Quality of public finances

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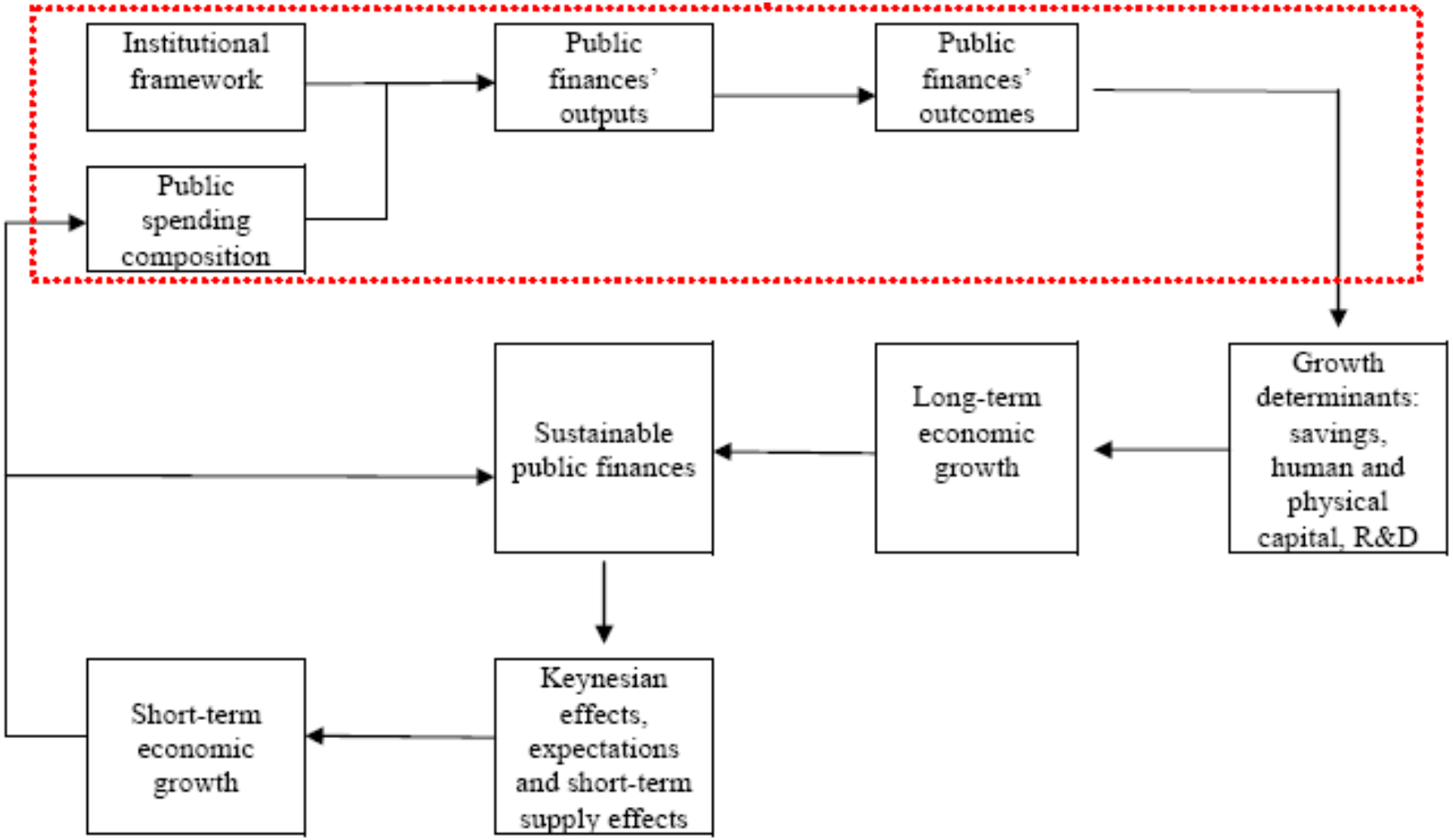
"Public expenditure ratios have steadily increased in the euro area since the 1960s before peaking and, in some cases, declining in more recent years. Public expenditure is nevertheless much higher than in most other industrialised countries. According to many observers, it exceeds the levels required for the efficient provision of essential public services."
(ECB, Monthly Bulletin, April 2006, p. 73).

