of the relative wages of teachers in each country. This indicator suggests that the relative wage level for teachers is particularly high in Portugal, Switzerland and Germany, cf Figure 3.1. Actually, relative wages seem to be highest in Korea, but PPPs based on education expenditure data was not available for that country.

Figure 3.1 Proxy for teacher wages relative to GDP per capita



Source: OECD (2003), ECON

3.2 Expenditure at various levels of education

Below we show the expenditure levels at various levels of education using the different PPP exchange rates. This chapter displays figures of the expenditure

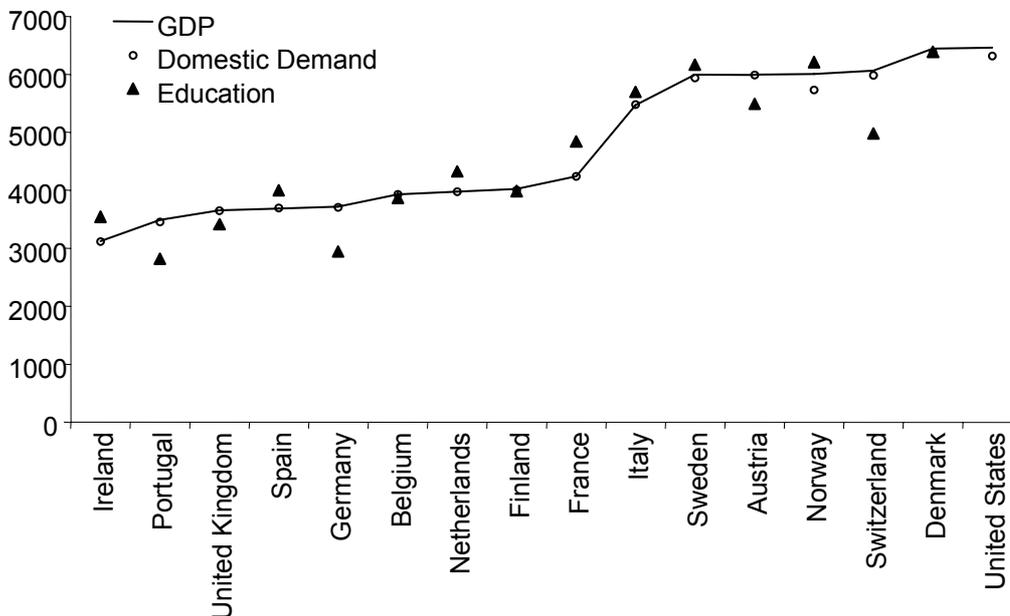
levels per student in common currency for a number of higher-income countries. The figures only show expenditures using the GDP-based PPP, the domestic demand-based PPP and the PPP based on the prices of education services. In the appendix is shown the expenditure levels for all countries that are included in the analysis.

3.2.1 Expenditure on primary education

Figure 3.2 shows that the effect of changing from GDP-based PPP to the domestic demand-based PPP means little for the estimate of education expenditures for almost all countries displayed. Only for Norway, going from the GDP-based to the domestic demand-based PPP produces noticeable changes in the estimated volumes of education expenditure. This mirrors the differences in the PPPs commented upon in section 3.1, and is probably related to the large Norwegian petroleum exports.

Because the PPP based on education services for Germany and Switzerland deviates so much from the GDP-based PPP because of, we believe, high teacher wages, the volumes of education expenditures in these countries are adjusted downwards when the education-based PPP is used. The fact that these countries use resources on education by paying teachers well, is accordingly not registered as a volume effect, but will be considered as a price effect, when using the PPP based on education services.

Figure 3.2 Expenditure on primary education in 2000, using different PPP's. Euro per student



Source: OECD, Eurostat, ECON.

Effects on country ranking

Table 3.2 shows the ranking of expenditures by country for all PPP's. In the appendix we show the absolute expenditure levels in 2000 by using the different PPPs.

The general impression is that the implications for the country rankings of choosing another PPP than the one based on GDP are relatively small for most countries. The exceptions from this rule are mainly linked to the use of the Non-market-services PPPs (Education and Government consumption). Here the ranking differs substantially when moving to the PPP based on education services for countries where teacher wages seem particularly high. The reduction in ranking is 5 places for Switzerland, 7 places for Germany and 5 places for Portugal. Contrary, Iceland moves from being 7th to first place when moving from PPP based on GDP to PPP based on education services. We do not know whether teacher wages are particularly low in Iceland, since teacher wages in Iceland are not reported in EaG (2003). We notice also that the ranking of medium income countries like Poland and Hungary is raised substantially when moving to the education-based PPP. This probably reflects the comparatively low overall (and teacher) real wages in these countries.

Table 3.2 Ranking of countries on level of expenditure on primary education per student in 2000, using different PPP's. European countries only

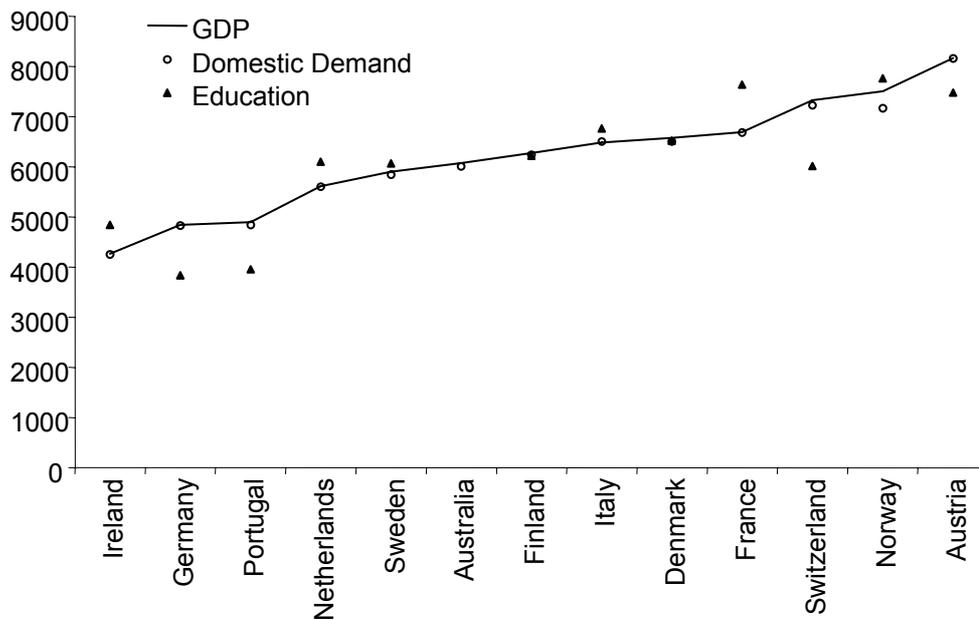
| | GDP | Domestic Demand | Actual individual consumption | Education | Final consumption by households | Final consumption by Government |
|----------------|-----|-----------------|-------------------------------|-----------|---------------------------------|---------------------------------|
| Denmark | 1 | 1 | 1 | 2 | 1 | 1 |
| Switzerland | 2 | 3 | 4 | 7 | 3 | 6 |
| Norway | 3 | 5 | 5 | 3 | 5 | 3 |
| Austria | 4 | 2 | 2 | 6 | 2 | 5 |
| Sweden | 5 | 4 | 3 | 4 | 4 | 2 |
| Italy | 6 | 7 | 6 | 5 | 6 | 7 |
| Iceland | 7 | 6 | 7 | 1 | 7 | 4 |
| France | 8 | 8 | 8 | 8 | 8 | 8 |
| Finland | 9 | 9 | 12 | 13 | 14 | 10 |
| Netherlands | 10 | 10 | 9 | 9 | 9 | 9 |
| Belgium | 11 | 11 | 10 | 14 | 11 | 13 |
| Germany | 12 | 12 | 11 | 19 | 10 | 17 |
| Spain | 13 | 13 | 13 | 12 | 13 | 12 |
| United Kingdom | 14 | 14 | 14 | 17 | 12 | 14 |
| Portugal | 15 | 15 | 15 | 20 | 15 | 15 |
| Ireland | 16 | 16 | 17 | 16 | 16 | 18 |
| Greece | 17 | 17 | 16 | 11 | 17 | 11 |
| Hungary | 18 | 18 | 18 | 10 | 18 | 16 |
| Poland | 19 | 19 | 19 | 15 | 19 | 19 |
| Czech Republic | 20 | 20 | 20 | 18 | 20 | 20 |
| Slovakia | 21 | 21 | 21 | 21 | 21 | 21 |

Source: OECD, Eurostat, ECON.

3.2.2 Expenditure on lower secondary education

The consequences of choosing different PPP-based exchange rates for expenditures on lower secondary education are shown below. The same pattern is found, since the only factor changing between alternatives is the type of exchange rate used for currency conversion.

Figure 3.3 Expenditure on lower secondary education in 2000, using different PPP's. Euro per student



Source: OECD, Eurostat, ECON.

Table 3.3 Ranking of countries on level of expenditure on lower secondary education per student in 2000, using different PPP's

