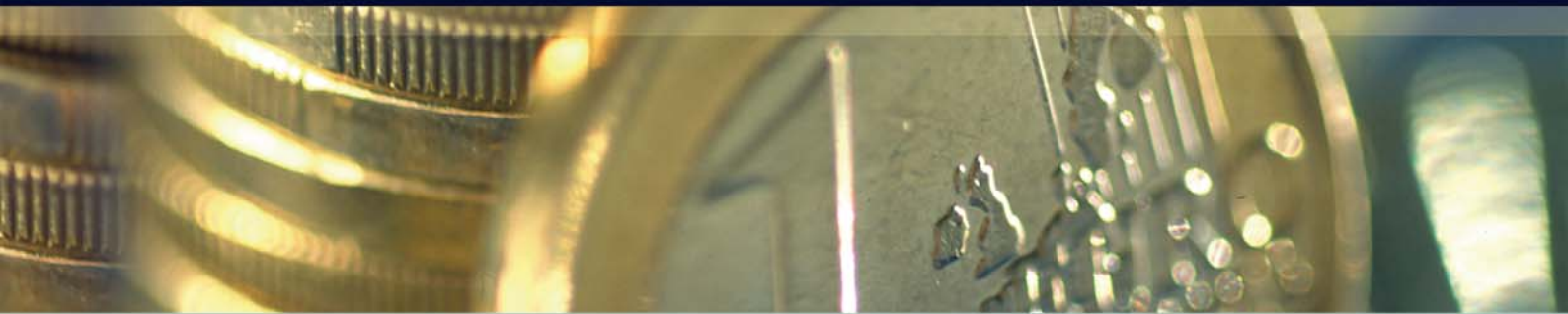


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## The effectiveness and efficiency of public spending

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# THE EFFECTIVENESS AND EFFICIENCY OF PUBLIC SPENDING

Ulrike Mandl, Adriaan Dierx, Fabienne Ilzkovitz

## **Abstract:**

At a time when Member States have to deal with increased pressures on public balances, stemming from demographic trends and globalisation, the improvement of the efficiency and effectiveness of public spending features high on the political agenda. This paper shows that the efficiency in public services more generally and in public spending on education and R&D in particular varies significantly between countries. Clearly, there is potential for increased efficiency in public spending. The paper, however, also illustrates the difficulties of measuring efficiency and effectiveness. Progress has been made in developing the necessary measurement techniques, but there is a lack of suitable data to apply those techniques. Good quality data are needed because the techniques available to measure efficiency are sensitive to outliers and may be influenced by exogenous factors. Against this background, analyses based upon individual spending areas (function-by-function approach) seem to be a more promising approach to measure efficiency and effectiveness on a cross-country basis. In-depth analyses of the areas in question allow for a better identification of meaningful indicators. As efficiency improvements can be achieved in many different ways, a specific mix of short-, medium- and long-term measures aimed at enhancing efficiency and ultimately effectiveness could in principle be defined, which would be appropriate to the situation in the country under consideration. However, making this possibility a reality would require further improvements in the measurement of the efficiency and effectiveness of public spending.

**Key words:** education spending, R&D spending, efficiency frontier, public administration, input, output, environmental factors

**JEL classification:** H11, H52, C14

## 1. Introduction<sup>1</sup>

At a time when Member States have to deal with increased pressures on public balances, stemming from demographic trends (higher spending on life-long learning, pensions and long term care) and globalisation (adjustment costs, mobile taxpayers) it is even more important that public resources are used in the most efficient and effective way. Given that resources in the public sector are mostly generated through taxes and taxes create distortions in the allocation of resources and thus constrain economic growth, it is essential that public expenditures are used to improve long-term growth perspectives and take equity considerations into account. Improved efficiency and effectiveness of public spending not only helps maintain the fiscal discipline requested by the Stability and Growth Pact (SGP) but also is instrumental in promoting the structural reform agenda of Lisbon. It alleviates budget constraints as it allows achieving the same results at lower levels of spending or increases value for money by achieving better outcomes at the same level of spending.

The objective of this paper is to outline the conceptual framework and to survey the different methods used for cross-country comparisons of the efficiency and effectiveness of public spending. The key questions addressed are: i) how to define efficiency and effectiveness; ii) how to measure efficiency and effectiveness; and iii) what are the main determinants of efficiency and effectiveness of public spending? The focus of this analysis is not on how to cut public expenditures, but rather more on increasing the value for money of public spending, i.e. how to make the most of limited public resources.

The paper is structured as follows. Section 2 presents the basic concepts of efficiency and effectiveness. Section 3 provides insights on how to measure efficiency in public sector activities. Section 4 presents some stylised facts on the composition of public spending and section 5 gives an illustration on the efficiency of educational and R&D spending. Section 6 concludes.

## 2. Concepts of efficiency and effectiveness of public performance

The analysis of efficiency and effectiveness is about the relationships between inputs, outputs and outcomes. In 1957, Farrell already investigated the question how to measure efficiency and highlighted its relevance for economic policy makers. "It is important to know how far a given industry can be expected to increase its output by simply increasing its efficiency, without absorbing further resources"<sup>2</sup>. Since that time techniques to measure efficiency have improved and investigations of efficiency have become more frequent, particularly in industry. Nevertheless, the measurement of efficiency and effectiveness of public spending<sup>3</sup> remains a conceptual challenge. Problems arise because public spending has multiple objectives and because public sector outputs are often not sold on the market which implies that price data is not available and that the output cannot be quantified.

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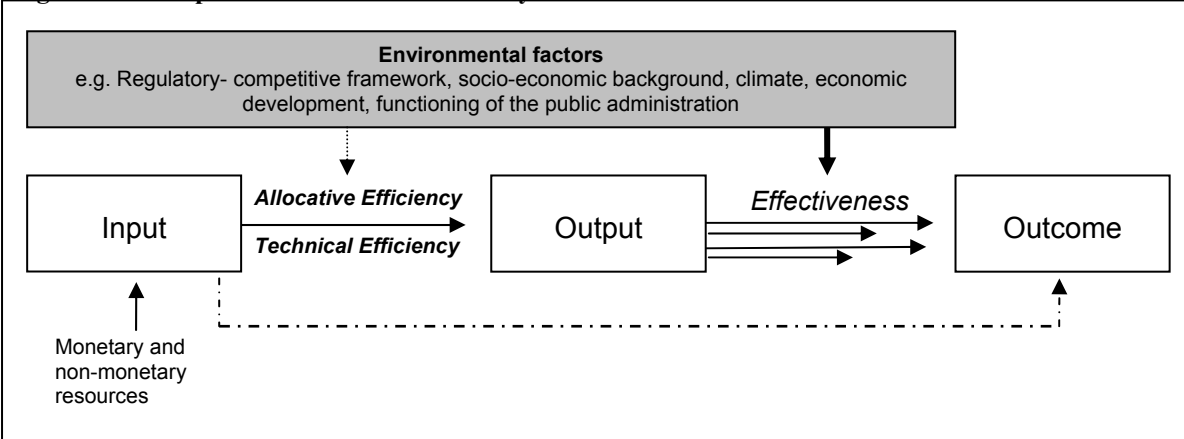
<sup>1</sup> We are grateful to the participants at the joint Commission/German Presidency Workshop on efficiency and effectiveness on public spending, Brussels, March 2007 for helpful comments, in particular Antonio Afonso, A. de la Fuente and G. Psacharopoulos and the members of the WG Quality of public finances, February 2007.

<sup>2</sup> Farrell (1957), pp. 11

<sup>3</sup> In this paper the distinction between public services, public sector and public spending is not explicitly made, even though the authors fully recognise this fact.

Figure 1 illustrates the conceptual framework of efficiency and effectiveness. It makes the link between input, output and outcome. The monetary and non-monetary resources deployed (i.e. the input) produce an output. For example, education spending (input) affects educational attainment rates (output). The input-output ratio is the most basic measure of efficiency. However, compared to productivity measurement, the efficiency concept incorporates the idea of the production possibility frontier, which indicates feasible output levels given the scale of operations. The greater the output for a *given* input or the lower the input for a *given* output, the more efficient the activity is. Productivity, by comparison, is simply the ratio of outputs produced to input used<sup>4</sup>.

**Figure 1: Conceptual framework of efficiency and effectiveness**



Effectiveness relates the input or the output to the final objectives to be achieved, i.e. the outcome. The outcome is often linked to welfare or growth objectives and therefore may be influenced by multiple factors (including outputs but also exogenous 'environment' factors). The effectiveness is more difficult to assess than efficiency, since the outcome is influenced political choice. The distinction between output and outcome is often blurred and output and outcome are used in an interchangeable manner<sup>5</sup>, even if the importance of the distinction between both concepts is recognised. For example, the outputs of an education system are often measured in terms of performance or attainment rates of pupils of a certain age. The final outcome, however, could be the educational qualifications of the working-age population as a whole. The effectiveness shows the success of the resources used in achieving the objectives set.

This implies that efficiency and effectiveness are not always easy to isolate. In addition, outputs and outcomes may be affected by environment factors, which may or may not be within the control of the policy maker. For instance, if we scrutinise the efficiency of education spending, the wage setting mechanism is seen as an exogenous factor, whereas if we consider the efficiency of the public administration as a whole, the wage setting mechanism might be an important input of efficiency. Whether specific characteristics are taken as given or seen as under the control of policy makers depends among others on the

<sup>4</sup> See for more details P.C. Smith/A. Street (2005), A. Pritchard (2001) for the Productivity measurement in the UK  
<sup>5</sup> Afonso et al. (2005), etc.

level of aggregation of the analysis. A high level of aggregation can conceal inefficiencies. For example, when we work at the more aggregated level specific sector-related circumstances would be taken for granted like the combination of inputs (e.g. allocation of funds) within the spending item. This illustrates the importance of correctly defining the scope of any efficiency and effectiveness analysis.

When measuring efficiency, a distinction can be made between technical and allocative efficiency. Technical efficiency measures the pure relation between inputs and outputs taking the production possibility frontier into account. Technical efficiency gains are a movement towards this production possibility frontier (“best practice”). However, not every form of technical efficiency makes economic sense, and this is captured by allocative efficiency, which introduces costs and benefits. Allocative efficiency reflects the link between the optimal combination of inputs taking into account costs and benefits<sup>6</sup> and the output achieved. For instance to instruct pupils, there is a mix of inputs necessary, such as teachers, books and infrastructure. The attainment rate could be maximised by an optimal combination of these inputs. Thus, the measurement of allocative efficiency requires in-depth analyses of the area in question as well as information on the broad country-specific strategies and most notably information on input prices<sup>7</sup>. A high degree of technical efficiency achieved at the level of each individual input does not guarantee an efficient functioning of public sector activities if alternative combinations of inputs would result in higher outputs.

Another complication, which one encounters when measuring efficiency and effectiveness in terms of the identification of inputs and outputs, is that many public services are interlinked. This is the case, for example, when the outputs of one public service are used as inputs by another. For example, the research output of public research institutions is at the same time an input for R&D activities at universities. Similarly, public services can influence each other. For example, the public transport system – the output of spending on infrastructure - affects the spending on education (input) as school buildings have to be reachable. Unlike the private sector the public sector cannot easily be represented by a clear input – output relationship.

## 2.1 Inputs

Assessing the efficiency and effectiveness of public spending requires the measurement of the inputs entering into the production of public sector activities. This can be done in monetary and non-monetary (physical) terms<sup>8</sup>. Compared to the private sector, the estimation of the actual costs of public sector activities is relatively complicated. While in the private sector, data are available at a very detailed level of activity, public sector accounts are typically designed differently, making it difficult to obtain information on all input costs, in particular at a disaggregated level. Estache et al. (2007) stress that public budgets are not really designed to track down specific sectoral expenditures.