"The need to improve competitiveness, concerns about fiscal sustainability and growing demands by taxpayers to get more value for public money as well as the need to reconsider the scope for state intervention in the economy has prompted efforts to increase the focus of budgets on more growth-enhancing activities and gear the tax mix and the allocation of resources within the public sector towards better efficiency and effectiveness." (EC, 2007, p. 9)

"The question we ask today is not whether our government is too big or too small, but whether it works (…). Where the answer is yes, we intend to move forward. Where the answer is no, programs will end. And those of us who manage the public's dollars will be held to account – to ***spend wisely, reform bad habits, and do our business in the light of day*** *– because only then can we restore the vital trust between a people and their government."* (Barack Obama inaugural speech, 20 January 2009)

Public finances efficiency and economic growth



General government expenditure, % of GDP

General government spending (% of GDP)

	2000	2007	2010	2014		2000	2007	2010	2014
BE	49,04	48,20	52,45	53,94	MT	39,45	41,78	41,59	44,35
BG	41,27	39,19	37,42	38,65	NL	44,17	45,25	51,44	50,36
CZ	41,65	41,05	43,79	42,99	AT	51,78	48,47	52,82	51,76
DK	53,57	50,78	57,53	56,32	PL	41,08	42,18	45,43	41,26
DE	45,10	43,51	47,85	44,64	PT	41,57	44,30	51,47	46,82
EE	36,12	33,98	40,47	38,30	RO	38,56	38,24	40,10	36,07
IE	31,18	36,70	65,49	40,28	SI	46,51	42,28	49,45	49,29
EL	47,12	47,20	51,28	47,98	SK	52,14	34,21	39,95	37,73
ES	39,18	39,15	46,31	43,78	FI	48,34	47,39	55,48	57,83
FR	51,67	52,59	56,54	57,10	SE	55,09	50,93	52,03	52,38
HR			46,90	47,27	UK	36,42	43,29	49,88	45,97
IT	45,78	47,67	50,52	50,55	**EA-17**	**46,16**	**45,98**	**51,04**	**49,39**
CY	37,07	41,33	46,17	47,29	**EU-28**			50,58	48,55
LV	37,61	35,95	43,44	35,71					
LT	39,78	35,31	42,22	34,82					
LU	37,59	36,26	43,52	43,33					
HU	47,72	50,71	49,89	51,26					

Source: European Commission spring 2014 economic forecast,.

Notes: The Irish figure for 2010 includes significant one-off costs, largely related to measures to support the banking sector, which total around 19% of GDP.

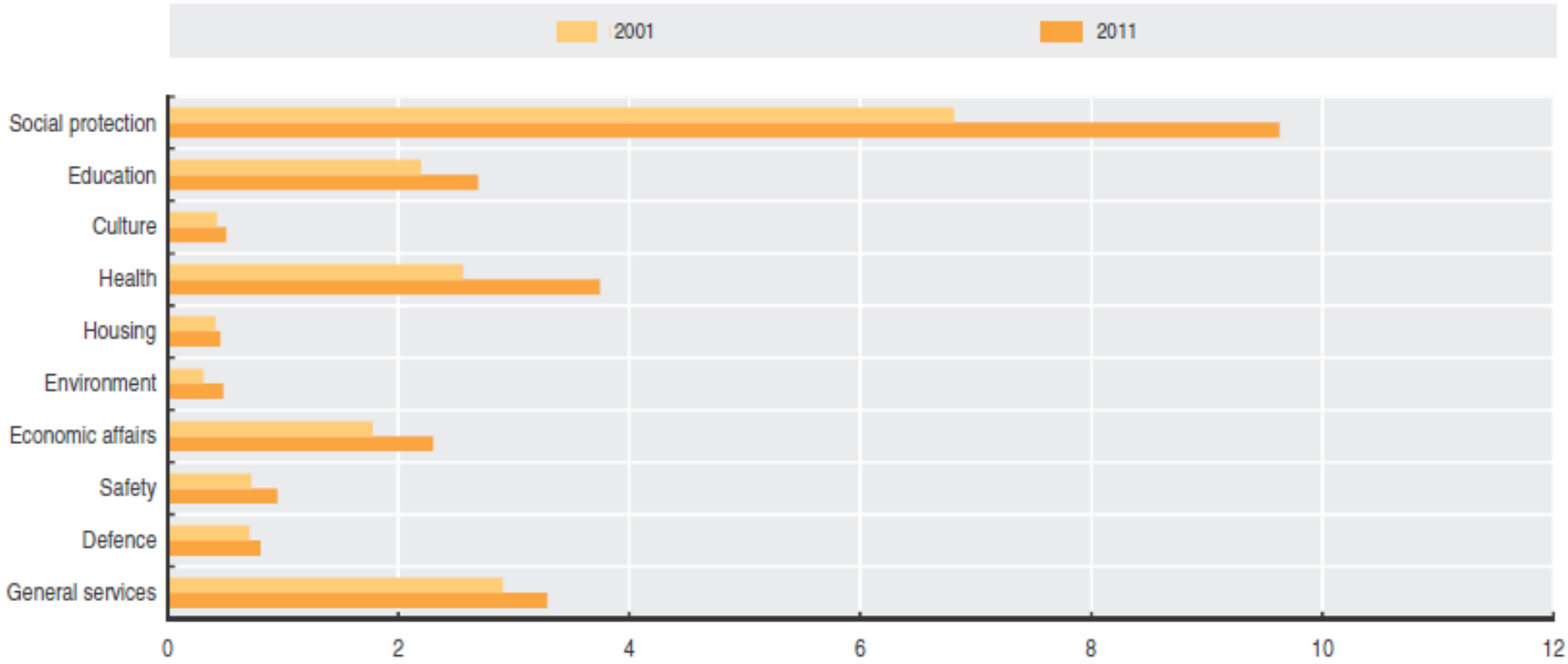
General government expenditure by function (% of GDP, 2011)