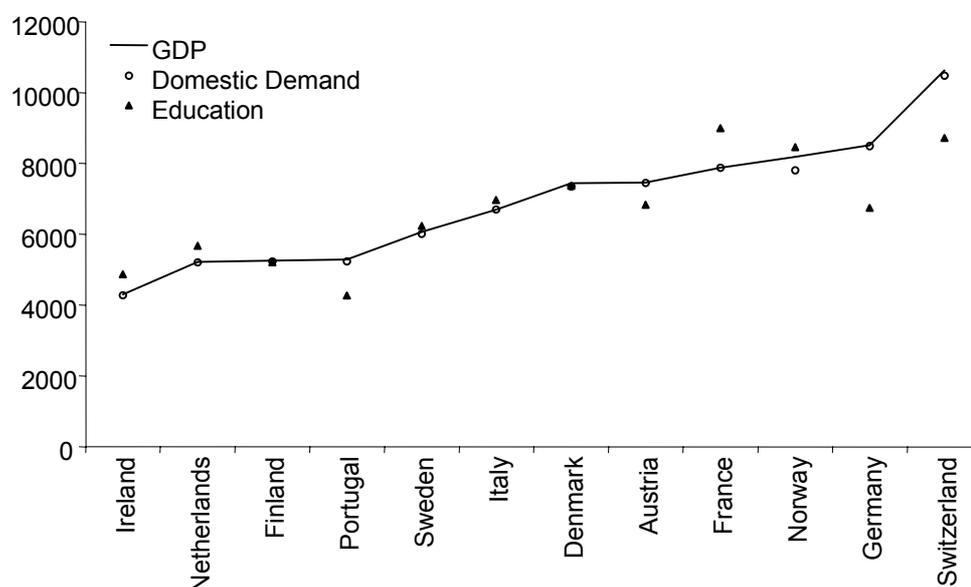
| | GDP | Domestic Demand | Actual individual consumption | Education | Final consumption by households | Final consumption by Government |
|----------------|-----|-----------------|-------------------------------|-----------|---------------------------------|---------------------------------|
| Austria | 1 | 1 | 1 | 4 | 1 | 1 |
| Norway | 2 | 3 | 2 | 1 | 3 | 2 |
| Switzerland | 3 | 2 | 3 | 10 | 2 | 5 |
| France | 4 | 4 | 4 | 2 | 5 | 3 |
| Denmark | 5 | 5 | 5 | 6 | 4 | 6 |
| Italy | 6 | 6 | 6 | 5 | 6 | 8 |
| Finland | 7 | 8 | 9 | 7 | 9 | 7 |
| Iceland | 8 | 7 | 7 | 3 | 7 | 4 |
| Sweden | 9 | 9 | 8 | 9 | 8 | 9 |
| Netherlands | 10 | 10 | 10 | 8 | 10 | 10 |
| Portugal | 11 | 11 | 12 | 14 | 12 | 11 |
| Germany | 12 | 12 | 11 | 15 | 11 | 14 |
| Ireland | 13 | 13 | 13 | 12 | 13 | 12 |
| Czech Republic | 14 | 14 | 14 | 11 | 14 | 13 |
| Hungary | 15 | 15 | 15 | 13 | 15 | 15 |
| Slovakia | 16 | 16 | 16 | 16 | 16 | 16 |

Source: OECD, Eurostat, ECON.

3.2.3 Expenditures on upper secondary education

In this section we display the per student expenditures on upper secondary education using different PPPs.

Figure 3.4 Expenditure on upper secondary education in 2000, using different PPP's. Euro per student



Source: OECD, Eurostat, ECON

Table 3.4 Ranking of countries on level of expenditure on upper secondary education per student in 2000, using different PPPs. European countries only

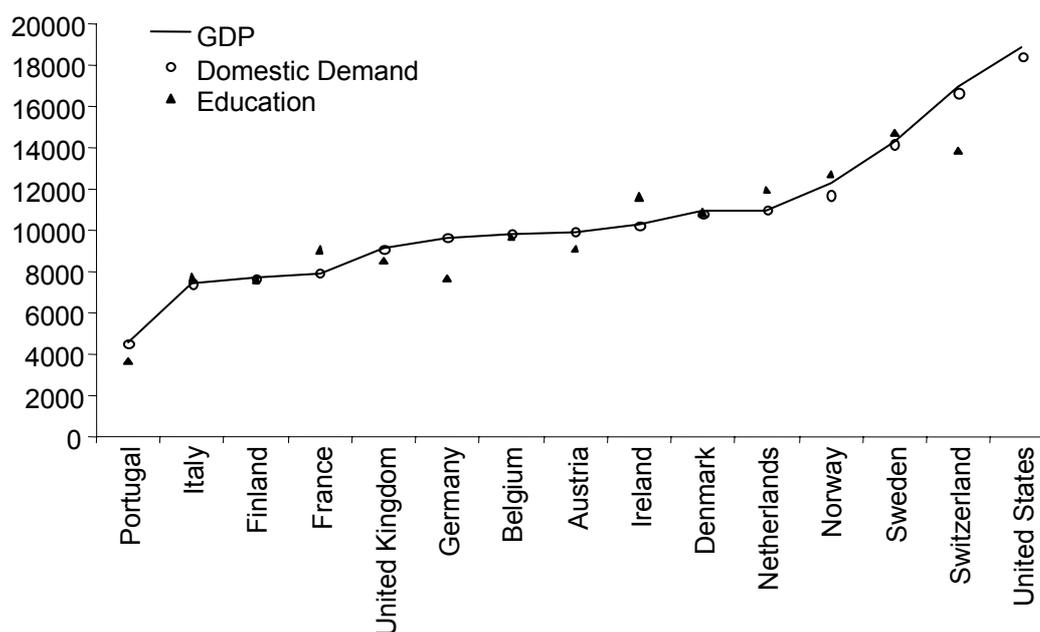
| | GDP | Domestic Demand | Actual individual consumption | Education | Final consumption by households | Final consumption by Government |
|----------------|-----|-----------------|-------------------------------|-----------|---------------------------------|---------------------------------|
| Switzerland | 1 | 1 | 1 | 2 | 1 | 1 |
| Germany | 2 | 2 | 2 | 8 | 2 | 4 |
| Norway | 3 | 4 | 4 | 3 | 3 | 3 |
| France | 4 | 3 | 3 | 1 | 4 | 2 |
| Austria | 5 | 5 | 5 | 7 | 5 | 6 |
| Denmark | 6 | 6 | 6 | 4 | 6 | 5 |
| Italy | 7 | 7 | 7 | 6 | 7 | 8 |
| Sweden | 8 | 8 | 8 | 9 | 8 | 9 |
| Iceland | 9 | 9 | 9 | 5 | 9 | 7 |
| Portugal | 10 | 10 | 11 | 16 | 10 | 12 |
| Finland | 11 | 11 | 12 | 13 | 12 | 11 |
| Netherlands | 12 | 12 | 10 | 11 | 11 | 10 |
| Ireland | 13 | 13 | 13 | 14 | 13 | 14 |
| Czech Republic | 14 | 14 | 14 | 10 | 14 | 13 |
| Hungary | 15 | 15 | 15 | 12 | 15 | 15 |
| Slovakia | 16 | 16 | 16 | 15 | 16 | 16 |
| Poland | 17 | 17 | 17 | 17 | 17 | 17 |

Source: OECD, Eurostat, ECON

3.2.4 Expenditures on tertiary education

In this section we display the per student expenditures on tertiary education using different PPPs.

Figure 3.5 Expenditure on tertiary education in 2000, using different PPP's. Euro per student



Source: OECD, Eurostat, ECON

Table 3.5 Ranking of countries on level of expenditure on tertiary education per student in 2000, using different PPPs. European countries only

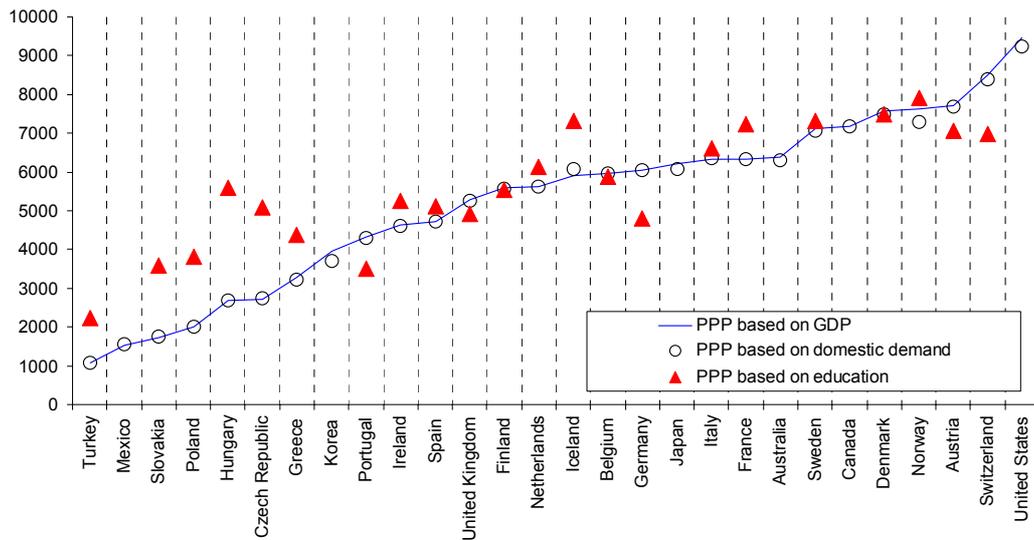
| | GDP | Domestic Demand | Actual individual consumption | Education | Final consumption by households | Final consumption by Government |
|----------------|-----|-----------------|-------------------------------|-----------|---------------------------------|---------------------------------|
| Switzerland | 1 | 1 | 1 | 2 | 1 | 1 |
| Sweden | 2 | 2 | 2 | 1 | 2 | 2 |
| Norway | 3 | 3 | 3 | 4 | 3 | 3 |
| Netherlands | 4 | 4 | 4 | 5 | 4 | 4 |
| Denmark | 5 | 5 | 5 | 7 | 5 | 6 |
| Ireland | 6 | 6 | 6 | 6 | 8 | 5 |
| Austria | 7 | 7 | 7 | 11 | 7 | 9 |
| Belgium | 8 | 8 | 9 | 8 | 9 | 8 |
| Germany | 9 | 9 | 8 | 16 | 6 | 12 |
| United Kingdom | 10 | 10 | 10 | 14 | 10 | 10 |
| France | 11 | 11 | 11 | 12 | 11 | 11 |
| Finland | 12 | 12 | 14 | 17 | 14 | 14 |
| Italy | 13 | 14 | 13 | 15 | 12 | 16 |
| Iceland | 14 | 13 | 12 | 10 | 13 | 13 |
| Hungary | 15 | 15 | 15 | 3 | 16 | 7 |
| Spain | 16 | 16 | 16 | 18 | 15 | 18 |
| Czech Republic | 17 | 17 | 17 | 9 | 17 | 15 |
| Portugal | 18 | 18 | 19 | 20 | 18 | 19 |
| Slovakia | 19 | 19 | 18 | 13 | 19 | 17 |
| Greece | 20 | 20 | 20 | 19 | 20 | 20 |

Source: OECD, Eurostat, ECON

3.2.5 Expenditures on primary through tertiary education

This section summarises the effects of varying PPPs on the per student expenditures on primary through tertiary education. Different from the preceding sections, we display the full range of countries.