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<sup>6</sup> E.g. Cost-efficiency measurements; i.e. cost minimising and revenue maximising. For some programmes cost-benefits-analyses are required. For example, in the framework of EU Cohesion Policy.

<sup>7</sup> The concept of cost-efficiency can be seen as a part of allocative efficiency. Cost-efficiency looks at the input prices in respect to the purchase options at the market, e.g. there is cost-inefficiency of one purchase inputs at higher than market prices, whereas allocative inefficiency points to an inefficient mix of inputs.

<sup>8</sup> Some studies replaced monetary input indicators by non-monetary input indicators to avoid comparability problems in cross-country analysis. A study done by the OECD illustrates the impact of the indicators used. For some countries, like the Czech Republic, Poland, the Slovak Republic, inefficiencies seem to be lower when education spending is used as an input instead of non-monetary inputs. This result, however, is due to the fact that the wage costs (teaching remuneration) are relatively low in these countries.

Recent literature<sup>9</sup> highlights especially the indirect costs, such as opportunity costs of using government-owned assets, like school buildings and hospitals, and the allocation of government fixed costs. The higher tax burdens associated with an increase in public expenditures cannot be neglected either. This, however, would lead to an even broader approach to evaluating the impact of public policies. This paper chooses a more narrow approach and considers the public spending allocated to the production of a given public service, like public spending on health, education or infrastructure as a measure of input. It also takes into account the complementarities of public and private spending. For example, the additional private spending on coaching has to be taken into account when measuring educational output (see box 1). An alternative approach to defining appropriate input indicators is to use non-monetary factors, like the number of civil servants deployed for a public activity or working hours spent on this activity. For instance, in the area of education the teachers/students ratio, class size and instruction time are quite common measures of inputs.

### **Box 1: Problems with cross-country comparisons**

Measurement of efficiency and effectiveness is highly sensitive to the data sets being used. The data used for international comparisons require a minimum level of homogeneity. Nevertheless, it is unavoidable that such data reflect the different organisations and traditions of government and therefore are not fully comparable between countries. For example, the different national boundaries between the public and the private sector could give rise to a rather misleading picture in cross-country investigations. Moreover, certain inputs are sometimes omitted because of a lack of appropriate data. For instance, in many areas where there is a combination of public and private funding, such as education, data on private spending are not always available<sup>10</sup>.

Furthermore, cross-country differences exist in terms of the source of public funding (financing instruments). Such differences reflect the design of the welfare state in terms of the use of tax expenditures and transfers, the degree of taxation of such transfers, as well as privatisation and outsourcing practices. For instance, the organisation of the health and long term care system (role of nongovernmental organisations, insurance systems, supply of public nursing homes, etc.) affects the public spending on health care. The pattern of public expenditures in a country relying on home care for the elderly will differ from that in countries providing nursing homes. In this respect, it also makes a difference whether countries allocate funds per beneficiary (e.g. based on number of students registered) or transfer a lump-sum amount of money to an institution. Finally, expenditures in one domain tend to be related to the level of total spending in the country or to the level of economic development. Similar difficulties occur with respect to output, since countries have both different starting points (e.g. supply of doctors or teachers) and priorities (e.g. quality requirements).

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<sup>9</sup> Afonso et al. (2006); Afonso/Gaspar (2007)

<sup>10</sup> According to the study on "Private household spending on education and training" (European Commission, Project Report, Education and Training 2010) there are no data on overall private household spending available for Germany, Estonia, Cyprus, Lithuania and Luxembourg.

As regards quality of inputs and outputs, the quality adjustment is one of the most pressing challenges in measuring efficiency. Many studies assume that the quality of inputs and outputs is equivalent across countries. However, this does not match with reality. Therefore, quality adjustments should be made. For some domains, like education and health, on-going work on national account output measurement, as presented in the Eurostat Handbook on price and volume measures in national accounts, suggests possible quality adjustment indicators<sup>11</sup>. For instance, the Dutch Social and Cultural Planning Office SCP (2004) uses quality indicators, such as the percentage of trains that run on time or the percentage of lessons cancelled in schools, when measuring of the performance of the public sector. However, quality adjustment is still in its infancy and there are no ready-made solutions.

If the quality of inputs and outputs is not properly taken into account when measuring efficiency, an underestimation of efficiency may result. For example a smaller class size - which is by and large assumed to be quality enhancing - would reduce the teacher-pupils ratio or increase the spending per pupil. This would decrease the measured efficiency. The private sector does not face this problem that much since price data can be used to supply the needed information on the quality of inputs and outputs.

## 2.2 Public service activities – the output

In the private sector, the market value of output is reflected in the national accounts. The public sector, however, mostly provides non-market goods and services, which implies that their market value is usually unknown. Input costs have therefore often been used as a proxy for the value of the output in the national accounts<sup>12</sup>. Consequently, public services could only produce more by employing more inputs (e.g. more teachers, nurses, etc.). This approach cannot be applied to measure efficiency as the input-oriented market valuation does not, by definition, take efficiency gains into account. Therefore, the output of the public sector has to be defined. An option is to use a volume measure of outputs that allows efficiency to increase and decrease over time. The most frequently used output indicators are performance indicators, such as pupils' performance at a specific level or doctors' performance in hospitals. When making cross-country comparisons the choice of appropriate indicators becomes even more difficult, since country-specific factors have to be taken into account (see box 1). The monitoring of the performance of public sector activities, for example by collecting performance information, could improve the data on outputs. The OECD PISA study, for example, presents a well-known measure of the performance of the educational system, which is based on test scores of 15-year-old pupils<sup>13</sup>.

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<sup>11</sup> For instance, the Eurostat Handbook mentions three methods for obtaining information on quality in the domain of education services: 1) using output-based measures, like examination results; 2) using direct quality information, for instance from school inspections; or 3) using indicators on the quality of inputs, e.g. pupil/teacher ratio.

<sup>12</sup> By the end of 2006, national accounts had to move to output-measures in the domains of education and health (Decision 2002/990/EC).

<sup>13</sup> While this education output indicator has certainly contributed to initiate discussions on educational reform, it cannot be considered an outcome indicator as the final objective of policy makers would more likely be to improve the employability of school leavers (outcome).



### **2.3 Measuring achievements - the outcome**

The outcome has to be seen in a broader context, as the selection of the underlying objectives is a political choice. The outcome covers all the long-term effects of public programmes in terms of welfare and should capture the various dimensions of society values. Such achievements reflect the effectiveness of different kinds of policy measures (different outputs yield one outcome). It is difficult to disentangle the effects of different outputs on the outcome. Often, there are delays between the implementation of measures and their impact and trade-offs between public programmes could blur specific achievements. Outcome is, moreover, often determined by external factors, such as life style and socio-economic backgrounds. It is therefore very difficult to isolate one transmission channel from another.

Although policy makers are interested in the final outcome of their policies, like increasing the growth potential, it is only partly under their direct influence and not always achievable within one political cycle. For instance, in order to achieve higher literacy rates (outcome) the public sector takes measures to increase course enrolments and improve the service provided by public libraries (output). Nevertheless, the literacy rate will not increase immediately.

### **2.4 Environmental factors**

Public sector performance can be affected by various factors, like institutional and structural factors or other country-specific features. These factors can be beyond the control of public authorities. However, uncertainty remains about the definition of "controllable". Depending on the scope of efficiency-investigations, the "constraints" include the regulatory environment, the institutional setting or even climate. Recent investigations show that such factors have a key impact on the efficiency level. The OECD (2007) shows that institutional settings influence the efficiency of education spending. Wilson (2005) concludes that inefficiencies in transition economies might result from managerial ineptitudes or from other constraints outside authorities' direct control. Such environment factors are crucial in the analysis of efficiency and effectiveness<sup>14</sup>. First, the neglect of such factors could lead to a bias in the measurement of efficiency and effectiveness. Second, such factors can be effective instruments to help improve efficiency and effectiveness.

## **3. How to measure efficiency and effectiveness**

Efficiency cannot be directly measured. Therefore, different approaches concerning data and methodological framework have been used. Sometimes indexes and performance indicators are used by themselves to measure efficiency. However, these approaches are rather measurements of productivity, since the best possible result that is achievable -with current technology- is not taken into account. The UK, for example, evaluates changes in the productivity of its public sector based on indicators that are calculated as the ratio of real output over real input. In these calculations the necessary adjustments for quality are incorporated<sup>15</sup>. Such productivity measurement is useful to assess the change of productivity

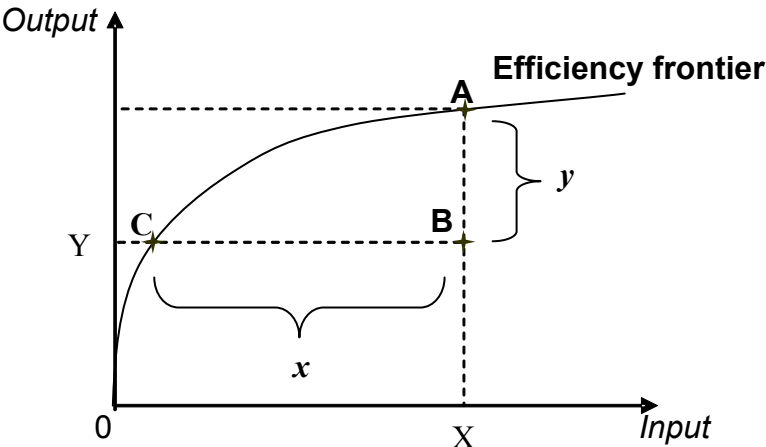
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<sup>14</sup> Most studies try to control for such factors by introducing a second step in their analysis, but some (Wilson, 2005) include the socio-economic status as an input indicator in the analysis of efficiency in education production.

<sup>15</sup> See for details Pritchard A. (2002). Recent results for the education sector are presented by the UKCeMGA (2007)

over time. However, it includes no information on the maximum possible achievements, which is the core of efficiency analyses.

**Figure 2:** The efficiency frontier



An alternative approach is based on the concept of efficiency frontier (productivity possibility frontier). Figure 2 illustrates this basic concept. If two countries A and B experience the same level of public expenditures (as input), but country A achieves a higher output, country A is considered to be more efficient. Based on this limited information available country A is considered to be on the efficiency frontier. Country C spends less and also achieves lower output. Nevertheless, C can also be found on the efficiency frontier. Efficiency in the case of countries A and C means that they have achieved the maximum amount of output that is achievable with the given amount of inputs. For country B two alternative conclusions can be drawn. First, country B can become more efficient by raising its output to the level of country A by  $y$ . Alternatively, it can reach the efficiency frontier by reducing its inputs by  $x$  to the same level as country C. This example illustrates that there are two options to reach the efficiency frontier. The country can aim at maintaining the fixed level of output ( $Y$ ) and adjust the amount of input necessary. This is so-called input-efficiency. However, the country can also keep the input ( $X$ ) unchanged and aim at improving the level of output. This is so-called output-efficiency. Therefore, the information on inefficiency can be used as a tool both to raise output and to reduce inputs.

There are multiple techniques to calculate or estimate the shape of the efficiency frontier. Most investigations aimed at measuring efficiency are based either on parametric or non-parametric methods. The main difference between the parametric and the non-parametric approach is that parametric frontier functions require the ex-ante definition of the functional form of the efficiency frontier.

The non-parametric approach<sup>16</sup> constructs an efficiency frontier using input/output data for the whole sample following a mathematical programming method. This frontier provides a benchmark by which the efficiency performance can be judged. This technique is therefore primary data-driven. By assumption, the frontier determines best practices (like Country A and C in figure 2) and all other countries can measure their potential efficiency gains by the distance to the frontier. The advantage of this approach is its transparency and its facility to handle multiple outputs. Moreover, this approach does not require assumptions about the specific functional form of the production function, i.e. no data on input and output prices are required, since the frontier relies on the input and output data only. The main disadvantage of this approach is its deterministic nature. Results tend to depend heavily on the composition and size of the sample as well as the selection of input<sup>17</sup> and output variables used. Moreover, non-parametric methods tend to be sensitive to measurement errors, statistical noise and outliers.