Figure 3.6 Expenditure on primary through tertiary education in 2000, using different PPP's. Euro per student



Source: OECD, Eurostat, ECON

Table 3.6 Ranking of countries on level of expenditure on primary through tertiary education per student in 2000, using different PPPs. European countries only

| | GDP | Domestic Demand | Actual individual consumption | Education | Final consumption by households | Final consumption by Government |
|----------------|-----|-----------------|-------------------------------|-----------|---------------------------------|---------------------------------|
| Switzerland | 1 | 1 | 1 | 7 | 1 | 1 |
| Austria | 2 | 2 | 2 | 6 | 2 | 3 |
| Norway | 3 | 4 | 4 | 1 | 4 | 2 |
| Denmark | 4 | 3 | 3 | 2 | 3 | 4 |
| Sweden | 5 | 5 | 5 | 4 | 5 | 5 |
| France | 6 | 7 | 6 | 5 | 8 | 6 |
| Italy | 7 | 6 | 7 | 8 | 7 | 8 |
| Germany | 8 | 9 | 8 | 17 | 6 | 13 |
| Belgium | 9 | 10 | 9 | 10 | 9 | 10 |
| Iceland | 10 | 8 | 10 | 3 | 11 | 7 |
| Netherlands | 11 | 11 | 11 | 9 | 10 | 9 |
| Finland | 12 | 12 | 13 | 12 | 13 | 11 |
| United Kingdom | 13 | 13 | 12 | 16 | 12 | 12 |
| Spain | 14 | 14 | 14 | 14 | 14 | 14 |
| Ireland | 15 | 15 | 15 | 13 | 15 | 15 |
| Portugal | 16 | 16 | 16 | 21 | 16 | 17 |
| Greece | 17 | 17 | 17 | 18 | 17 | 18 |
| Czech Republic | 18 | 18 | 19 | 15 | 18 | 19 |
| Hungary | 19 | 19 | 18 | 11 | 19 | 16 |
| Poland | 20 | 20 | 20 | 19 | 20 | 20 |
| Slovakia | 21 | 21 | 21 | 20 | 21 | 21 |
| Turkey | 22 | 22 | 22 | 22 | 22 | 22 |

Source: OECD, Eurostat, ECON

3.3 Concluding comments

From this data exercise we find that the effects of utilising other PPPs than the GDP-based PPP rate in 2000 produces relatively small changes in country rankings of education expenditure. For Norway, the ranking is between 2 and 4, using alternative definitions.

For the ranking of education expenditures per student from primary through tertiary education, the average change of rank was 0.4 places when switching from the GDP-based PPP to the PPP based on domestic demand. When switching to the PPP based on education, the average change of rank was 2.7 places. The average changes of rank was higher than these averages for tertiary education expenditure per student (3.2 places when switching to PPP based on education). For Lower secondary and upper secondary this average change of rank was smaller, 2.1 places for lower secondary education and 2.2 places for upper secondary education.

The general impression is that the education-based PPP produces the most different results from those using the GDP-based PPP. It is a general tendency that using the education-based PPP raises education expenditure in low- and medium income countries in central Europe. For traditional medium income countries in western Europe, we find exceptions, however (e.g. Portugal). There are also some noticeable differences from using the education-based PPP, foremost the much lower expenditures in Germany, Switzerland and the UK when this PPP is used.

4 Growth estimates 1995-2000 using alternative price indices

In this chapter, the consequences of using different deflators (price indices) are described. In EaG per cent increase in real expenditure per student is estimated by deflating nominal values in 1995 by the GDP deflators of the different countries. Below we display the resulting estimates of volume growth by also using the price indices for

- Domestic demand
- Individual consumption (private or government financed)
- Education services
- Household consumption
- Government consumption.

Data in national currency, constant prices, were first calculated by using the GDP-based PPPs found in EaG. Expenditure in current prices were calculated by using the GDP-deflators from OECD. These current prices-data were then subject to deflation with the different price indices mentioned above. We utilise Eurostat data, which do not cover non-European OECD countries (US, Canada, Japan, etc).

We show per cent change in the volume of education services per student from 1995 to 2000 for primary and secondary education and for tertiary education, cf. tables and figures below. The effects of using different price indices are the same for the sub-groups lower secondary education and higher secondary education, since in all cases it is only the price index that varies.

The figures display the percentage change from 1995 to 2000 with the highest estimate, the lowest estimate and the estimate using the GDP deflator.

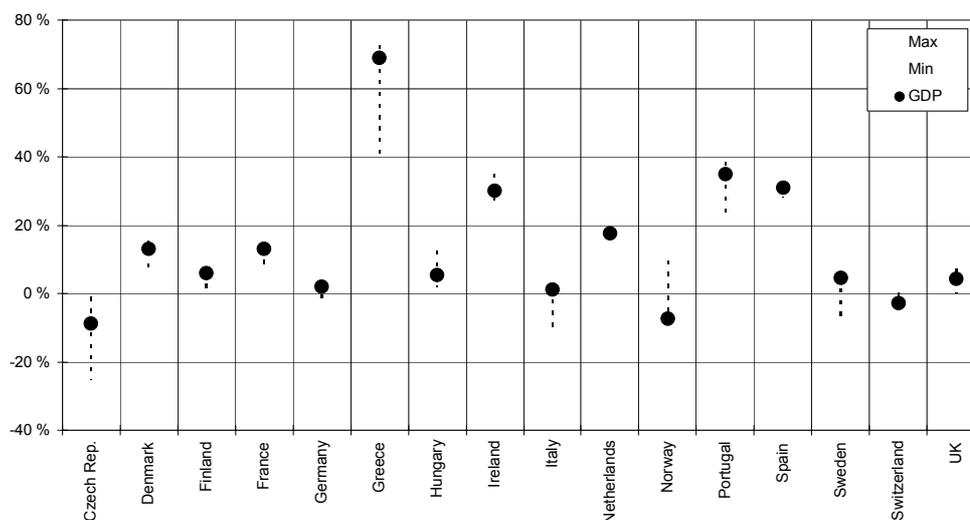
4.1 Primary and secondary education

Table 4.1 Increase in real education expenditure per student from 1995 to 2000 using alternative deflators – Primary and secondary education⁹. Per cent

| | <i>Deflator used to compare expenditure in 1995 and 2000</i> | | | | | | |
|----------------|--|-----------------|-------------------------------|-----------|---------------------------------|---|--|
| | GDP (used in Education at a Glance) | Domestic demand | Actual individual expenditure | Education | Final consumption by households | Final Consumption expenditure by government | |
| Czech Republic | -8,9 | -5,4 | -6,8 | (*) | -1,4 | -25,0 | |
| Denmark | 13,1 | 15,4 | 12,5 | 7,9 | 12,9 | 11,7 | |
| Finland | 5,9 | 1,1 | 3,3 | 3,3 | 3,7 | 1,6 | |
| France | 13,1 | 12,6 | 12,0 | 6,9 | 12,3 | 11,5 | |
| Germany | 1,9 | 0,5 | -0,5 | -1,7 | -1,5 | 3,0 | |
| Greece | 69,1 | 69,8 | 69,6 | 40,2 | 72,2 | 53,6 | |
| Hungary | 5,5 | 4,0 | 3,1 | 12,3 | 2,4 | 4,1 | |
| Ireland | 30,0 | 27,1 | 34,2 | (*) | 34,9 | 30,5 | |
| Italy | 1,2 | 0,4 | -0,2 | -10,5 | 1,3 | -6,3 | |
| Netherlands | 17,7 | 16,5 | 16,6 | (*) | 17,3 | 15,4 | |
| Norway | -7,3 | 6,5 | 6,8 | -0,4 | 9,3 | -0,2 | |
| Portugal | 34,9 | 34,3 | (*) | (*) | 38,2 | 22,5 | |
| Spain | 30,8 | 30,5 | (*) | 28,5 | 31,6 | 31,5 | |
| Sweden | 4,6 | 0,5 | 1,0 | -8,1 | 4,3 | -5,5 | |
| Switzerland | -2,7 | -2,7 | (*) | (*) | (*) | -0,1 | |
| United Kingdom | 4,2 | 6,9 | 4,3 | (*) | 5,9 | 0,2 | |

(*) Deflator not available from Eurostat

Figure 4.1 Increase in real education expenditure per student from 1995 to 2000 – Official EaG-calculation and the highest and lowest alternative calculations – Primary and secondary education



⁹ Including post-secondary non-tertiary education

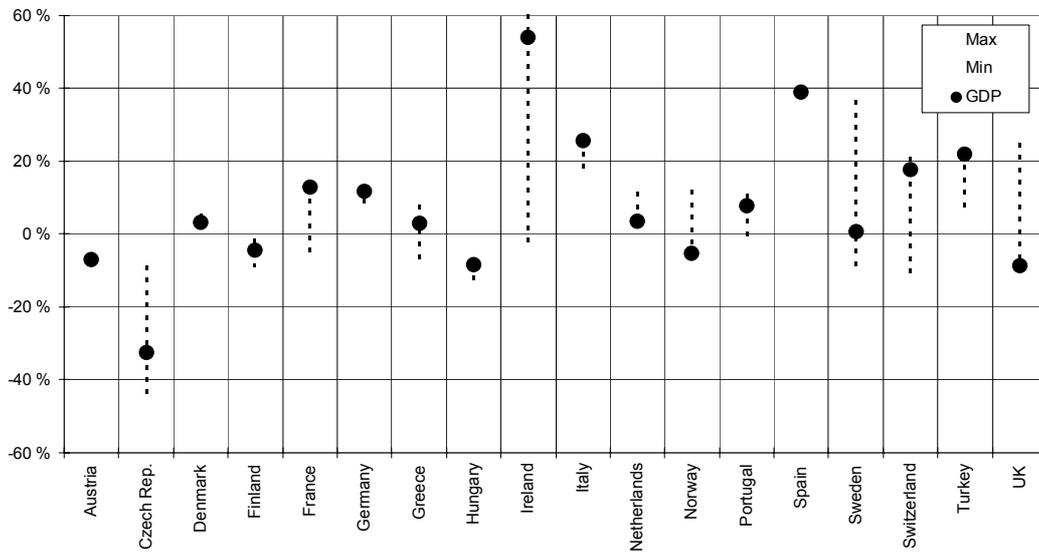
4.2 Tertiary education

Table 4.2 Increase in real education expenditure per student from 1995 to 2000 using six alternative deflators – Tertiary education. Per cent

| | <i>Deflator used to compare expenditure in 1995 and 2000</i> | | | | | |
|----------------|--|-----------------|-------------------------------|-----------|---|---|
| | GDP (used in Education at a Glance) | Domestic demand | Actual individual expenditure | Education | Final consumption expenditure by households | Final Consumption expenditure by government |
| Austria | -7,0 | -8,4 | -8,3 | -9,1 | -8,2 | -8,7 |
| Czech Republic | -32,4 | -29,8 | -30,8 | (*) | -26,9 | -44,3 |
| Denmark | 3,2 | 5,4 | 2,7 | -1,5 | 3,1 | 2,0 |
| Finland | -4,5 | -8,8 | -6,8 | -6,8 | -6,5 | -8,3 |
| France | 13,0 | 12,5 | 11,9 | 6,8 | 12,2 | 11,3 |
| Germany | 11,7 | 10,2 | 9,1 | 7,8 | 8,0 | 12,9 |
| Greece | 3,1 | 3,5 | 3,4 | -14,6 | 5,0 | -6,4 |
| Hungary | -8,3 | -9,5 | -10,3 | -2,3 | -10,9 | -9,4 |
| Ireland | 54,2 | 50,8 | 59,2 | (*) | 60,0 | 54,9 |
| Italy | 25,6 | 24,6 | 23,9 | 11,1 | 25,8 | 16,4 |
| Netherlands | 3,6 | 2,6 | 2,6 | (*) | 3,3 | 1,6 |
| Norway | -5,2 | 8,9 | 9,2 | 1,9 | 11,7 | 2,1 |
| Portugal | 7,9 | 7,5 | (*) | (*) | 10,6 | -2,0 |
| Spain | 39,1 | 38,8 | (*) | 36,6 | 39,9 | 39,8 |
| Sweden | 0,8 | -3,2 | -2,6 | -11,4 | 0,6 | -8,9 |
| Switzerland | 17,7 | 17,7 | (*) | (*) | (*) | 20,9 |
| Turkey | 22,1 | 21,6 | (*) | 24,9 | 21,1 | 7,3 |
| United Kingdom | -8,7 | -6,3 | -8,5 | (*) | -7,1 | -12,1 |

(*) Deflator not available from Eurostat

Figure 4.2 Increase in real education expenditure per student from 1995 to 2000 – Official EaG-calculation and the highest and lowest alternative calculations – Tertiary education



4.3 Concluding comments

The differences in per cent change in the volume of resources per student from 1995 to 2000 as a consequence of using different price indices are the same for the average of primary and secondary education as for tertiary education, because in both cases the PPPs are the only variable that varies. We thus comment only on the effects of per cent change for the average of primary and secondary education.

For Norway, we see the striking effect of using the GDP price index compared to the results when we use price indices for domestic use of goods and services. Using the GDP price index, real expenditures on primary and secondary education declined by 7 percent, while it increased if one chose any of the other price indices. Using the deflator for domestic demand, real expenditure per student increased by more than 6 per cent. This is a consequence of the extraordinary high reliance on petroleum products in Norwegian exports, and the effect of the extraordinary surge in oil and gas prices in the second half of the 1990's. Since petroleum exports is a large fraction of Norwegian exports and because Norwegian exports is a large fraction of GDP, the oil and gas price increase in the late 1990s manifested itself in an extraordinary large increase in the GDP deflator. But this export price hike did not affect domestic prices to any noticeable degree. Therefore the increase in the GDP deflator from 1995 to 2000 far outpaced the increase in the deflator for domestic demand. From Appendix table 2 we see that while the deflator for domestic demand had increased by 14 per cent from 1995 to 2000, the GDP deflator had increased by 31 per cent.

Also for other small open economies such as Sweden and Denmark we find substantial discrepancies between estimates of real growth in education expenditures from switching from the GDP price index to price indices for domestic demand. The difference between growth estimates are 4 per cent points for Sweden, 5 per cent points for Finland and 2 per cent points for Denmark. Even for Germany and the United Kingdom there were noticeable differences in the growth of real educa-

tion expenditures when changing from the GDP-deflator to the domestic demand deflator.

Switching to the education price index for calculating volume changes over time results, as in the case of PPPs, in huge changes of estimates. First, it is a general tendency that growth estimates are revised downwards, and for some countries very much so. Growth estimates for real primary and secondary education expenditures in Italy declines from 1,2 per cent using the GDP price index to -10.5 per cent using the price index for education. In France the growth estimate changes from 13 per cent to 7 per cent. These changes are probably the results of increases in teachers' real wages per man-year, as a consequence of the general increases in real wages over time.

When real wages increase, the price indices of education (and other price indices of non-market services where wage indices are used as input prices) will rise faster than the general price indices (whether they be the GDP deflator or deflator for domestic demand components). Higher price increases in the period gives lower real growth estimates.

The growth estimates using the education price index are usually either the highest or the lowest growth estimate for each country. We do not have a good explanation why this is so. It may reflect inter-country differences in the development of real wages for public sector employees in general and for teachers in particular.

The consequences of using the price indices for government consumption, private consumption or domestic demand (the weighed average of these three deflators) seem to be relatively smaller than the consequences of using the education deflator.

In general the growth estimates are very sensitive to the choice of price index. For around half the countries, the difference between highest and lowest growth estimate is more than 10 percentage points, or approximately 2 percentage points per year.

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Appendix 1: Theoretical ideals.

A1.1 Price comparisons across borders

Expenditure data cannot be directly used to compare volumes of educational expenses. The reason is, of course, that expenditure data come in different currencies or relate to prices before and after inflation. To compare volumes using expenditure data one needs a price index or exchange rate. A price index actually is a particular exchange rate, namely that between price levels before and now, so we use the name *exchange rate* to comprise both phenomena. The question is how to construct an ideal exchange rate? To discuss current practice for constructing exchange rates we begin by defining what the ideal practice would be. In other words, what is one striving for when one constructs exchange rates in order to accurately comparing educational expenses?

The ideal practice is a theoretical ideal. It abstracts from all, or at least most measurement errors, missing data and other practical limitations. Still the theoretical ideal is a reasonable benchmark for actual practice. Does the current practice come “close” to the theoretical ideal, or is it “far” from the ideal? Is the current practice closer to, or farther away than some alternative practice? These are examples of how one might use the theoretical ideal to benchmark actual practice for constructing exchange rates.

We wish to compare the volume of *inputs to the educational system*

The appropriate choice of exchange rate depends on what one is interested in comparing. We are interested in measuring the price of one resource unit used for education. Let us assume that this smallest resource unit is one man-year (and thus abstract from any quality differences). Thus, the price of one teacher man-hour (or man-year) is the price of this smallest unit.¹⁰

However, even if the education sector is labour intensive, and inputs to the educational system mainly consist of labour services for students and for supporting services, other input factors must also be accounted for. Besides labour services, inputs to the educational system are intermediate inputs (pencils and text-books are trivial examples) and capital services (class-rooms, swimming halls, school libraries, etc).

The main problem is adjusting for quality

An obvious, but extremely important point with respect to labour, intermediate inputs and capital services is quality differences. A teacher with a PhD is expected to supply a better educational service to high-school students than a teacher without a university education; a headmaster is considered more important than a secretary; a well equipped science lab has higher quality than a poorly equipped one,

¹⁰ Researchers in the PPP literature (cf. e.g. Dean, 2002) have tried to measure the services received by each student by adjusting for e.g. differences in class size. This might (or might not) be appropriate in the contexts of measuring the volume of educational services reaching each student, but not when trying to measure the price levels of one unit of resources used in education, which is the task in this project.

etc. The main problem in comparing the volume of educational inputs lies in how to account for the quality of educational services. To illustrate, we will first deduct principles for the correct exchange rate to use between two countries, Norway and Portugal, given that there are no quality difference to worry about.

Rate of comparison (exchange rate) given no quality difference

Say that we wish to compare the volume of educational services in Norway and Portugal. The most important component is labour – teaching. Assume, as is in fact the case, that the number of teacher man-years is known in Portugal and Norway. Then make the extreme assumption that there is no difference in quality between different teachers within each of Norway and Portugal, nor is there any difference between the Norwegian teacher (now only one type) and the Portuguese teacher. Then we can use the number of teachers directly as a measure of the volume of teaching input. But assume that we are prohibited from using the number of teachers directly. We must start from expenses used on teachers in local currencies, and use the correct exchange rate to derive the volume of teaching input. We proceed as follows:

Since we know the number of teaching man-years and the expenses on teaching, we find the average wage for teachers in each of Norway and Portugal. Say that it is 300 000 NOK in Norway and 20 000 € in Portugal. Then we know that we find the number we are interested in by dividing expenses in Norway by 300 000 and expenses in Portugal by 20 000. But on reflection we see that dividing expenses in Norway by 30 000 and those in Portugal by 2000 will also generate a correct impression of the volume of teaching services (only that the resulting number is ten times the number of teachers in both Norway and Portugal.). It is the relative difference between wage levels in Norway and Portugal that matters. So it is also correct to divide expenses in Norway by 15 (or multiply those in Portugal by the same number).¹¹

After treating labour we move on to intermediate expenses including pencils, books etc. Say that we are fortunate enough to know, to a reasonable degree of precision, the content of the basket of intermediate expenses in Norway and Portugal. This information is provided by the statistics bureaus in each country and is presented as a fixed-price basket. Equipped with our assumption that there is no quality difference we proceed as before and find the relative exchange rate between Norway and Portugal¹². We cannot expect it to be precisely the same as in the case of labour. Say that for intermediate expenses it is 10.

¹¹ A simple formula may help some readers: We assume the equality $w_N L = e w_P L$, where w_N is the wage in Norway (300000 NOK in the example above), w_P is the wage in Portugal (20000 € in the example above, L is the number of teacher man-years (1 in the example above, this variable will be more important in the next section) and e is the exchange rate (15 in the example). Solving the equation for e yields $e = w_N / w_P$. In practice we are given $C_N = w_N L_N$ and $C_P = w_P L_P$, and wish to compare which is largest. Let us try comparing by multiplying C_P and e . We find that $e C_P < C_N$ equals $w_N / w_P * w_P L_P < w_N L_N$, which equals $L_N < L_P$. Thus $e C_P < C_N$ if and only if $L_N < L_P$. In words, the cost in Portugal multiplied by “our” exchange rate, is lower than the cost in Norway if and only if Portugal employs fewer teachers (by definition they have the same quality).

¹² Note that in this case we not only assume that the quality of pencils, computers etc. is the same in both countries, but also that both countries purchase the same number of pencils and computers to their schools. Otherwise, in case Norway only purchases pencils and Portugal only purchases computers there would be a quality difference. It might not be realistic that Norway only purchases pencils and Portugal only computers, but one reason for expecting systematic differences between countries is the fact that some expenses are privately paid in some countries and publicly paid in others.

Finally we take on capital services and perform the same operation there: An estimate of the fixed-price bundle in each country, and assuming no quality difference¹³, gives us the tools to estimate the relative exchange rate. Say that in this case it is 17.

Given the assumption of no quality difference the numbers 15, 10 and 17 are all that we need to compute the *volume of educational services* in Norway compared to Portugal. If we benchmark the volume in Portugal to unity, we find the similarly benchmarked volume in Norway by dividing Norwegian labour expenses by 15, intermediate expenses by 10 and capital expenses by 17.