A very common parametric approach is the Stochastic Frontier Analysis (SFA). It is a statistical method to fit the frontier. It is based on econometric methods. This approach assumes a specific functional form for the relationship between input and output. The advantage of this method is that it is able to cover the effects of exogenous shocks, i.e. non-discretionary factors. The model can specify the equations based on such assumptions. For example, specific variables covering exogenous factors can be included in the model.

### **Box 2: Composite Indicators**

Composite indicators are very often by-products of efficiency measurements since they are constructed to serve as input or output indicator. The World Bank set up composite indicators in the context of their governance project ("government effectiveness"), which takes into account inter alia quality of public civil services. Afonso et al. (2005) computed composite indicators of public sector performance and public sector efficiency for 23 industrialised countries. In 2006, these indicators were computed for the New Member States and emerging markets. The OECD is working on composite indicators for education, inter alia for institutional characteristics (OECD, 2007). The problem with such composite indicators is twofold. First, the choice of the sub-indicators used is highly subjective and can therefore reflect prejudice. For example, an indicator like the "size of the public sector" may reflect a specific assumption on the tasks of a state. Second, the weighting of each sub-indicator is a complex issue, as there may be trade-offs or complementarities between the different aspects measured. Afonso et al. (2005), however, point out that in most cases giving alternative weights to the sub-indicators does not change the results very much.

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<sup>16</sup> Among the different non-parametric methods the Free Disposal Hull (FDH) technique imposes the fewest restrictions. It follows a stepwise approach to construct the efficiency frontier. The Data Envelope Analysis (DEA) approach is based on a linear combination of input and outputs in order to specify the efficiency frontier. Convexity of the set of input-output combinations is assumed since this method constructs an envelope around the observed combinations. Comparing the two approaches the DEA method tends to assign efficiency to fewer countries than the FDH method does.

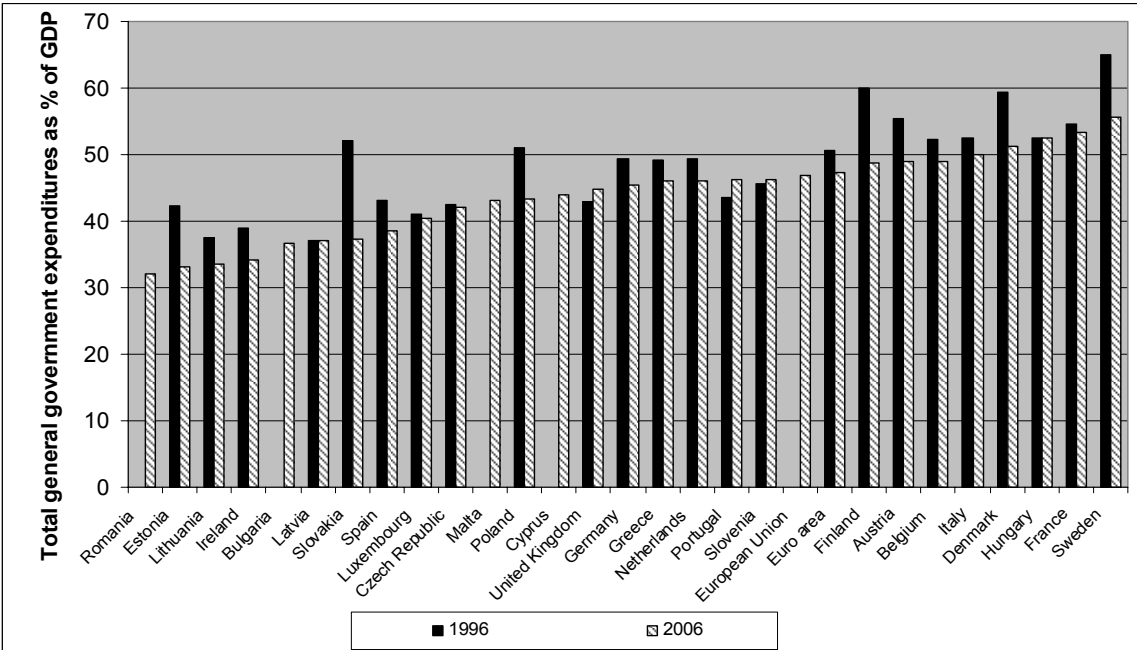
<sup>17</sup> See e.g. J. Ruggiero (2003) for discussion on input selection.

**4. The composition of expenditures – some stylised facts**

**4.1 Development and composition of public spending**

At the most aggregated level, the composition of public expenditures has an impact on the output of the public sector and its economy-wide outcome. The composition of public spending affects the performance of the public sector (output) through several channels. First, a high share of non-discretionary expenditures limits the room for manoeuvre of the government and consequently reduces the possibility to have a well-targeted economic policy. Second, the composition of expenditures reveals the priority setting of an economy, e.g. when a large share of spending is devoted to future-oriented areas such as education and R&D. Finally, it allows to draw conclusions on the focus of the State on its Musgravian functions (stabilisation, growth, adjustment).

**Figure 3: Level of public spending (1996, 2006) as percentage of GDP**



Source: Eurostat

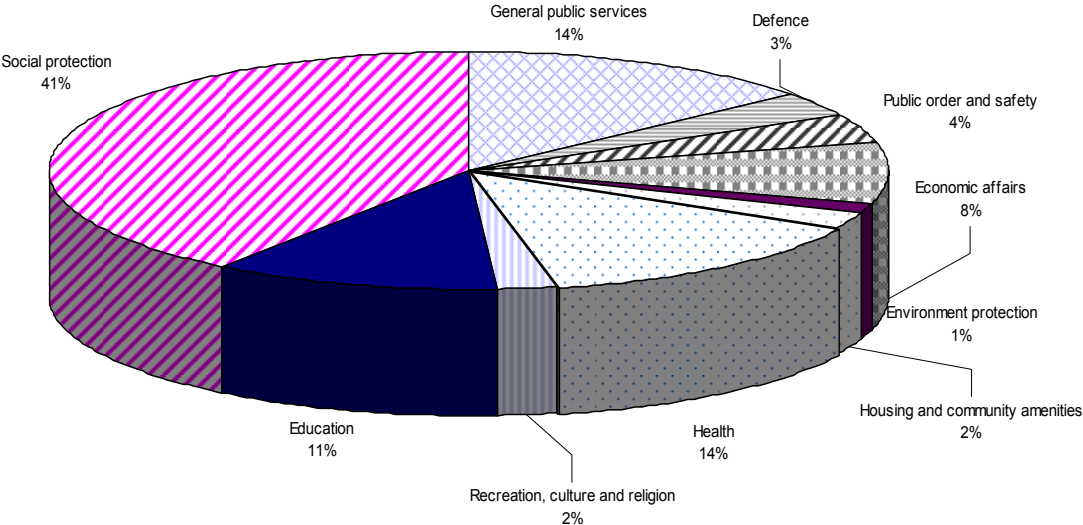
Within the EU there are large country differences in terms of the level and development of public expenditures (see figure 3). In 2006 the total public expenditures as a percentage of GDP averaged 46.8 % and ranged from 32% in Romania to 56% in Sweden. The share of expenditures in GDP for the US, by way of comparison, rose from 32.3% in 1970 to 34.5% in 2006. The expenditures-to-GDP ratio in the EU Member States was on an upward trend as well, at least until 1995. Public expenditures as a percentage of GDP rose from 30.7% in 1970 to 45.7% in 1995<sup>18</sup>. Since then a decline associated with an increased fiscal discipline has been observed. In the euro area the expenditures-to-GDP ratio decreased from 50.7% in 1996 to 47.2% in 2006. The recent trend of expenditure cuts has been caused inter alia by countries' commitment to fiscal discipline under the SGP. The recorded large decreases in interest payments in all Member States since the late 1990s created scope for improvement in the national budgets. For the period 2005-2008, the Stability and Convergence Programmes

<sup>18</sup> In light of data availability, the following countries are covered: BE, DK, IE, EL, ES, FR, IT, NL, AT, PT, FI, SE, UK

foresee a reduction in the expenditures to GDP ratio (by 1.4% on average for the EU-25)<sup>19</sup>. Therefore, the allocation of public funds to different policy areas will likely become the subject of increased scrutiny.

Generally, one would expect that public funds are directed to the essential policy areas, which support the overall objectives of the State. The literature name for instance stabilisation, adjustment and sustainability as main goals, but also growth and equity objectives are essential. Figure 4 shows that the main functional components of public expenditures in the EU Member States are social protection with 41%, general public services and health each with 14% and education with 11% of total spending. Altogether, these spending items account for 3/4 of total public spending. A clear-cut classification based on main objectives is not feasible at this aggregated level. For example, the function on general public services includes expenditure for executive and legislative organs, for financial and fiscal affairs, for external affairs, for basic research, for general services and for public debt transactions<sup>20</sup>. It is hardly possible to devote one main objective to this spending function. In some other areas like education it might be easier to identify a growth objective, but equity objectives should not be unconsidered. Some spending items count for a small share of total spending, but nevertheless these expenditures should not be underestimated as they can have important leverage effects, e.g. R&D spending.

**Figure 4: Public expenditures by function (EU- 27, 2004)**



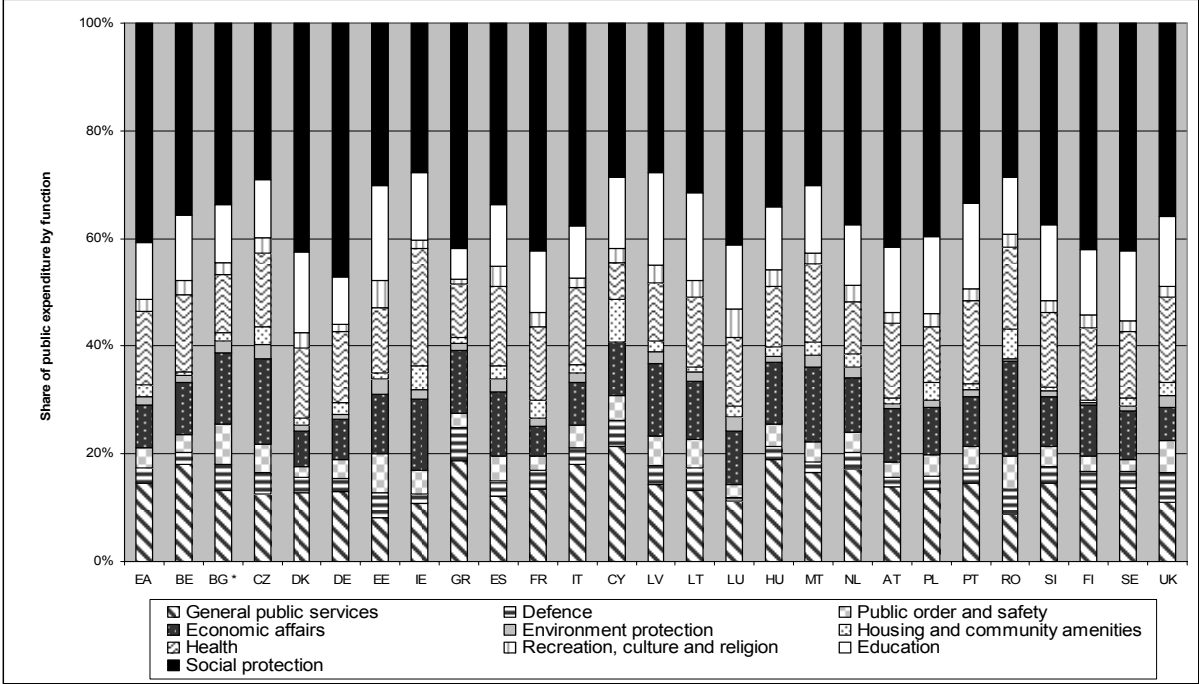
Source: Eurostat

The comparison of public spending at country level reveals that Member States vary in terms of the composition of public expenditures by spending items (see figure 5). For example,

<sup>19</sup> European Commission (2006b), Public Finances in EMU 2006  
<sup>20</sup> This function does, however, not include expenditure for other functions. For example, administration costs for education are included in the function "education".

spending on social protection varies from 9.5% in Ireland to 23.8% in Sweden. Similarly, spending on general public services ranges from 2.7% in Estonia to 9.4% in Hungary. The country-specific developments and trends in the composition of public spending can reflect either country-specific objectives or inefficiencies in spending areas, if the input does not deliver the expected performance in terms of output and outcome.