Two things are worth noticing: a) Only the prices of educational services enter into the comparison, and b) actually we will also reach the correct answer by adding together all educational expenses in Norway and dividing by the weighted average of 15, 10 and 17, using the share of each expenditure category as weights. This weighted average is the purchasing power parity index for educational services – given the assumption of no quality difference. Note the two requirements to this index: only the right inputs should enter, i.e. educational expenditure inputs, and the weights should refer to educational expenditure, in the same year, adding over those inputs. In addition, of course, everything should be measured correctly and the maintained hypothesis is that of no quality difference.

But quality differences exist

Quality differences do exist, but the example without quality differences is instructive because it hints at how to handle those differences. There are two general procedures: distinguishing finer categories of input and obtaining quality adjustment estimates from independent sources.

Distinguishing finer categories obviously alleviates the problem that different broad categories, like intermediate inputs, contain different baskets, like pencils and computers. This implies distinguishing different categories of teachers, different categories of material inputs, different categories of capital services etc.

However, there is a limit to differentiation as one cannot list, e.g. intermediate inputs of all shapes and colours. In practical terms the limits are set by statistical agencies in each country, by Eurostat, OECD etc. It does not matter who does it really, but someone has to set a limit. Within the confines of the practical limits there remains quality difference between inputs.

The task, after having finely distinguished between categories, is to adequately adjust for quality differences. But how? The answer to this question obviously requires a notion of what quality is, and that is not so obvious since we explicitly have stated that we do not attempt to measure educational output or outcomes. Just like high quality leather does not necessarily make a high quality shoe we are looking for a concept of quality of educational services that can be entered as an input to the process without necessarily affecting outcomes.

¹³ Again, it is not only the case of a classroom being a classroom in both countries, but also a case of whether the same amount of classrooms, swimming halls, science labs etc enter into the baskets of each country. In fact, the same issue is present in the case of labour: it is not only the case of headmasters being of the same quality in each country, but also the case of whether the same amount of headmasters, assistants etc. enter into the labour “basket”.

The analogy with high quality leather suggests that quality may be operationally defined in terms of educational background of teachers, chip power of computers, age of physical capital etc. This is the same question that statisticians grapple with when controlling for quality in statistical measurements, not least the National Accounts. Their debate currently centres on how to handle quality advances in computer technology and capital services in general, see, e.g. the article by Pakes (2003) in the December 2003 issue of *American Economic Review* for a demonstration that this debate is current and topical. Dean (2002) discusses various attempts at correcting for quality in labour input in education with a perspective slightly different from ours.

The hedonic perspective to quality

One approach to quality is to use market information to measure quality differences. While it would take us far beyond our scope to enter into the debate on adjusting inputs for quality, it is worth recalling that the general starting point in the debate is the perspective that is called the hedonic perspective in economics. The hedonic perspective says that how much more the market is willing to pay for one object compared to a seemingly similar other object, indicates the quality difference between the two objects. Is this principle relevant here? Let us consider an example where we look at two regions with the same currency, but with different education policy. These regions might be two European countries in the Euro zone.

In the first region, education policy has high priority, teacher must have long education and high personal skills. To recruit enough of such teachers, the authorities must offer teachers high wages in return. In the other region, education is given lower priority, requirements for teacher education are more lax and personal skills are not considered that important. Therefore the authorities may be able to recruit and keep a sufficient number of teachers even though wages are lower than in region one.

In this situation, the relative wage levels can be good estimates for the quality of one teacher man-year in country one relative to the quality of one teacher man-year in country two.

The idea of the hedonic principle can be spelled out in the case of Norway. Return to our Norwegian teacher earning an income of 300 000. The hedonic perspective would ask: Suppose that this teacher is transplanted to Portugal, where he instantly obtains a family, children and speaks the language like a native. Everything that affects his welfare is equal to Norway, except that he is situated in Portugal. How much would this teacher demand in pay, given that he at any point can costlessly return to his former life in Norway and earn 300 000?

Assume that wages generally are lower in Portugal, but so is the price of wine, housing and everything else that the teacher cares for. The teacher might consider as follows: 300 000 NOK in Norway, where the price level is high, is equivalent for me to 30 000 € in Portugal. This despite the fact that 30 000 €, at the current nominal exchange rate of 8 NOK/€, converts into only 240 000 NOK. The analyst could then say that the relative difference between 30000 and 20000, that is 1.5, indicates the quality difference between the Norwegian teacher and his Portuguese counterpart, while the rest of the nominal difference between Norwegian and Por-

tuguese wages should be eliminated by the purchasing power parity exchange rate.

Lacking the actual transplanted teacher it is interesting for the analyst to trace the steps in the reasoning of the hypothetical one. The crucial step is where the teacher compares how far his wage reaches in expensive Norway compared to cheap Portugal. In this step he compares prices on goods *in his consumption basket*.¹⁴ The lesson for the analyst is to use the *consumption* Purchasing Power Parity exchange rate in adjusting for quality.¹⁵

Thus in conclusion the purchasing power parity index of educational services gets intertwined with that of private consumption. First, use the consumption PPP to estimate quality difference. Then, use the educational labour input PPP together with the estimate of quality difference to estimate the difference in volume of educational labour service.

Some readers may find it easier if we describe our argument in a formula.

In fact it turns out that the educational labour input PPP cancels from this formula, so we are left with his is perhaps most succinctly stated in a formula:

$$PPP\text{-exchange rate teaching input} = q_N/q_P^{16}$$

Where q_N is the price level of the consumption basket in Norway and q_P is the price level of the consumption basket in Portugal. Remember that we use the exchange rate to help determine, on the basis of expenditure data which of Portugal and Norway has the highest volume of educational services. Denote educational expenses (on labour) by C and the exchange rate by e . w means wage and q means price. Subscript P denotes Portugal and N denotes Norway. We can show that

$$e C_P < C_N \text{ if and only if } L_P < (q_P/q_N) * (w_N/w_P) L_N^{17}$$

The formula says that educational expenses are lower in Portugal if and only Portugal uses fewer teachers in quality adjusted terms. Interestingly, quality is now a variable that depends on wages and prices in the two countries.

Finally on this item it should be said that the example did not account for labour costs except for wages, in particular, taxes, between countries. Nor did it account for the different standard of public services between countries. Fortunately, the tax and public service effects tend to net each other out since one is used to finance the other. It is too much to ask that they do so completely, however.

The conclusion from this discussion is that the hedonic principle leads us to use the private consumption PPP when converting educational expenditure between countries. However, in our opinion this is not necessarily a good solution. In the

¹⁴ Denote by w^* the wage that the Norwegian teacher accepts in Portugal. Let the price of the Norwegian consumption basket be q_N , and the price of the Portugese is q_P . We have $w^*/q_P = w_N/q_N$.

¹⁵ Given that wages pick up skills, the quality difference ratio is $a = w^*/w_P$. Inserting for w^* one obtains $a = q_P/q_N * w_N/w_P$.

¹⁶ We have $e = w_N/(w_P a)$ from fn. 4, and $a = q_P/q_N * w_N/w_P$ from fn. 7. Thus $e = q_N/q_P$.

¹⁷ Just use the formula of fn. 4 and insert for a from fn. 7.

educational policy debate, the data for resource use per student is often used as a measure of real inputs. For example resource use is often related to student scores in e.g. the PISA reports. Using the consumption PPP thus automatically implies that resource use is higher in high-income countries than in low-income countries. When comparing resource use with outcomes, low-income countries would automatically have low resource use. These properties would often be viewed as problematic in practical use of the expenditure indicators.

The hedonic perspective extended to non-labour services

It is more difficult envisaging the hedonic perspective used on capital services and intermediate services. In the case of capital services a possible candidate for the “consumption basket”, would be the general investment goods PPP, which, like the consumption goods PPP is available in official statistics. The argument leading to recommending the investment goods PPP is: Say that capital services, for instance science labs, have higher quality in Norway than Portugal, but the cost difference in science lab service production reflects both quality difference and price level difference. As a thought experiment we ask how much it would have cost to build the Norwegian quality science lab in Portugal at Portuguese investment good prices. So, instead of the consumption goods basket we need the investment goods basket.

Similarly, in case of intermediate services the relevant PPP is the “intermediate service PPP”. This PPP is probably not generally available. One could consider using the PPP of gross production value (which, unlike the GDP, consumption and capital service PPP’s at least includes intermediate services), but it would be a crude PPP, the more so since intermediate goods in the education sector are different from intermediate goods in general.

Problems with the hedonic principle

The appeal of the hedonic principle may become less obvious when we compare educational expenditures in countries or regions with very different real income levels. Let us thus look at measuring the price of education inputs in a high-income region in the Euro area (e.g. Germany) with a region with low real income level (Portugal).

In Germany, overall real wages are higher than in Portugal. This means that wages (and prices, but wages more so than prices) are generally higher in Germany. In order to employ a teacher of a given quality, the teacher wage level must be higher in Germany than in Portugal in real terms, permitting the German teacher to have a higher living standard than the Portuguese one. Otherwise not enough Germans would like to be teachers, but would rather work in the private sector. German teachers thus earn more than Portuguese teachers, even if the German teachers have not received more formal education or are not better teachers in other ways. The only reason why the German teacher earns more is because she or he lives in a more wealthy country¹⁸.

¹⁸ This effect has been labelled Baumol’s disease (Baumol, 1964). The mechanism runs as follows. Much of public services such as education and health care are by nature not subject to much technical change. As countries’ real income rises, wages rise more than prices on consumption goods. Since large parts of government sector is labour intensive and subject to little technical progress, there is a tendency for real prices of government services to rise above general inflation. The unit price of say one teacher

The hedonic principle in this case would nevertheless say that the differences in market wages reflect quality differences. If our German teacher earns 30.000 € per year, and our Portuguese teacher earns 25.000 € per year (and the number of students per teacher are the same in the two countries), one would conclude that in Germany one uses 20 per cent ($30.000/25.000$) more resources per student than in Portugal.

This is correct, but does this reflect differences in what we purport to measure; the differences in the volume of *inputs* into the education sector? The answer depends on what questions we actually ask. If we want to compare the volume of inputs in the education sector with students' scores in PISA tests, there are arguments in favour of not letting differences in real income levels between regions be interpreted as quality differences of teacher man-years. The economic values of a teacher may still be higher in high-income Germany than lower-income Portugal, since the economic value of the output (students' scores) are not the scores themselves, but the wages that students with a given score can earn in German industry.

In the case of establishing the PPP factor for comparing educational services between two countries with different currencies, the hedonic principle leads to the use of a private consumption or domestic demand PPP. The rejection of the hedonic principle, as we argued should be the case if we wanted to compare PISA scores in different countries, would be to let wages per teacher man-year or more generally the price level of education constitute the basis for the PPPs.

Appendix 2: General background data

*Appendix table 1 Purchasing Power Parities for year 2000
Euros and EU-15 price structure*

| | GDP (used in Education at a Glance) | Domestic demand | Actual indi- vidual expe- diture | Education | Final con- sumption expenditure by house- holds | Final Con- sumption expenditure by govern- ment |
|----------------|---|--------------------|--|---|---|---|
| Austria | 0,9952 | 0,9960 | 0,9923 | 1,0871 | 0,9817 | 1,0352 |
| Belgium | 1,0031 | 1,0038 | 1,0142 | 1,0204 | 1,0182 | 1,0149 |
| Czech Republic | 15,4685 | 15,3983 | 14,4239 | 8,2751 | 16,1388 | 10,0359 |
| Denmark | 9,1514 | 9,2488 | 9,2075 | 9,2364 | 9,1674 | 9,4204 |
| Finland | 1,0659 | 1,0708 | 1,1520 | 1,0749 | 1,1831 | 1,0556 |
| France | 0,9962 | 0,9963 | 0,9950 | 0,8725 | 1,0291 | 0,9108 |
| Germany | 1,0684 | 1,0707 | 1,0501 | 1,3485 | 1,0159 | 1,2060 |
| Greece | 0,7453 | 0,7593 | 0,7536 | 0,5590 | 0,7980 | 0,5820 |
| Hungary | 116,7420 | 115,7108 | 105,4840 | 55,8561 | 121,1110 | 70,5964 |
| Iceland | 90,6221 | 88,4380 | 91,7740 | 73,2234 | 95,2766 | 81,2860 |
| Ireland | 1,0379 | 1,0409 | 1,0534 | 0,9152 | 1,0738 | 0,9960 |
| Italy | 0,8796 | 0,8777 | 0,9015 | 0,8436 | 0,9038 | 0,9064 |
| Netherlands | 1,0066 | 1,0074 | 0,9808 | 0,9262 | 1,0022 | 0,9548 |
| Norway | 9,8180 | 10,2852 | 10,3075 | 9,4947 | 10,4352 | 9,8381 |
| Poland | 1,9792 | 1,9818 | 1,9120 | 1,0486 | 2,1637 | 1,2544 |
| Portugal | 0,7083 | 0,7158 | 0,7118 | 0,8776 | 0,7062 | 0,7151 |
| Slovakia | 17,4455 | 17,3907 | 16,1638 | 8,4541 | 18,0983 | 10,3211 |
| Spain | 0,8080 | 0,8068 | 0,8032 | 0,7451 | 0,8180 | 0,7551 |
| Sweden | 10,0073 | 10,1015 | 10,1218 | 9,7298 | 10,2974 | 9,9219 |
| Switzerland | 2,0837 | 2,1141 | 2,1681 | 2,5402 | 2,1320 | 2,3076 |
| Turkey | 294 985 | 296 616 | 300 641 | 142 403 | 335 141 | 173 052 |
| United Kingdom | 0,6886 | 0,6902 | 0,6859 | 0,7376 | 0,6874 | 0,6707 |
| Australia | 1,4382 | 1,4542 | 1,4676 | <i>No data for non-Eurostat countries</i> | | |
| Canada | 1,3139 | 1,3142 | 1,3453 | | | |
| Japan | 168,5574 | 172,9402 | 183,6722 | | | |
| Korea | 792,3442 | 851,3217 | 816,2770 | | | |
| Mexico | 6,6952 | 6,6504 | 6,5198 | | | |
| United States | 1,0836 | 1,1075 | 1,1122 | | | |

Appendix table 2 National deflators for year 2000 (1995 = 100)

| | GDP (used in Education at a Glance) | Domestic demand | Actual indi- vidual expe- diture | Education | Final con- sumption expenditure by house- holds | Final Con- sumption expenditure by govern- ment |
|----------------|---|--------------------|--|-----------|---|---|
| Austria | 104,92 | 106,51 | 106,46 | 107,34 | 106,34 | 106,91 |
| Czech Republic | 146,27 | 140,9 | 142,99 | (*) | 135,24 | 177,75 |
| Denmark | 110,95 | 108,7 | 111,48 | 116,27 | 111,06 | 112,33 |
| Finland | 108,47 | 113,52 | 111,19 | 111,17 | 110,73 | 112,99 |
| France | 105,29 | 105,79 | 106,32 | 111,44 | 106,03 | 106,84 |
| Germany | 103,07 | 104,54 | 105,55 | 106,8 | 106,61 | 102 |
| Greece | 128,52 | 128,01 | 128,1 | 155,04 | 126,18 | 141,48 |
| Hungary | 192,69 | 195,41 | 197,04 | 180,89 | 198,45 | 195,14 |
| Ireland | 122,27 | 124,97 | 118,41 | (*) | 117,82 | 121,72 |
| Italy | 114,8 | 115,71 | 116,33 | 129,78 | 114,61 | 123,89 |
| Netherlands | 110,8 | 111,92 | 111,84 | (*) | 111,09 | 112,95 |
| Norway | 131,31 | 114,34 | 113,94 | 122,15 | 111,4 | 121,96 |
| Portugal | 118,34 | 118,85 | (*) | (*) | 115,48 | 130,36 |
| Spain | 115,32 | 115,6 | (*) | 117,46 | 114,68 | 114,74 |
| Sweden | 105,68 | 110,06 | 109,41 | 120,34 | 105,98 | 117,04 |
| Switzerland | 102,04 | 102,08 | (*) | (*) | (*) | 99,38 |
| Turkey | 1322,55 | 1327,75 | (*) | 1293,4 | 1334,09 | 1505,71 |
| United Kingdom | 113,36 | 110,47 | 113,21 | (*) | 111,49 | 117,8 |

(*) Deflator not available from Eurostat

Appendix 3: Detailed results for education expenditures using alternative PPPs

Appendix table 3 Detailed estimates of education expenditure in Euros per student for 2000 using different PPPs – Primary education

| | GDP (used in Education at a Glance) | Domestic demand | Actual individual expenditure | Education | Final consumption expenditure by households | Final Consumption expenditure by government |
|----------------|-------------------------------------|-----------------|-------------------------------|-----------|---|---|
| Austria | 5 995 | 5 990 | 6 012 | 5 488 | 6 077 | 5 763 |
| Belgium | 3 932 | 3 929 | 3 889 | 3 866 | 3 874 | 3 887 |
| Czech Republic | 1 653 | 1 661 | 1 773 | 3 090 | 1 584 | 2 548 |
| Denmark | 6 444 | 6 376 | 6 405 | 6 385 | 6 433 | 6 260 |
| Finland | 4 019 | 4 001 | 3 719 | 3 986 | 3 621 | 4 059 |
| France | 4 240 | 4 240 | 4 245 | 4 841 | 4 105 | 4 638 |
| Germany | 3 713 | 3 705 | 3 778 | 2 942 | 3 905 | 3 289 |
| Greece | 3 123 | 3 065 | 3 088 | 4 163 | 2 916 | 3 998 |
| Hungary | 2 029 | 2 047 | 2 246 | 4 241 | 1 956 | 3 356 |
| Iceland | 5 374 | 5 507 | 5 307 | 6 651 | 5 111 | 5 991 |
| Ireland | 3 123 | 3 114 | 3 077 | 3 542 | 3 019 | 3 255 |
| Italy | 5 465 | 5 477 | 5 333 | 5 698 | 5 319 | 5 304 |
| Netherlands | 3 977 | 3 974 | 4 081 | 4 322 | 3 994 | 4 193 |
| Norway | 6 006 | 5 733 | 5 720 | 6 210 | 5 650 | 5 993 |
| Poland | 1 975 | 1 972 | 2 044 | 3 728 | 1 806 | 3 116 |
| Portugal | 3 490 | 3 454 | 3 473 | 2 817 | 3 500 | 3 457 |
| Slovakia | 1 119 | 1 122 | 1 208 | 2 309 | 1 078 | 1 891 |
| Spain | 3 685 | 3 691 | 3 707 | 3 996 | 3 640 | 3 944 |
| Sweden | 5 993 | 5 937 | 5 925 | 6 164 | 5 824 | 6 045 |
| Switzerland | 6 065 | 5 978 | 5 829 | 4 975 | 5 928 | 5 477 |
| Turkey | (*) | (*) | (*) | (*) | (*) | (*) |
| United Kingdom | 3 654 | 3 646 | 3 669 | 3 412 | 3 661 | 3 752 |
| Australia | 4 584 | 4 534 | 4 492 | | | |
| Canada | (*) | (*) | (*) | | | |
| Japan | 5 082 | 4 954 | 4 664 | | | |
| Korea | 2 912 | 2 710 | 2 826 | | | |
| Mexico | 1 191 | 1 199 | 1 223 | | | |
| United States | 6 455 | 6 315 | 6 289 | | | |