**Figure 5: Composition of public spending in EU-MS (2005)**

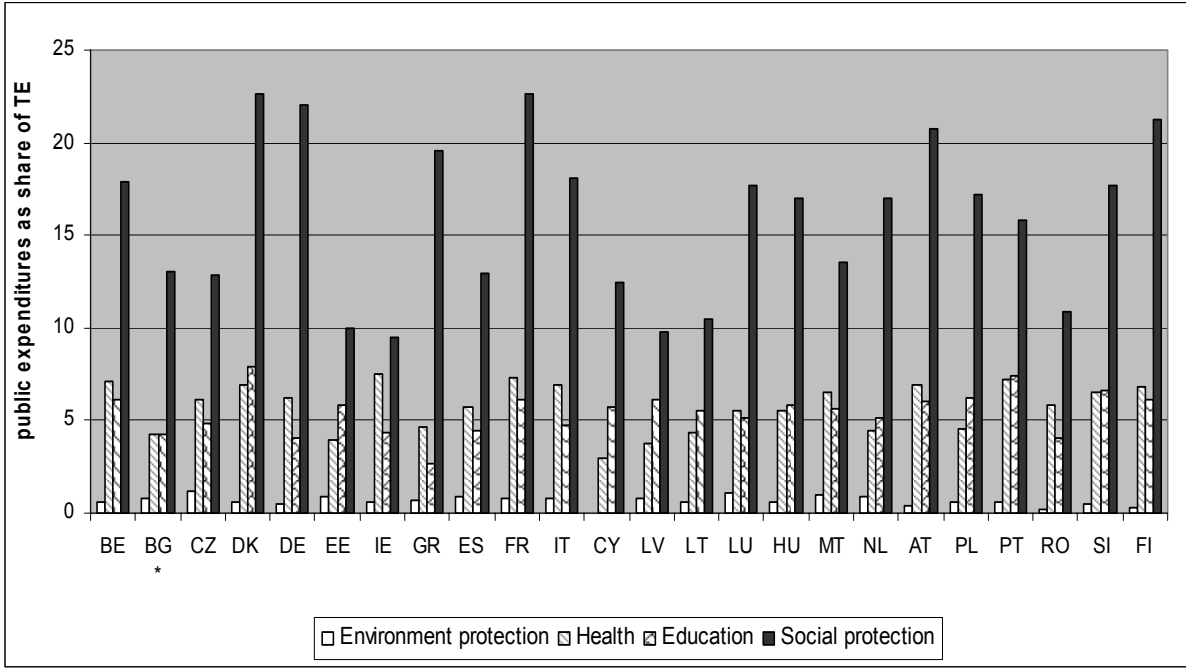


Source: Eurostat

Note: For Bulgaria data from 2004.

Spending on social protection could increase even more, given ageing populations in the coming years. Figure 6 shows that spending on social protection is relatively high in all EU-countries. However, spending pressure might also increase in an area such as environmental protection. Consequently, the room of manoeuvre for other areas that could be growth enhancing, such as education, would diminish (see figure 6). Against the background of efficiency and effectiveness analyses, it is important to scrutinise both large spending items, like social protection, and small, but growth-enhancing ones. As regards the latter one, even if the spending items account for a small share of total spending, they can have a major impact on the performance of an economy.

**Figure 6: Public expenditures on education, health, environment protection and social protection by country (2005)**



Source: Eurostat

Note: Fore Bulgaria data from 2004.

**4.2 Public sector efficiency**

Neither the concept nor the measurement of efficiency and effectiveness of public spending is straightforward. Nevertheless, bearing the limitations in mind, it is worthwhile to investigate in the efficiency and effectiveness of public spending. Cross-country evaluations moreover could reveal interesting insights into key drivers of efficiency. To measure efficiency in public services at the macro level many investigations compute efficiency scores based on composite indicators. Afonso et al. (2005) studied the performance of 23 industrialised OECD countries<sup>21</sup> and the new Member States (Afonso et al., 2006) by constructing a public sector performance (PSP) and efficiency (PSE) composite indicator<sup>22</sup> as output/outcome indicator. This composite indicator includes information on administration, education (secondary school enrolment, education achievement), health (life expectation, infant mortality), income distribution, economic stability (inflation) and economic performance outcomes (10 year-average unemployment rate).

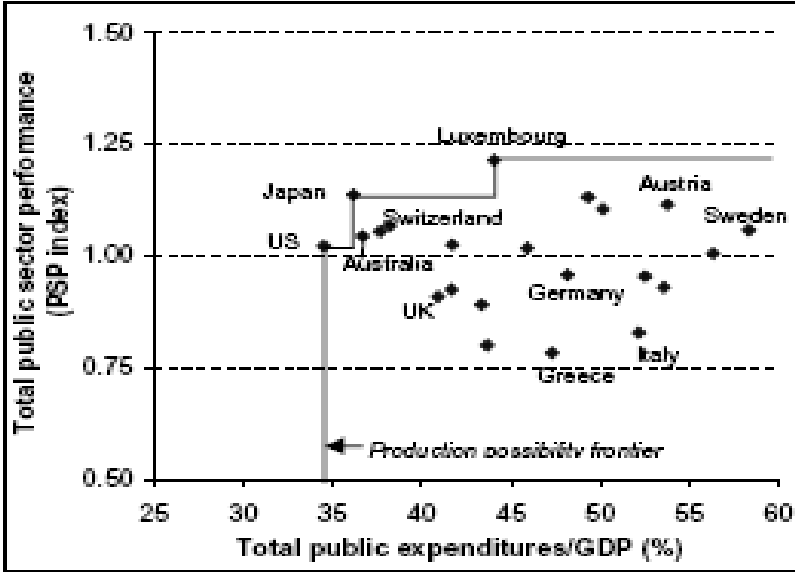
These studies by Afonso et al. indicate that significant efficiency gains in the public sector are possible. Moreover, the earlier study shows diminishing marginal returns of higher public spending. An analysis of the performance of 23 OECD Member States argues that countries

<sup>21</sup> Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Japan, Luxembourg, Netherlands, New Zealand, Norway, Portugal, Spain, Sweden, Switzerland, UK, US

<sup>22</sup> The Public Sector Efficiency indicator (PSE) is equal to Public Sector Performance (PSP) weighted by the relevant category of public spending.

with small public sectors<sup>23</sup> on average have a more efficient provision of public services. When applying the Free Disposal Hull"-technique the US, Japan and Luxembourg are seen as efficient (see figure 7). The Scandinavian countries, on the other hand, have relatively high expenditure rates and could obtain the same output with only around 60% of their inputs. This analysis also illustrates that input inefficiencies are larger than output inefficiencies, particularly in countries with a sizeable public sector. These conclusions, should however be used with care due to data limitations and the methodological framework used. Afonso et al. (2006) use the DEA ("Data Envelope Analysis") technique to confirm that substantial efficiency gains are possible for the new Member States and emerging markets.

Figure 7: Efficiency frontier with the FDH methodology (23 OECD Member States, 2000)



Source: Afonso et al. (2005)

The Social and Cultural Planning Office of the Netherlands (SCP, 2004) investigated the performance for education, health care, law and order and public administration using indicators for stabilisation, distribution, allocation and quality of public administration<sup>24</sup>. Their analysis shows that countries, such as Ireland and Finland, which have high income per capita and relatively low expenditures, perform better on average.

Such cross-country efficiency analyses at aggregated level are very useful to compare countries' performances. Nevertheless, such an aggregated composite indicator could misrepresent the functioning of a country's economy. Therefore, such cross-country analyses have to be complemented by individual country analyses since countries vary in terms of traditions and cultures (institutional settings, citizens' involvement, general aspects of political economy, etc.). Such factors can lead either to an under- or overestimation of the efficiency and effectiveness. Moreover, given the limitations of the non-parametric techniques used, the robustness of the results should be confirmed by applying parametric methods as well.

<sup>23</sup> In the paper Afonso et al. classified the countries as followed: small governments spend less than 40% of GDP (2000) and big governments spend more than 50% of GDP (2000).

<sup>24</sup> The SCP's work is partly based on ECB analysis. Worth mentioning is that SCP included private spending on education and health in its analysis.



A complementary approach is to investigate efficiency spending item by spending item. This allows to better consider specific circumstances and various sources of inefficiency. Consequently, such investigations make it easier to draw policy implications.

### 4.3 Environmental factors

As mentioned before, factors other than inputs and outputs can affect the efficiency and effectiveness levels. These factors are institutional settings, structural framework conditions or, in the case of cross-country evaluations, country-specific features. Studies aimed at explaining overall efficiency levels need to take these exogenous factors into account. These environmental factors can be very multifaceted and, *inter alia*, depend on the scope of the analysis. Defining borderline between direct influence-factors (inputs) and such exogenous factors is not always straightforward.

Within the public sector, the functioning of the public administration sits on this borderline. The public administration can be considered as an institution that affects the input, produces the output and has a significant impact on the outcomes of government policies. The functioning of the public administration will therefore have an important influence on the efficiency and effectiveness of public spending. Empirical research indicates that modern and efficient public administrations have a positive impact on productivity and growth<sup>25</sup>. There is evidence showing that EU Member States reformed their public administration in order to achieve efficiency gains<sup>26</sup>. Based on the information on efficiency enhancing reforms (see annex), which was provided by the Member States, most national reform initiatives during the last five years tackle following key aspects:

- i) **performance-orientation:** There is evidence that in many Member States there is an increased focus on the medium-term in budgetary planning. Moreover, many countries have adopted a result-oriented approach to budgetary planning. Finally, a coherent consideration of all budgetary resources could be an important tool for improving public sector efficiency and effectiveness.
- ii) **organisational aspects:** in many Member States, the roles and responsibilities of the different governmental departments have been reviewed in order to simplify the organisation of the public administration. The trend towards an externalisation of the public sector has also affected management practices within the public administration.
- iii) **human resource management:** the streamlining of the public administration has in many cases been accompanied by reforms of human resource management, including flexibility in recruiting, flexible working opportunities, performance pay and performance evaluation systems.
- iv) **encouraging the use of ICT tools:** many countries use ICT to reduce administrative costs and enhance the quality of service delivered to businesses and citizens by creating the possibility for interaction with the public via the internet, but also by optimising internal processes through a wider use of electronic information flows.

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<sup>25</sup> M. St. Aubyn (2007): Modernising public administration and economic growth, Conference paper for the Workshop on "Modernising public administration and its impact on competitiveness" organised by the Portuguese Presidency and the European Commission.

<sup>26</sup> European Commission/EPC (2007)

Nonetheless, experience shows that the design of appropriate reform strategies needs to be based on a good understanding of the dynamics of the national public administration system. This highlights even more that, as regards efficiency analyses, these various circumstances can hardly be taken into account in aggregated analyses and therefore spending item by spending item should be scrutinised. The OECD (2004) used its surveillance of public expenditures within the context of its country reviews to identify three institutional determinants of efficiency. First, the budget process can improve the allocation of funds, for instance by making use of fiscal rules or performance information. Second, modern management practices, such as performance budgeting, can simplify the budgetary process and enhance its output. Finally, the use of market instruments in the provision of public services may improve the provision of public services via voucher schemes, open tendering etc. These results were confirmed by OECD (2007), which stressed the value added of using performance information in decision-making to enhance efficiency. Nevertheless, the OECD also made the point that there is no blueprint for enhancing public sector efficiency.