(*) Expenditure data not available

Appendix table 4 Detailed estimates of education expenditure in Euros per student for 2000 using different PPPs – Lower secondary education

| | GDP (used in Education at a Glance) | Domestic demand | Actual individual expenditure | Education | Final consumption expenditure by households | Final Consumption expenditure by government |
|----------------|-------------------------------------|-----------------|-------------------------------|-----------|---|---|
| Austria | 8 164 | 8 158 | 8 188 | 7 474 | 8 276 | 7 849 |
| Belgium | (*) | (*) | (*) | (*) | (*) | (*) |
| Czech Republic | 2 836 | 2 848 | 3 041 | 5 300 | 2 718 | 4 370 |
| Denmark | 6 578 | 6 509 | 6 538 | 6 518 | 6 567 | 6 390 |
| Finland | 6 272 | 6 243 | 5 803 | 6 219 | 5 650 | 6 333 |
| France | 6 689 | 6 687 | 6 696 | 7 637 | 6 474 | 7 316 |
| Germany | 4 838 | 4 827 | 4 922 | 3 833 | 5 088 | 4 286 |
| Greece | (*) | (*) | (*) | (*) | (*) | (*) |
| Hungary | 1 907 | 1 924 | 2 110 | 3 985 | 1 838 | 3 153 |
| Iceland | 6 155 | 6 307 | 6 078 | 7 618 | 5 854 | 6 862 |
| Ireland | 4 267 | 4 255 | 4 204 | 4 839 | 4 124 | 4 446 |
| Italy | 6 487 | 6 501 | 6 329 | 6 763 | 6 313 | 6 295 |
| Netherlands | 5 610 | 5 606 | 5 757 | 6 097 | 5 634 | 5 914 |
| Norway | 7 505 | 7 164 | 7 148 | 7 760 | 7 061 | 7 489 |
| Poland | (*) | (*) | (*) | (*) | (*) | (*) |
| Portugal | 4 895 | 4 844 | 4 870 | 3 951 | 4 909 | 4 848 |
| Slovakia | 1 333 | 1 337 | 1 439 | 2 750 | 1 285 | 2 253 |
| Spain | (*) | (*) | (*) | (*) | (*) | (*) |
| Sweden | 5 901 | 5 846 | 5 834 | 6 069 | 5 735 | 5 952 |
| Switzerland | 7 329 | 7 224 | 7 044 | 6 012 | 7 163 | 6 618 |
| Turkey | (*) | (*) | (*) | (*) | (*) | (*) |
| United Kingdom | (*) | (*) | (*) | (*) | (*) | (*) |
| Australia | 6 071 | 6 005 | 5 950 | | | |
| Canada | (*) | (*) | (*) | | | |
| Japan | 5 449 | 5 310 | 5 000 | | | |
| Korea | 3 373 | 3 139 | 3 274 | | | |
| Mexico | 1 189 | 1 197 | 1 221 | | | |
| United States | (*) | (*) | (*) | | | |

(*) Expenditure data not available

Appendix table 5 Detailed estimates of education expenditure in Euros per student for 2000 using different PPP's – Upper secondary education

| | GDP (used in Education at a Glance) | Domestic demand | Actual individual expenditure | Education | Final consumption expenditure by households | Final Consumption expenditure by government |
|----------------|-------------------------------------|-----------------|-------------------------------|-----------|---|---|
| Austria | 7 461 | 7 455 | 7 483 | 6 831 | 7 564 | 7 173 |
| Belgium | (*) | (*) | (*) | (*) | (*) | (*) |
| Czech Republic | 3 040 | 3 054 | 3 261 | 5 683 | 2 914 | 4 686 |
| Denmark | 7 437 | 7 358 | 7 391 | 7 368 | 7 424 | 7 224 |
| Finland | 5 252 | 5 228 | 4 859 | 5 208 | 4 731 | 5 303 |
| France | 7 878 | 7 876 | 7 887 | 8 994 | 7 625 | 8 616 |
| Germany | 8 512 | 8 494 | 8 660 | 6 744 | 8 952 | 7 541 |
| Greece | (*) | (*) | (*) | (*) | (*) | (*) |
| Hungary | 2 557 | 2 580 | 2 830 | 5 344 | 2 465 | 4 228 |
| Iceland | 5 855 | 5 999 | 5 781 | 7 246 | 5 569 | 6 527 |
| Ireland | 4 295 | 4 283 | 4 232 | 4 871 | 4 152 | 4 476 |
| Italy | 6 687 | 6 701 | 6 524 | 6 972 | 6 507 | 6 489 |
| Netherlands | 5 215 | 5 212 | 5 352 | 5 668 | 5 238 | 5 498 |
| Norway | 8 183 | 7 811 | 7 794 | 8 462 | 7 699 | 8 166 |
| Poland | 1 679 | 1 677 | 1 738 | 3 170 | 1 536 | 2 650 |
| Portugal | 5 287 | 5 232 | 5 260 | 4 267 | 5 302 | 5 236 |
| Slovakia | 2 127 | 2 134 | 2 296 | 4 390 | 2 051 | 3 596 |
| Spain | (*) | (*) | (*) | (*) | (*) | (*) |
| Sweden | 6 064 | 6 007 | 5 995 | 6 237 | 5 893 | 6 116 |
| Switzerland | 10 630 | 10 478 | 10 217 | 8 720 | 10 390 | 9 599 |
| Turkey | (*) | (*) | (*) | (*) | (*) | (*) |
| United Kingdom | (*) | (*) | (*) | (*) | (*) | (*) |
| Australia | 6 851 | 6 776 | 6 714 | | | |
| Canada | (*) | (*) | (*) | | | |
| Japan | 6 105 | 5 950 | 5 602 | | | |
| Korea | 4 098 | 3 814 | 3 978 | | | |
| Mexico | 2 138 | 2 152 | 2 195 | | | |
| United States | (*) | (*) | (*) | | | |

(*) Expenditure data not available

Appendix table 6 Detailed estimates of education expenditure in Euros per student for 2000 using different PPPs – Tertiary education

| | GDP (used in Education at a Glance) | Domestic demand | Actual individual expenditure | Education | Final consumption expenditure by households | Final Consumption expenditure by government |
|----------------|-------------------------------------|-----------------|-------------------------------|---|---|---|
| Austria | 9 916 | 9 907 | 9 944 | 9 077 | 10 051 | 9 533 |
| Belgium | 9 826 | 9 820 | 9 719 | 9 660 | 9 681 | 9 713 |
| Czech Republic | 4 914 | 4 936 | 5 270 | 9 185 | 4 710 | 7 574 |
| Denmark | 10 913 | 10 798 | 10 847 | 10 813 | 10 894 | 10 602 |
| Finland | 7 675 | 7 640 | 7 101 | 7 611 | 6 914 | 7 750 |
| France | 7 915 | 7 913 | 7 924 | 9 036 | 7 661 | 8 657 |
| Germany | 9 638 | 9 617 | 9 806 | 7 636 | 10 136 | 8 539 |
| Greece | 3 201 | 3 142 | 3 166 | 4 268 | 2 990 | 4 099 |
| Hungary | 6 350 | 6 406 | 7 028 | 13 271 | 6 121 | 10 500 |
| Iceland | 7 338 | 7 520 | 7 246 | 9 082 | 6 980 | 8 181 |
| Ireland | 10 225 | 10 196 | 10 075 | 11 596 | 9 884 | 10 656 |
| Italy | 7 379 | 7 395 | 7 200 | 7 694 | 7 181 | 7 161 |
| Netherlands | 10 975 | 10 966 | 11 263 | 11 928 | 11 023 | 11 570 |
| Norway | 12 243 | 11 687 | 11 661 | 12 660 | 11 519 | 12 218 |
| Poland | (*) | (*) | (*) | (*) | (*) | (*) |
| Portugal | 4 529 | 4 482 | 4 506 | 3 655 | 4 542 | 4 486 |
| Slovakia | 4 233 | 4 246 | 4 569 | 8 735 | 4 080 | 7 155 |
| Spain | 6 234 | 6 243 | 6 272 | 6 760 | 6 158 | 6 671 |
| Sweden | 14 280 | 14 147 | 14 119 | 14 688 | 13 878 | 14 403 |
| Switzerland | 16 876 | 16 634 | 16 219 | 13 843 | 16 494 | 15 239 |
| Turkey | (*) | (*) | (*) | (*) | (*) | (*) |
| United Kingdom | 9 103 | 9 083 | 9 139 | 8 499 | 9 118 | 9 346 |
| Australia | 11 862 | 11 732 | 11 625 | <i>No data for non-Eurostat countries</i> | | |
| Canada | 13 827 | 13 824 | 13 503 | | | |
| Japan | 10 072 | 9 816 | 9 243 | | | |
| Korea | 5 646 | 5 255 | 5 480 | | | |
| Mexico | 4 326 | 4 355 | 4 442 | | | |
| United States | 18 786 | 18 381 | 18 304 | | | |

(*) Expenditure data not available

Appendix table 7 Detailed estimates of education expenditure in Euros per student for 2000 using different PPPs – Primary through tertiary education

| | GDP (used in Education at a Glance) | Domestic demand | Actual individual expenditure | Education | Final consumption expenditure by households | Final Consumption expenditure by government |
|----------------|-------------------------------------|-----------------|-------------------------------|-----------|---|---|
| Austria | 7 703 | 7 697 | 7 726 | 7 052 | 7 809 | 7 406 |
| Belgium | 5 970 | 5 966 | 5 905 | 5 869 | 5 881 | 5 901 |
| Czech Republic | 2 718 | 2 731 | 2 915 | 5 081 | 2 605 | 4 190 |
| Denmark | 7 562 | 7 482 | 7 516 | 7 493 | 7 549 | 7 346 |
| Finland | 5 589 | 5 563 | 5 171 | 5 542 | 5 035 | 5 644 |
| France | 6 341 | 6 340 | 6 348 | 7 240 | 6 138 | 6 935 |
| Germany | 6 057 | 6 044 | 6 162 | 4 799 | 6 370 | 5 366 |
| Greece | 3 288 | 3 227 | 3 251 | 4 383 | 3 070 | 4 210 |
| Hungary | 2 672 | 2 696 | 2 958 | 5 585 | 2 576 | 4 419 |
| Iceland | 5 918 | 6 064 | 5 843 | 7 324 | 5 628 | 6 597 |
| Ireland | 4 628 | 4 614 | 4 560 | 5 248 | 4 473 | 4 822 |
| Italy | 6 339 | 6 353 | 6 185 | 6 609 | 6 169 | 6 151 |
| Netherlands | 5 633 | 5 629 | 5 781 | 6 122 | 5 657 | 5 938 |
| Norway | 7 640 | 7 293 | 7 277 | 7 900 | 7 188 | 7 624 |
| Poland | 2 016 | 2 013 | 2 086 | 3 804 | 1 844 | 3 180 |
| Portugal | 4 326 | 4 280 | 4 304 | 3 491 | 4 338 | 4 284 |
| Slovakia | 1 735 | 1 740 | 1 872 | 3 580 | 1 672 | 2 932 |
| Spain | 4 711 | 4 718 | 4 739 | 5 108 | 4 653 | 5 041 |
| Sweden | 7 117 | 7 050 | 7 036 | 7 320 | 6 916 | 7 178 |
| Switzerland | 8 517 | 8 395 | 8 185 | 6 986 | 8 324 | 7 691 |
| Turkey | 1 082 | 1 076 | 1 062 | 2 241 | 952 | 1 844 |
| United Kingdom | 5 271 | 5 259 | 5 292 | 4 921 | 5 280 | 5 412 |
| Australia | 6 371 | 6 301 | 6 243 | | | |
| Canada | 7 165 | 7 163 | 6 997 | | | |
| Japan | 6 224 | 6 066 | 5 711 | | | |
| Korea | 3 962 | 3 688 | 3 846 | | | |
| Mexico | 1 538 | 1 548 | 1 579 | | | |
| United States | 9 450 | 9 246 | 9 207 | | | |