Besides the functioning of public administration itself, other exogenous factors may have a positive effect on efficiency. For example, Afonso et al. (2005) found that the security of property rights appeared to have a positive influence on the efficiency of public spending. Competition is generally seen as efficiency enhancing. This explains why the provisions of the public procurement directives<sup>27</sup> encourage free and fair competition in public procurement markets. This increased competition provides public authorities with better value in terms of lower prices and higher quality through more competitive procurement<sup>28</sup>. Public procurement, defined in the broadest sense as goods and services purchased by the Government or public utility services, make up over 16% of the European Union's GDP in 2005. Around 20% of this is covered by the procurement directives. When assessing the efficiency of the public spending in general, Afonso et al. (2005) considered a number of other environment factors, including indicators on the educational level, trade openness, transparency in public policy and political accountability. They concluded that the educational level affected public expenditure efficiency positively. They used secondary school enrolment as a proxy for level of education, assuming that better qualified people take actively part in political life. Furthermore, the competence of the civil servants seems to be efficiency enhancing. This indicates once more the importance of a well-working public administration for efficiency and effectiveness.

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<sup>27</sup> Directives 2004/17/EC and 2004/18/EC. The current Public Procurement Directives provide rules on how to buy but leave the choice on what to buy up to the public authorities. The Directives contain a number of features which allow public authorities the possibility to direct their purchasing operations in favour of a particular policy goal.

<sup>28</sup> An initial evaluation of the EU public procurement Directives in force between 1993 and 2002 has demonstrated that the implementation of the Directives raised compliance costs for both awarding authorities and suppliers. However, these costs are outweighed by the significant overall benefits. Efficient and expanding suppliers have benefited from improvements to transparency and fairness; other less efficient suppliers have suffered from the increased competition as well as from the increased administrative costs. In general, suppliers as a whole may be said to have benefited simply by becoming more efficient. However, there is evidence that the impacts differ regarding Member States. Member States with more centralised and/or formal procurement functions have benefited more as have those where efforts have been made to integrate national and EU legislation.

## **5. Efficiency and effectiveness of educational and R&D spending**

Analyses at the aggregated level need to be complemented by assessments of efficiency and effectiveness at the level of individual spending items. First, investigations at a more disaggregated level allow a better identification of the relevant input, output and outcome indicators. Second, all other relevant environmental factors can be better covered and finally, it might be easier to spot the sources of inefficiency. This chapter gives an overview of work done in the area of educational and R&D spending, since these spending items are very important for economic growth and in particular R&D spending can have significant leverage effects.

### **5.1 Public spending on education – inputs of the education system**

A qualified labour force is a key determinant of economic growth. The literature refers to education as growth enhancing asset and it is a key pillar of the Lisbon Strategy. Moreover, Gonand (2007) highlights that efficiency gains in education spending will have large effects on GDP in the long run. A 10% increase on educational output might raise GDP by an estimated 3-6% in the long run in most OECD countries<sup>29</sup>. Since the launch of the Lisbon Strategy, average EU-25 public expenditures on education (including all levels of education) have increased from 4.7% in 2000 to 5.2% of GDP in 2003<sup>30</sup>. Nevertheless, in some countries education expenditures as a percentage of GDP have decreased for some years<sup>31</sup>. In these countries the decrease has occurred mainly in terms of public spending (see figure 9). Private expenditures have not offset this decline, but have decreased as well. In countries, however, where total educational spending has increased, it seems that public efforts have encouraged private spending. However, expenditure on education per pupil has increased in most countries. It has to be said that for countries, such as Ireland and some new Member States, the development of expenditures as a percentage of GDP could be misleading, since the period was characterised by very high GDP growth. Spending on education, however, does not appear to depend directly on a country's living standard (see figure 8). Both countries with a high GDP/capita (DK, SE) and countries with a low GDP/capita (HU, PL) devote a large share of their GDP to education.

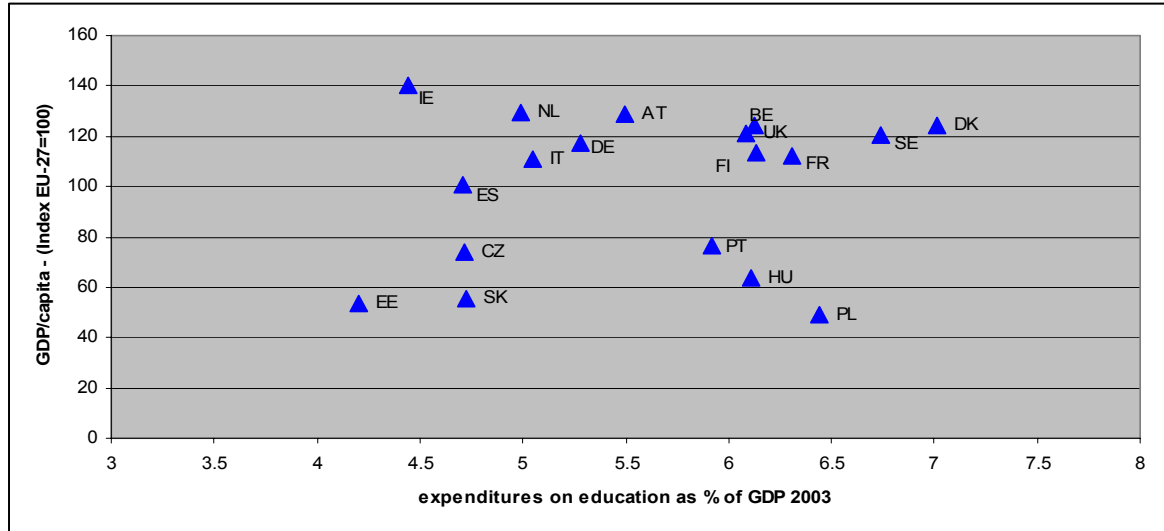
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<sup>29</sup> Gonand (2007)

<sup>30</sup> Eurostat

<sup>31</sup> Comparison of total spending on education as % of GDP 1995 and 2003: AT, CZ, SF, DE, IRL, ES

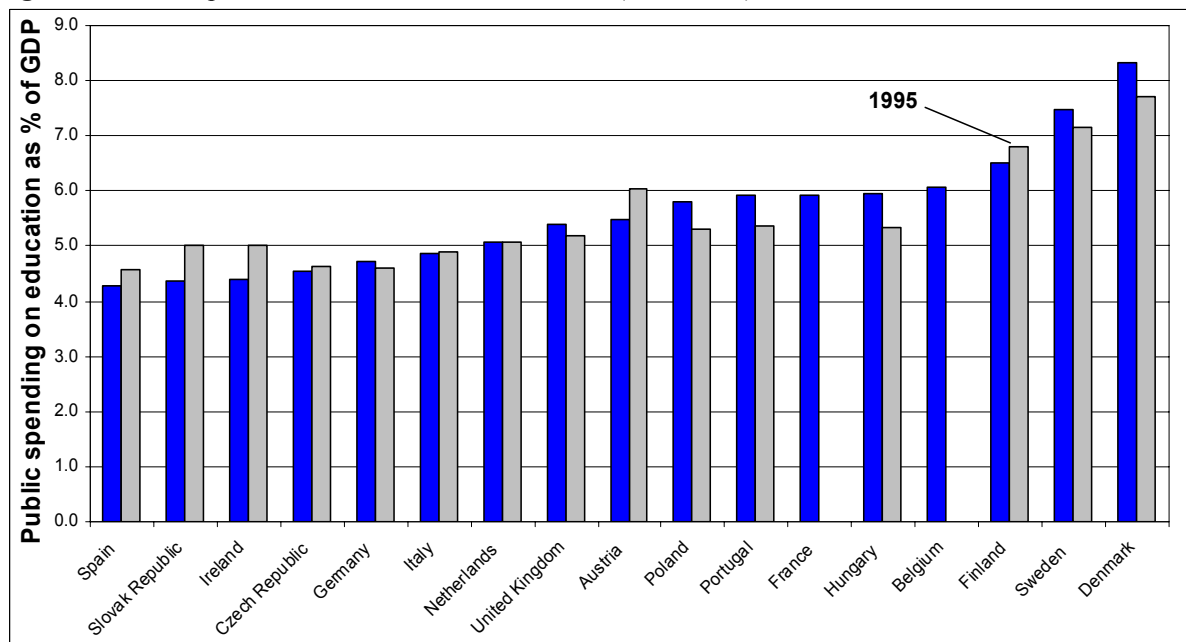
**Figure 8: Relation between spending on education and GDP/capita**



Source: OECD, AMECO

Traditionally, the European education system is mainly financed by public means. Depending on the state structure and the fiscal relations within a country, the schools and universities are financed by municipalities or by federal authorities (see figure 10 and 11). The proportion of public expenditures on primary, secondary and post-secondary non-tertiary education is above 90% of total expenditures on education in the vast majority of countries. UK is the only country, where household expenditures are above 10%. In Germany private sources other than households account for around 16%, e.g. funding by religious institutions. The level of public educational spending depends on the overall education system of a country (see box 3). While in some countries private institutions (such as religious organisations or trade unions) provide educational services (funded by public resources), in other countries this is much less the case.

**Figure 9: Public expenditures on education as % of GDP (1995, 2003)**



Source: OECD

In tertiary education the share of public sources is lower (EU19 average 84%) since household spending is more important, especially in Poland, Spain, Italy and UK (see figure 11). Nevertheless, the proportion of public spending on tertiary education in the EU is very high<sup>32</sup> in comparison with that in the US (43%). Most European universities find it, although, difficult to compete with other universities<sup>33</sup>.

**Box 3: Taking into account characteristics of inputs – funding of educational expenditures**

Countries use different ways of distributing funds earmarked for educational services (direct public expenditures, public transfers to households, tax expenditures, etc.). These funding channels have to be considered since they can affect the educational output. For instance transfers to households could enhance the competition between schools and enhance quality of teaching; tax expenditures could create encourage further training.

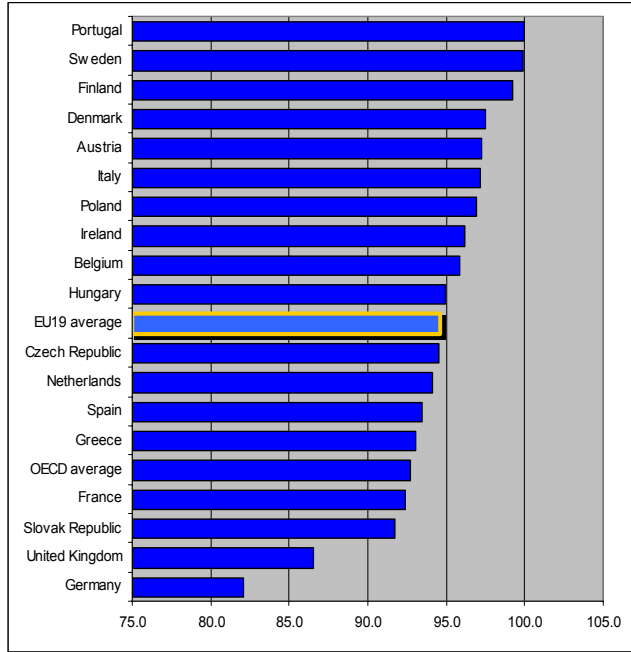
In most countries transfers to private households (grants, family or child allowances) represent less than 10% of total public education expenditures as far as primary, secondary and post-secondary non-tertiary education is concerned. Denmark (where transfers are above 14%) is an exception. Regarding tertiary education, public transfers and payments to the private sector are more common, especially in Denmark, Netherlands, Sweden and UK. In these countries public funded scholarships and grants appear to be more important. The vast majority of countries distribute their financial means via direct funding of public educational institutions. The Netherlands, Belgium and to a lesser extent UK are exceptions in the European context, since large shares of their direct public expenditures go to private institutions. In Belgium and the Netherlands the same pattern is recognisable in primary/secondary and tertiary education levels, whereas in the UK the funds are destined to private institutions at the tertiary level. In the Netherlands, 70.6% of total public expenditures on education in the primary, secondary and post secondary non tertiary education go to private institutions, in Greece and Austria by contrast above 98% of total public expenditures flows to public institutions. The Dutch constitution places public and private schools on an equal financial footing. In other countries, like in Denmark, the decision on public funding on private schools include specific features other than those applied for public schools, such as the size of school or the seniority of teachers.

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<sup>32</sup> The developments related to the Bologna Process give rise to discussions about cross-country financing of higher education: either the country of origin of the student (which is likely to benefit from the high skilled labour force) or the country which has produced the extra human capital. Gerard (2007) deals in particular with the European problem, where the Bologna harmonisation is under way, but EU jurisdiction does not allow for differentiation of students based on their (EU) origin. In the last years especially Belgium and Austria had to deal with these questions. Gerard argue for multilateral arrangement similar to what exists for taxation, social security or health expenditures, which imposes the country of origin to pay for studies of its resident students either at home or abroad.

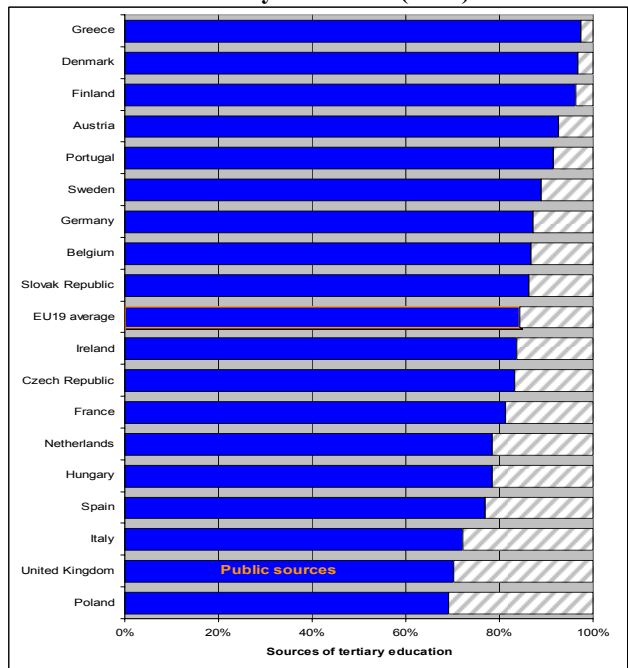
<sup>33</sup> See Jacobs/van der Ploeg (2006)

**Figure 10: Public sources for primary, secondary and post-secondary non-tertiary education (2003)**



Source: OECD

**Figure 11: Private and public sources for tertiary education (2003)**



Source: OECD

## 5.2 Output and outcome of education systems

There is a wide range of policy objectives which could be viewed as an aim of the education system besides knowledge accumulation. For instance easy geographical accessibility for pupils or even issues of integration and social policy, e.g. how countries support pupils that have special needs, can be included. In reality, all these tasks would have to be taken into account when measuring efficiency.

The OECD - PISA scores<sup>34</sup> are often used as output indicator of the education system with emphasis on primary and secondary education (see figure 12). It aims to measure how well 15-year-old-adults are prepared to meet the real-life challenges (basic skills of reading, mathematic and scientific literacy, problem solving). As it does not focus on the extent to which the pupils have mastered a specific school programme (like a test), its scope is wide enough to measure *educational output*<sup>35</sup>, even if it is too narrow to indicate the overall outcome of the educational system. Other output indicators are attainment rates or the percentage of pupils that graduate from secondary education. An outcome indicator would be the actual qualifications obtained by pupils. Regarding tertiary education, the definition of output seems to be even more complex, even within countries. The reasoning is that universities vary in their composition of faculties (scientific fields), which causes different kind of outputs since the output "teaching" and "research" can have very heterogeneous characteristics depending on the department. Faculties vary as regards cost-structure, including the possibilities to absorb grants, etc. For instance, taking patenting as an indicator for research would lead to the measurement of relatively high productivity levels in technical, medical faculties, but lower levels in social science or linguistics. Moreover, the patent patterns would be affected by the focus on applied research as opposed to basic research. Patenting would only cover the research output of a university. However, teaching, consultancy and other educational services are also important outputs of universities. The number of graduates could be a reasonable teaching output. However, here one could argue about the quality aspect. Furthermore, the efficiency scores might be biased due to the different costs of research. While research in some areas requires costly equipment, this is not the case in other areas of research.

### 5.3 Efficiency of spending on education

There is no clear link between spending on education and the observable performance of pupils. Figure 12 shows countries' PISA scores in the area of reading in relation to the money spent on education<sup>36</sup>. For instance Finland, Austria and Portugal spend roughly the same share of GDP on education, but the performance in PISA is very different. This may be explained by non-monetary determinants of education performance or lead to the conclusion that education expenditures in some countries are used inefficiently.

It could be said that this kind of comparison is too simple to draw reasonable conclusions and that efficiency is not properly measured. In recent years investigations on the efficiency of education have become increasingly frequent. Through OECD work ("Education at a glance, PISA) education is likely to be the area for which most systematic and consistent cross-country data are available. Moreover, the methodologies employed have improved.

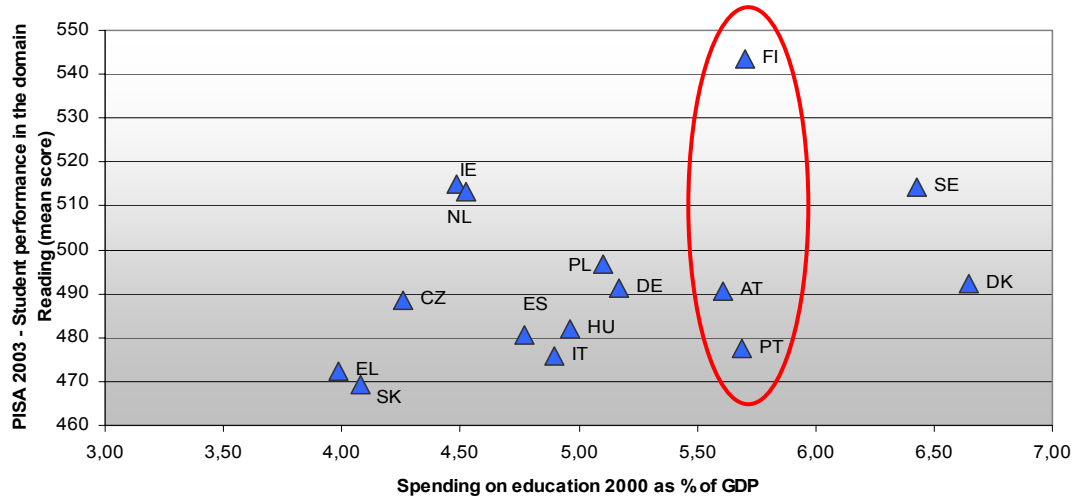
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<sup>34</sup> In each test subject, the score for each participating country is the average of all student scores in that country. (OECD)

<sup>35</sup> The OECD introduced the term of educational output.

<sup>36</sup> Since the results from PISA 2003 may depend on the money spent on education the years before the testing phase, the figure compares the spending in 2000 with the PISA results from 2003 in "reading". The comparison with the PISA scores on other competences (science, mathematics, problem solving) allows the same conclusion.

**Figure 12: The correlation between PISA scores and money spend on education**



Source: OECD

Note: The OECD does not give a collective score for all subjects combined; rather it gives a score for each subject area and countries are ranked by their mean score in each area. PISA 2003 ranked countries according to their performance in reading, mathematics and science, as well as problem solving.

Clements (2002) applied the FDH technique to relate total primary and secondary expenditures per student with the percentage of the population finishing secondary school at the normal graduation age in European countries. Wilson (2005) applied FDH and DEA to analyse the efficiency in education in some former Soviet states, Latin American and East Asian countries. Afonso and St. Aubyn (2006) investigated the cross-country efficiency of secondary education provision with a more sophisticated method, the so called two-stage semi-parametric procedure. They compared the efficiency of education spending of 25 OECD States with the PISA results (2003). The OECD itself has done extensive analysis on efficiency of education spending as well. Their latest paper (2007) investigates the linkage between performance and institutions in primary and secondary education. Earlier papers by the OECD assessed technical and cost-efficiency. They used teaching resources and socio-economic background of parents as input indicators to measure technical efficiency.

Table 1 summarises some of the results obtained from these cross-country investigations on education spending. The four investigations presented here all show that efficiency gains are possible. Nevertheless, as the indicators chosen and the methodology applied affect the efficiency scores, one should be extremely cautious when using these results. Moreover, the results vary between the four investigations. For example, according to Mattina and Gunnarsson (2007) Sweden is on the efficiency frontier, while according to the OECD (2007) the results show that with the same input a 6% higher output could have been obtained. Some other countries show the same patterns (Ireland, Hungary, Greece, etc.).

Based on Clements' investigations, Hungary, Norway, Ireland, Finland and Greece are among the most efficient countries within Europe. The FDH analyses done by Afonso/St. Aubyn (2005) put Hungary<sup>37</sup> again on the efficiency frontier together with Japan, Korea, Mexico and

<sup>37</sup> Simply due to methodology reasons, Hungary seems to be efficient when using FDH technique; however, with the DEA approach Hungary disappears from the efficiency frontier (Afonso et al., 2006).



Poland. The DEA analysis (Afonso et al., 2006) places Finland and Sweden on the efficiency frontier. However, all investigations come to the conclusion that the most (European) education systems are inefficient. On average the results by Afonso/St. Aubyn (2005) show that the same output could have been obtained with 61% of inputs used, i.e. substantial efficiency gains by reducing the inputs are possible. This is true in particular for Italy, Portugal, Germany and Austria.

**Table 1: Efficiency gains of education spending using the same resources (in % of output)**

Countries	Clements (2002)(1)	OECD (2007)(2)	Afonso et al. (2006)(3)	Mattina/Gunnarsson (2007)(4)
<b>Possible efficiency gains using the same resources</b>				
Austria	1.3	6.0	9.5	21
Belgium (*Fl.)	-	2.0	5.5	30
Czech Republic	0.9	6.0	6.8	6
Denmark	1.7	4.9	9.3	0.0
Finland	0.0	1.6	0.0	29
France	1.3	5.4	7.2	25
Germany	1.3	9.1	8.3	4
Greece	0.0	7.0	8.2	-
Hungary	0.5	4.7	10.5	0.0
Ireland	0.0	2.2	7.9	0.0
Italy	1.4	6.9	5.1	0.0
Netherlands	1.1	5.1	3.7	-
Poland	-	3.8	-	0.0
Portugal	5.3	2.2	6.1	19
Slovak Republic	-	5.3	1.8	4
Spain	2.0	3.4	2.9	0.0
Sweden	1.7	6.0	0.0	0.0
UK	-	6.1	-	0.0
US	2.4	8.2	-	-

Source: based on results by OECD (2007), Afonso et al. (2006), Clements (2002), Mattina/Gunnarsson (2007)

Note: (1) Education spending to GDP and educational attainment levels; FDH methodology, (2) Teachers per 100 students and socio-economic background as input and PISA scores and homogeneity of Pisa scores as output; DEA methodology, Bootstrap estimates, non-increasing returns to scale (3) Teachers-students ratio, hours in school as input and PISA 2003 as output; DEA methodology (4) Average public spending as share of GDP as input, secondary school enrolment rates and proportion of university graduates relative to the school-age population as output.