Appendix 4: Detailed trend-results

Appendix table 8 Detailed estimates for real education expenditure per student in 1995 and 2000 using GDP-deflators and -PPPs

| <i>Constant 2000 Euro (EU-15 = 1)</i> | Primary and secondary education | | Tertiary education | |
|---|---------------------------------|-------|--------------------|--------|
| | 1995 | 2000 | 1995 | 2000 |
| Austria | (*) | 7 204 | 10 658 | 9 916 |
| Czech Republic | 2 637 | 2 403 | 7 266 | 4 914 |
| Denmark | 5 991 | 6 774 | 10 573 | 10 913 |
| Finland | 4 654 | 4 927 | 8 037 | 7 675 |
| France | 5 332 | 6 030 | 7 005 | 7 915 |
| Germany | 5 366 | 5 468 | 8 636 | 9 649 |
| Greece | 1 961 | 3 316 | 3 106 | 3 201 |
| Hungary | 2 066 | 2 178 | 6 921 | 6 350 |
| Ireland | 2 793 | 3 630 | 6 633 | 10 226 |
| Italy | 6 095 | 6 166 | 5 876 | 7 379 |
| Netherlands | 4 016 | 4 724 | 10 594 | 10 975 |
| Norway | 7 319 | 6 784 | 12 916 | 12 243 |
| Portugal | 3 170 | 4 277 | 4 196 | 4 529 |
| Spain | 3 313 | 4 335 | 4 481 | 6 234 |
| Sweden | 5 716 | 5 979 | 14 160 | 14 280 |
| Switzerland | 6 778 | 6 595 | 14 334 | 16 876 |
| Turkey | (*) | 828 | 3 402 | 4 154 |
| United Kingdom | 4 420 | 4 603 | 9 965 | 9 103 |

(*) Expenditure data not available

Appendix table 9 Detailed estimates for real education expenditure per student in 1995 and 2000 using “Domestic demand”-deflators and -PPPs

| <i>Constant 2000 Euro (EU-15 = 1)</i> | Primary and secondary education | | Tertiary education | |
|---|---------------------------------|-------|--------------------|--------|
| | 1995 | 2000 | 1995 | 2000 |
| Austria | (*) | 7 198 | 10 811 | 9 907 |
| Czech Republic | 2 552 | 2 414 | 7 031 | 4 936 |
| Denmark | 5 808 | 6 702 | 10 249 | 10 798 |
| Finland | 4 848 | 4 904 | 8 372 | 7 640 |
| France | 5 356 | 6 029 | 7 037 | 7 913 |
| Germany | 5 431 | 5 457 | 8 741 | 9 628 |
| Greece | 1 917 | 3 255 | 3 036 | 3 142 |
| Hungary | 2 114 | 2 198 | 7 082 | 6 406 |
| Ireland | 2 847 | 3 619 | 6 760 | 10 196 |
| Italy | 6 157 | 6 179 | 5 935 | 7 395 |
| Netherlands | 4 053 | 4 721 | 10 693 | 10 966 |
| Norway | 6 084 | 6 476 | 10 736 | 11 687 |
| Portugal | 3 151 | 4 232 | 4 170 | 4 482 |
| Spain | 3 326 | 4 342 | 4 499 | 6 243 |
| Sweden | 5 897 | 5 924 | 14 610 | 14 147 |
| Switzerland | 6 683 | 6 500 | 14 134 | 16 634 |
| Turkey | (*) | 824 | 3 397 | 4 131 |
| United Kingdom | 4 297 | 4 593 | 9 689 | 9 083 |

(*) Expenditure data not available

Appendix table 10 Detailed estimates for real education expenditure per student in 1995 and 2000 using “Actual individual expenditure”-deflators and -PPPs

| <i>Constant 2000 Euro (EU-15 = 1)</i> | Primary and secondary education | | Tertiary education | |
|---|---------------------------------|-------|--------------------|--------|
| | 1995 | 2000 | 1995 | 2000 |
| Austria | (*) | 7 225 | 10 846 | 9 944 |
| Czech Republic | 2 765 | 2 578 | 7 618 | 5 270 |
| Denmark | 5 983 | 6 732 | 10 559 | 10 847 |
| Finland | 4 414 | 4 558 | 7 623 | 7 101 |
| France | 5 390 | 6 037 | 7 081 | 7 924 |
| Germany | 5 591 | 5 563 | 8 998 | 9 817 |
| Greece | 1 933 | 3 279 | 3 062 | 3 166 |
| Hungary | 2 338 | 2 411 | 7 833 | 7 028 |
| Ireland | 2 665 | 3 576 | 6 329 | 10 075 |
| Italy | 6 027 | 6 016 | 5 809 | 7 200 |
| Netherlands | 4 160 | 4 849 | 10 974 | 11 263 |
| Norway | 6 049 | 6 462 | 10 676 | 11 661 |
| Portugal | (**) | 4 255 | (**) | 4 506 |
| Spain | (**) | 4 362 | (**) | 6 272 |
| Sweden | 5 850 | 5 912 | 14 494 | 14 119 |
| Switzerland | (**) | 6 338 | (**) | 16 219 |
| Turkey | (*) | 813 | (**) | 4 076 |
| United Kingdom | 4 431 | 4 622 | 9 991 | 9 139 |

(*) Expenditure data not available

(**) Deflator not available from Eurostat

Appendix table 11 Detailed estimates for real education expenditure per student in 1995 and 2000 using "Education"-deflators and -PPPs

| <i>Constant 2000 Euro (EU-15 = 1)</i> | Primary and secondary education | | Tertiary education | |
|---|---------------------------------|-------|--------------------|--------|
| | 1995 | 2000 | 1995 | 2000 |
| Austria | (*) | 6 595 | 9 982 | 9 077 |
| Czech Republic | (**) | 4 493 | (**) | 9 185 |
| Denmark | 6 221 | 6 711 | 10 978 | 10 813 |
| Finland | 4 730 | 4 885 | 8 168 | 7 611 |
| France | 6 443 | 6 885 | 8 465 | 9 036 |
| Germany | 4 405 | 4 333 | 7 090 | 7 645 |
| Greece | 3 154 | 4 421 | 4 995 | 4 268 |
| Hungary | 4 053 | 4 553 | 13 580 | 13 271 |
| Ireland | (**) | 4 116 | (**) | 11 596 |
| Italy | 7 185 | 6 429 | 6 926 | 7 694 |
| Netherlands | (**) | 5 135 | (**) | 11 928 |
| Norway | 7 040 | 7 015 | 12 424 | 12 660 |
| Portugal | (**) | 3 452 | (**) | 3 655 |
| Spain | 3 660 | 4 701 | 4 950 | 6 760 |
| Sweden | 6 694 | 6 150 | 16 585 | 14 688 |
| Switzerland | (**) | 5 410 | (**) | 13 843 |
| Turkey | (*) | 1 716 | 6 892 | 8 605 |
| United Kingdom | (**) | 4 298 | (**) | 8 499 |

(*) Expenditure data not available

(**) Deflator not available from Eurostat

Appendix table 12 Detailed estimates for real education expenditure per student in 1995 and 2000 using "Final consumption expenditure by households"-deflators and -PPPs

| <i>Constant 2000 Euro (EU-15 = 1)</i> | Primary and secondary education | | Tertiary education | |
|---|---------------------------------|-------|--------------------|--------|
| | 1995 | 2000 | 1995 | 2000 |
| Austria | (*) | 7 302 | 10 950 | 10 051 |
| Czech Republic | 2 337 | 2 304 | 6 439 | 4 710 |
| Denmark | 5 987 | 6 762 | 10 565 | 10 894 |
| Finland | 4 280 | 4 438 | 7 391 | 6 914 |
| France | 5 197 | 5 837 | 6 828 | 7 661 |
| Germany | 5 837 | 5 751 | 9 394 | 10 147 |
| Greece | 1 798 | 3 097 | 2 848 | 2 990 |
| Hungary | 2 051 | 2 100 | 6 871 | 6 121 |
| Ireland | 2 601 | 3 508 | 6 178 | 9 884 |
| Italy | 5 922 | 6 001 | 5 709 | 7 181 |
| Netherlands | 4 044 | 4 745 | 10 668 | 11 023 |
| Norway | 5 842 | 6 383 | 10 310 | 11 519 |
| Portugal | 3 103 | 4 289 | 4 107 | 4 542 |
| Spain | 3 255 | 4 282 | 4 402 | 6 158 |
| Sweden | 5 570 | 5 811 | 13 801 | 13 878 |
| Switzerland | (**) | 6 445 | (**) | 16 494 |
| Turkey | (*) | 729 | 3 020 | 3 656 |
| United Kingdom | 4 354 | 4 611 | 9 818 | 9 118 |

(*) Expenditure data not available

(**) Deflator not available from Eurostat

Appendix table 13 Detailed estimates for real education expenditure per student in 1995 and 2000 using “Final consumption expenditure by government”-deflators and -PPPs

| <i>Constant 2000 Euro (EU-15 = 1)</i> | Primary and secondary education | | Tertiary education | |
|---|---------------------------------|-------|--------------------|--------|
| | 1995 | 2000 | 1995 | 2000 |
| Austria | (*) | 6 925 | 10 441 | 9 533 |
| Czech Republic | 4 940 | 3 704 | 13 610 | 7 574 |
| Denmark | 5 893 | 6 580 | 10 399 | 10 602 |
| Finland | 4 895 | 4 975 | 8 454 | 7 750 |
| France | 5 917 | 6 596 | 7 774 | 8 657 |
| Germany | 4 704 | 4 844 | 7 572 | 8 548 |
| Greece | 2 765 | 4 246 | 4 378 | 4 099 |
| Hungary | 3 460 | 3 602 | 11 591 | 10 500 |
| Ireland | 2 897 | 3 782 | 6 881 | 10 656 |
| Italy | 6 384 | 5 984 | 6 153 | 7 161 |
| Netherlands | 4 316 | 4 981 | 11 386 | 11 570 |
| Norway | 6 784 | 6 770 | 11 972 | 12 218 |
| Portugal | 3 459 | 4 236 | 4 578 | 4 486 |
| Spain | 3 528 | 4 639 | 4 771 | 6 671 |
| Sweden | 6 385 | 6 031 | 15 818 | 14 403 |
| Switzerland | 5 961 | 5 955 | 12 606 | 15 239 |
| Turkey | (*) | 1 412 | 6 602 | 7 081 |
| United Kingdom | 4 715 | 4 726 | 10 632 | 9 346 |

(*) Expenditure data not available