In line with the results on efficiency in the public sector as a whole, in the area of education the output inefficiencies are less than the input inefficiencies (Wilson, 2005). On average output could have been improved by 3.3% taking the inputs as fixed (FDH technique). Particularly Portugal, Italy and Germany could increase value for money. The DEA analysis (Afonso/St. Aubyn, 2006) even came to the conclusion that countries could have increased their output efficiency by 11.6% using the same resources.

#### **5.4 Environmental factors of educational spending**

Regarding the efficiency and effectiveness of educational spending, both factors within and outside the education system can affect the efficiency and effectiveness level. The recent Afonso and St. Aubyn (2006) paper used the efficiency scores calculated to explain in a

second step the determinants of efficiency. They conclude that efficiency of secondary education provision is strongly related to family background, measured by GDP per head, and education of parents. This result confirms the finding of the OECD (2006) that technical efficiency could be improved when controlling for the effects of socio-economic background on educational attainment. Other relevant factors, including institutional factors have been investigated by the OECD (2007), which used a composite indicator as a proxy for institutional setting. However, there seems to be no clear linkage of this composite indicator with the performance of pupils (PISA scores).

Nevertheless, some characteristics of the education system itself seem to affect efficiency, like the school size, the teachers/pupils ratio and the residency-based selection of pupils (OECD, 2007). As regards factors outside the education system Afonso and St. Aubyn (2006) show that the efficiency scores changes significantly when taking environment factors such as GDP/capita and education of parents into account. Portugal, Hungary and Spain improve their relative position, whereas Sweden, Denmark, Germany and Austria worsen their position compared to the initial approach that investigates only technical efficiency. The OECD confirms these findings, especially for Portugal and Finland. That means that the relative high inefficiency in some countries is related to the overall "harsh environment" (lower GDP/capita, lower education of parents, etc.).

This highlights the importance of improving our knowledge on the sources of efficiency. Investigations at a disaggregated level allow in this respect into better insights. For example, empirical studies<sup>38</sup> in the area of education economics show that various factors influence the efficiency and effectiveness of education systems and therefore are helpful in identifying the sources of inefficiency. Boarinin et al. (2007) conclude in their paper on tertiary education that increased private spending (tuition fees) leads to efficiency gains, because first, students are made more responsible with respect to completion, quality of learning etc. (demand-side effects); and second, tuition fees transmit signals on the quality of education provided, increase competition among universities, etc (supply-side effects). Additionally, increased financial participation of the industrial sector may enhance interactions between firms and universities and consequently, improve the matching process between education delivered and skills required.

#### **Box 4: Measuring efficiency and effectiveness of tertiary education**

Kempkes/Pohl (2007) investigated the efficiency of German universities and came to the conclusion that universities as such are too heterogeneous to be compared using for instance the DEA methodology. This leads to the conclusion that cross-country comparisons of efficiency of tertiary education are hardly possible for the time being. It appears to be more useful to compare faculties instead of whole universities. This was the approach taken by Kocher et al. (2005). They measured efficiency in economic research on a cross-country basis (21 OECD countries) taking R&D expenditures, number of universities with economic departments as input and publications in selected academic journals as output. Notably they showed that the size of population affects the efficiency level. These first efforts illustrate the difficulties in choosing appropriate indicators. Van Pottelsberghe and Saragossi (2003) stress that patent statistics are misleading indicators of the productivity of universities. This is due to the fact that many inventions are developed at universities, but patented by other institutions.

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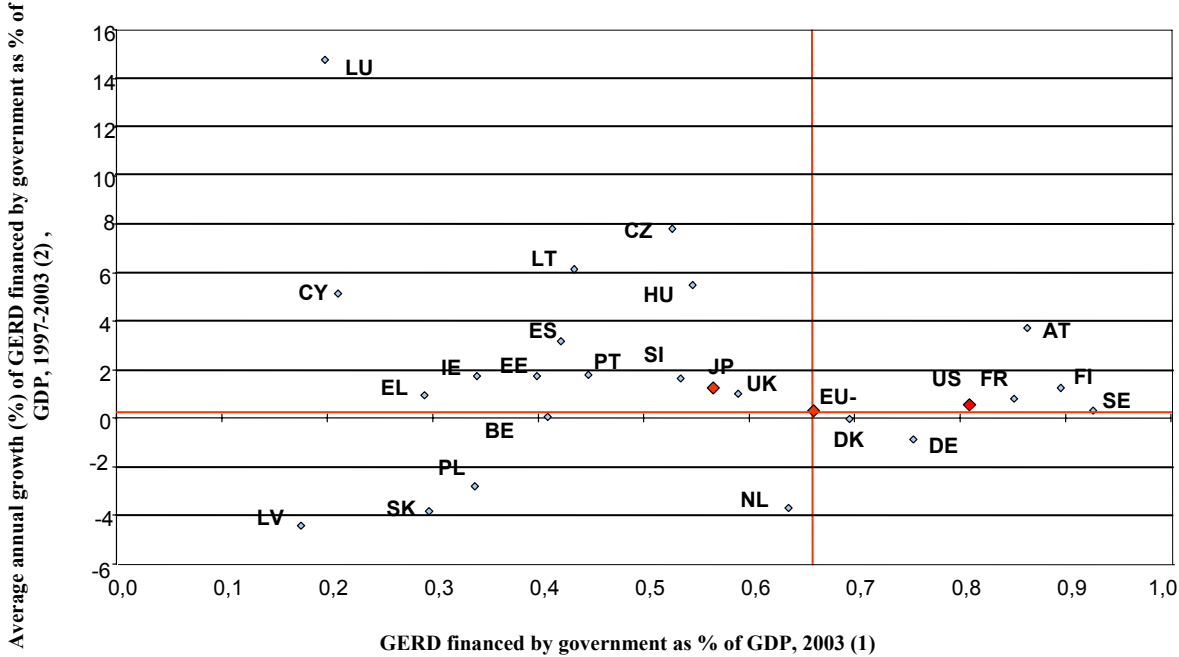
<sup>38</sup> De la Fuente / Jimeno (2006), Boarinin et al. (2007), Hoxby, C. (2000), Gundlach et al. (2001), etc.

### 5.5 Public spending on R&D

New growth models emphasise the key role of R&D for increased productivity and growth. The level of government spending on R&D has been very stable in the EU-25 since the end of the 1990s at around 0.65% of GDP (GERD financed by governments<sup>39</sup>). However, there is a significant variation amongst the EU Member States. The level of government funding of R&D as percentage of GDP is quite substantial in many highly innovative economies such as the three Nordic states, Austria, Germany and France. In other countries like Cyprus, Lithuania, the Czech Republic or Hungary, public spending on R&D has been growing very fast, indicating increasing efforts to gradually build up their science base. Conversely, in Poland, Latvia and Slovakia it has decreased and remains at a rather low level. Finally, the declines in average annual growth of GERD financed by government reported for the Netherlands, Germany, Denmark and Belgium, should be considered in the context of a trend reversal to switch from direct public funding towards more indirect stimulation of R&D through tax incentives.

There are considerable differences in the use of fiscal incentives and direct subsidies in support of private R&D between EU Member States<sup>40</sup>. Most of the countries employ a mix of both direct and indirect mechanisms. The focus of countries on one or the other mechanism reflects different beliefs about their impacts.

Figure 13: R&D expenditure (GERD) financed by government as % of GDP



Source: Eurostat, OECD

Notes: (1) DE: 2004; AT: 2005; (2) DE: 1997-2004; EE, CY, US: 1998-2005; FR, LT, LE: 2000-2003; IT, MT: data not available

<sup>39</sup> Gross Domestic Expenditures on Research and Development (GERD) refers to spending for Research and Development (R & D) performed within the country in a given year. The performing sectors are divided into government, business enterprise, private non-profit and higher education sectors

<sup>40</sup> Private R&D can be supported either through direct measures (like grants targeted at a specific scientific or technological theme, academic discipline or industrial sector) or through indirect measures which aim to reduce the costs of R&D investment (tax incentives). Since the end of the 1990s, mounting evidence shows that indirect measures are gaining ground compared to direct funding.

## 5.6 Output and outcome of R&D activities

The most important outputs and outcomes of R&D investment, i.e. knowledge, skills and experience, are intangible and immeasurable. Moreover, the realisation of their benefits can be delayed in time and their impact may occur in seemingly unrelated areas. For example, scientific instruments developed for specific purposes are transferred to other scientific disciplines, e.g. from physics to chemistry, or to the industry. Additional difficulties arise with the measurement of the spin-off and external effects of R&D activities.

These characteristics make it very challenging to identify meaningful output and outcome indicators necessary for efficiency investigations. Scientific publications or new products, services and processes (patent indicators) are often used as output indicators of R&D investment. In fact, to get an idea about the efficiency and the effectiveness, the output and outcome indicators have to reflect the additional R&D activities induced by inputs deployed.

Similar to the outcome of educational spending, the ultimate outcome should be considered in terms of productivity and growth. Innovation could be interpreted as an intermediate outcome of R&D investment. Against this background, composite indicators such as the summary innovation index (SII) constructed for the European Innovation Scoreboard (EIS) are used in the literature. The scoreboard is composed of 26 indicators grouped into two main categories: First, innovation input indicators<sup>41</sup> and second, innovation output indicators<sup>42</sup>. However, the use of composite indicators to assess innovation performance is still a pioneering field and their construction is not straightforward<sup>43</sup>.

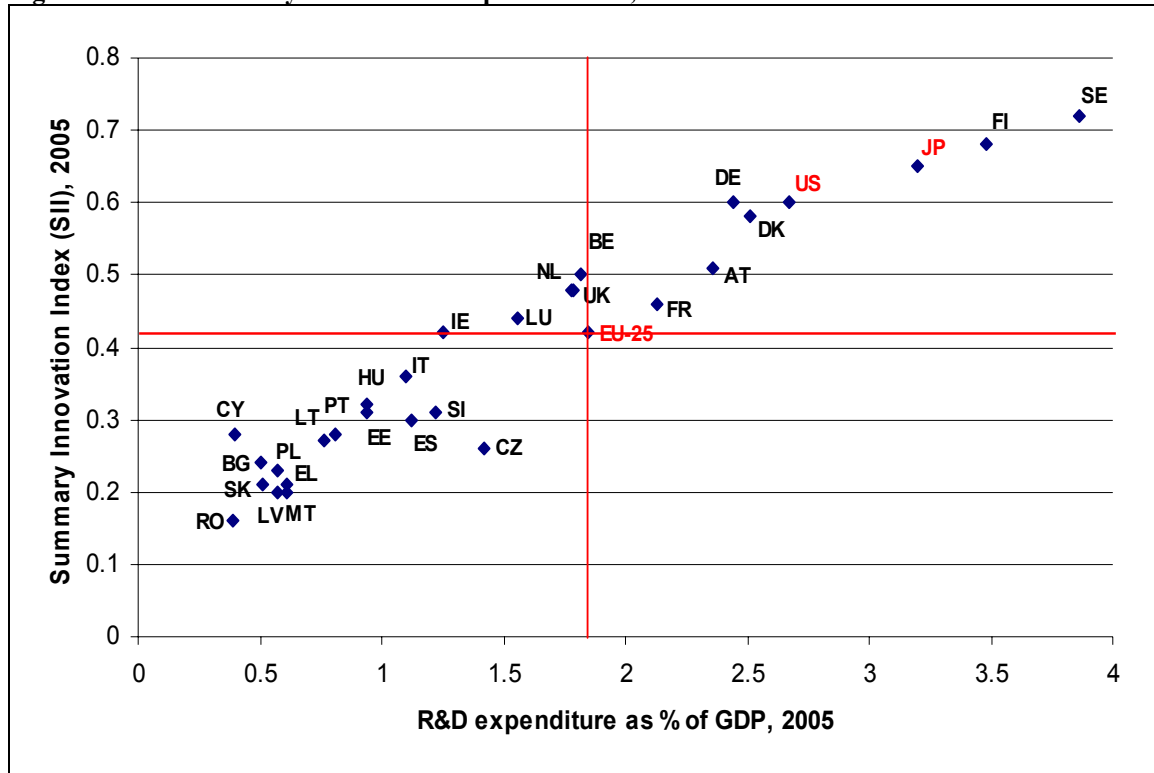
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<sup>41</sup> This group captures (i) investment in human capital and R&D; (ii) structural conditions required for developing innovation potential, e.g. broadband penetration rate; and (iii) innovative effort at the firm level, e.g. SMEs innovating in-house as percentage of all SMEs.

<sup>42</sup> This group captures (i) performance in terms of labour and business activities, and their value added in innovative sectors, e.g. sales of new-to-firm products as percentage of total turnover; and (ii) intellectual property, in particular in high-tech sectors, e.g. triadic patent families per million population.

<sup>43</sup> EIS Methodology Report (2005)

**Figure 14: R&D intensity and innovation performance, 2005**



Source: European Innovation Scoreboard, 2005

The results by the Summary Innovation Index (SII) show that wealthier economies with high levels of R&D investment receive higher innovation scores than countries with low levels of R&D (see figure 12). Sweden, Finland, Japan, US, Denmark and Germany are part of the group of "leaders", with the remaining countries lagging behind.

### 5.7 Efficiency and effectiveness of R&D activities

Unlike the figure on PISA scores and spending on education (see figure 12), figure 14 shows a strong correlation between SII and spending on R&D. However, this result is somewhat misleading. Higher levels of R&D spending do not automatically imply higher levels of innovation outcome. The efficiency and effectiveness of public spending in support of R&D is determined by numerous factors related not only to the overall institutional settings and framework conditions in which private and public actors operate. Protection of the intellectual property rights, well-educated and highly skilled labour force, access to sound money, competition and strength of linkages between public research and private sector are crucial in this respect. This makes efficiency analyses in this area even more demanding as the borderline between the various inputs and environmental factors can be blurred.

The empirical research on the effectiveness and efficiency of public spending on R&D has focused so far on the leveraging effect of public over private R&D investment and measuring the impact of public support on R&D profitability<sup>44</sup>. A forthcoming study by Cincera et al. aims to analyse the efficiency of public spending in support of R&D activities. The analysis

<sup>44</sup> See Cincera et al. (forthcoming) for a literature review.

shows that some specific issues have to be considered, including the crowding out effects through wage increases as a result of increased public spending on R&D<sup>45</sup>.

However, the limitations of measuring efficiency with the techniques presented in this paper come out more strongly as a result of the strong correlation between the data and the multiple factors that affect R&D activities. For example, the econometric analysis, normally, aims at minimising the error term. With the application of the Stochastic Frontier Approach (SFA), the error term becomes the centre of interest. However, the decomposition of the error term into an inefficiency component and a residual remains a major challenge and requires strong assumptions. As such limitations of the techniques used could very well hamper a meaningful efficiency analysis the objectives of such efficiency analysis have to be scaled down.

## 6. Concluding remarks

This paper has highlighted that good value for money is essential because of the increased pressure on public expenditures. The paper's assessment of the efficiency in public services more generally and in public spending on education and R&D in particular shows a large variation between countries. Clearly, there is a significant potential for increased efficiency in public spending. Such efficiency gains may be realised either by raising outputs for a given amount of public spending or by reducing the inputs required to obtain a given amount of output. This latter option would allow cutting public expenditures. For growth-enhancing spending categories such as education and R&D in most countries, the approach aiming at higher output is perhaps more promising. Furthermore the paper showed that environmental conditions have to be considered as they can have a significant impact on efficiency and effectiveness. Especially investigations of R&D activities showed that various factors interfere with the measurement of efficiency and effectiveness.

In spite of these difficulties, substantial progress has been made in developing the necessary measurement techniques. However, the application of these new techniques is hampered by lack of suitable data to apply those techniques. Quality data are needed because the techniques available to measure efficiency are sensitive to outliers and may be influenced by exogenous factors. This also suggests applying a combination of techniques to measure efficiency and effectiveness. Moreover, the precise definition of inputs, outputs and outcomes may influence results.

Against this background, analyses based upon individual spending areas (function-by-function approach)<sup>46</sup> seem to be a more promising approach to measure efficiency and effectiveness on a cross-country basis than aggregated investigations. As discussed in the paper in-depth analyses of the areas in question allow for better identification of meaningful indicators for input, output and also exogenous factors. Consequently, the models can be better specified. The estimates in the area of education, for example, shows possible efficiency gains in term of higher outputs using unchanged inputs. However, the observation that a country is far away from the efficiency frontier does not necessarily imply that there are

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<sup>45</sup> Public funds devoted to R&D activities can increase the demand for researchers and consequently the wages could increase, depending on the supply of such skilled workforce. Hence, firms have to cope with higher R&D costs and could therefore reallocate their funds to other investment projects. (Cincera et al., forthcoming)

<sup>46</sup> Public activities in R&D, education, health care, infrastructure, etc.

substantial inefficiencies<sup>47</sup> within the system in question. It may simply be a reflection of environment factors that have a negative effect on outputs. By changing these external factors countries could improve their efficiency positions. Though to derive at such policy conclusions, the analyses must allow for the identification of efficiency enhancing determinants. Thus, the sources of inefficiency should be detected, not only efficiency scores. As efficiency improvements can be achieved in many different ways for every country a specific mix of short-, medium- and long term measures could be defined to enhance efficiency and therefore effectiveness.

The improvement of the efficiency and effectiveness of public spending features high on the political agenda. However, to fulfil the policy makers' demands further progress in this area is necessary to overcome various shortcomings as techniques and data are concerned. In the context of the Lisbon Strategy and the Stability- and Growth Pact, it may make sense to focus attention on spending items that are at the one hand seen as growth enhancing and on the other hand account for a large share of public spending. Nevertheless, spending items with other objectives, like equity or adjustment should not be neglected.

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<sup>47</sup> Afonso et al. (2006)

**Annex: Illustration of reform initiatives taken by Member States**

Country	Objectives	Reform initiatives	Problems and Challenges (Examples)
<b>Belgium</b>	Efficient public management/ quality of public services	e-Government/ Reducing administrative burden Human resource management reform; Business process reengineering of administrations	Technical constraints, Cooperation between all Ministries and levels of government
<b>Bulgaria</b>	Stable medium term public expenditure framework	Public Expenditure Management Reform	Coordination between different strands of the reform, capacity constraints during design and implementation
		Law on audit and control	
		Public finance School	
<b>Czech Republic</b>	Efficient public budget management	Medium-term expenditure framework Methodology for the quantification of costs of the performance of public administration Analysis of the administrative burden on businesses and its reduction by 20% until 2010	Enforcing modifications given the long-established procedures
<b>Denmark</b>	Efficient public sector	e-Government	Creating new business-models based on digitalisation but still including all citizens/businesses
		Local Government reform	
		Central Government budget and account reform	
<b>Germany</b>	Efficient public sector	Constitutional reform of federalism	Cooperation among all levels of government, challenging decision- making process,
		Cutting red tape	
		Focused on the Future: Innovations for Administration including the programme E-Government 2.0	
<b>Estonia</b>	Efficient public sector/ quality of public services	Strategic planning system	Making the paradigm shift
		Medium-term expenditure framework	
		Modernisation of Civil Service Law	Co-operation among state agencies
		Provision of e-services/e-government, different initiatives (citizen charters)	
<b>Ireland</b>	Delivering better services	Human Resource management	
<b>Greece</b>	Efficient public management	Establishing a General Directorate of Fiscal Audit	
	Mobility of public sector employees	New operating framework for public enterprises and entities	
		Civil servants code	
<b>Spain</b>	Efficient public services	States Agencies Law, e.g. State Agency for the evaluation of public policies and service quality	Spreading new assessment culture among all levels with spending powers
	Quality of public services	e-Administration	Coordination at all levels of government
		Basic statute for civil servants	
<b>France</b>	Efficiency and effectiveness	LOLF	Designing performance indicators, changing behaviour, technical constraints,
		General review of public policies (audit) Microeconomic analysis process for public investment in transport infrastructure	Cooperation with all Ministries
<b>Italy</b>	Improve the performance of Public Administration; efficient budget management, fiscal discipline and budget procedures	Performance based budgeting; E-Government; fiscal federalism reform	



<b>Cyprus</b>	Efficiency of public sector	Medium term budgetary framework	Formulating objectives, monitoring outputs/outcomes, expanding forecasting beyond traditional one-year horizon
		FIMAS (Financial accounting system)	Fine-tuning with the Medium-term budgetary framework
<b>Latvia</b>	Efficient public budget management	Reform of the budget (avoiding earmarking of revenues and expenditures)	
<b>Lithuania</b>	Effective management of public spending	Budget reform	
	Efficient public sector	Better management of human resources, innovations in provision of public services and e-government.	
<b>Luxembourg</b>	Efficient budget management	Establishing a direction du controle financier and reform of the Court of Auditors	Changing behaviour in the civil service
<b>Hungary</b>	Cost cutting	Staff reduction partly through concentration of institutions Flexible wage system with renewed performance evaluation system	Coordination and harmonisation among different levels of governments due to local governmental autonomy
	Rationalise	Central Service Directorate General (Procurement) Concentration of institutions from county level to regional level	
<b>Malta</b>	Quality of public services	Quality Service charters in the Public Service	Changing behaviour and moving towards performance management, Cooperation with all stakeholders , in particular during the implementation of reforms
	Result-oriented employee appraisal system	Performance Management Programme	
	Efficient budget management	Financial Management Monitoring Unit	
<b>Netherlands</b>	Efficient welfare system	Social assistance reform	Creating win-win situations (allocation of responsibilities and budget power)
	Accountability	Performance based budgeting	Formulating policy objectives, performance measures, etc., monitoring and assessing results based on methodological sound evaluations
	Simplified funding	Funding reform of education system	
<b>Austria</b>	Efficient public sector	Administrative reform, including staff reduction, reducing administrative burden	Coordination among different levels of government and at the central level
		eGovernment	
<b>Poland</b>	Transparency, effectiveness, simplification	Public Finances Reform, incl. cheap and efficient state programme	Changing to a multi-annual planning horizon, organisational challenges
		IT system	
<b>Portugal</b>	Simplified and modern public administration	PRACE Restructuring programme for the government central administration	Active involvement of all stakeholders, good design of targets and measurements, clear system of monitoring
		SIMPLEX Simplification programme for public services	
<b>Romania</b>	Budgetary discipline	Medium term budgetary framework	The selection and use of indicators, incl. providing relevant information
	Efficient public budget management	Programme budgeting	
<b>Slovenia</b>	Efficient budget management	Result-oriented budgeting	Reporting objectives, avoiding additional administrative burden
	Flexible allocation of funds	Changing of funding of higher education	Monitoring the quality of higher education institutes, claim responsibility of universities to the public

<b>Slovakia</b>	Transparent and stable medium term framework	Public Finance Management Reform	Cooperation and coordination among departments involved, defining specific formats and reporting methodologies, technical constraints, additional capacity needed during implementation
		Fiscal decentralising	
<b>Finland</b>	Efficiency and effectiveness	Restructuring of municipalities and services	Political commitment at all decision-making levels
	Productivity of public sector	Productivity programme	
<b>Sweden</b>	Cost- saving and efficient public services	"Independent schools", Customer choice system within elderly care	Exceeding costs due the need of a certain amount of overcapacity
		Reform of fiscal relations	
<b>UK</b>	Modern budget management	Comprehensive Spending reviews	Coordination among different levels of government, defining performance targets, demand for good-quality, outcome-focused data
	Efficient public sector	Efficiency Programme (Gershon review)	

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