	Total expenditure	General public services	Defence	Public order and safety	Economic affairs	Environment protection	Housing and community amenities	Health	Recreation, culture and religion	Education	Social protection
Australia	..	..	..	..	..	..	..	..	..	..	..
Austria	50.8	6.6	0.7	1.5	5.3	0.5	0.6	7.8	1.0	5.6	21.1
Belgium	53.5	8.0	1.0	1.9	6.5	0.8	0.4	7.9	1.3	6.3	19.5
Canada	..	..	..	..	..	..	..	..	..	..	..
Chile	..	..	..	..	..	..	..	..	..	..	..
Czech Republic	43.2	4.6	0.9	1.8	6.0	1.4	0.8	7.8	1.3	4.9	13.7
Denmark	57.7	8.0	1.4	1.1	3.5	0.4	0.3	8.3	1.6	7.8	25.2
Estonia	37.7	3.1	1.5	2.1	4.5	-0.3	0.6	5.0	1.9	6.4	12.9
Finland	55.3	7.4	1.5	1.5	4.8	0.2	0.6	7.9	1.2	6.4	23.8
France	55.9	6.4	1.8	1.7	3.5	1.1	1.9	8.2	1.4	6.0	23.8
Germany	45.0	6.1	1.1	1.6	3.5	0.7	0.6	7.0	0.8	4.2	19.5
Greece	51.8	12.8	2.4	1.7	3.2	0.5	0.2	6.0	0.6	4.1	20.4
Hungary	50.1	8.8	1.1	1.9	7.2	0.7	0.8	5.2	1.8	5.2	17.2
Iceland	47.4	8.4	0.0	1.4	5.9	0.6	0.3	7.6	3.3	8.1	11.6
Ireland	47.1	5.3	0.4	1.7	7.7	1.0	0.6	7.3	0.9	5.1	16.9
Israel	44.6	6.6	6.6	1.7	2.6	0.6	0.5	5.5	1.7	7.4	11.5
Italy	49.9	8.6	1.5	2.0	3.6	0.9	0.7	7.4	0.6	4.2	20.5
Japan	42.3	4.6	0.9	1.3	4.1	1.2	0.8	7.3	0.4	3.6	18.1
Korea	30.2	4.6	2.6	1.3	6.1	0.7	1.0	4.6	0.7	4.8	3.9
Luxembourg	42.9	4.9	0.4	1.1	4.3	1.2	0.8	4.9	1.7	5.2	18.5
Mexico	..	..	..	..	..	..	..	..	..	..	..
Netherlands	50.1	5.6	1.4	2.1	5.5	1.7	0.6	8.5	1.8	5.8	17.3
New Zealand	..	..	..	..	..	..	..	..	..	..	..
Norway	43.9	4.3	1.6	1.0	4.2	0.7	0.7	7.3	1.3	5.6	17.5
Poland	43.4	5.8	1.2	1.8	5.6	0.7	0.9	4.7	1.3	5.5	15.9
Portugal	49.3	8.4	1.3	2.0	4.0	0.5	0.6	6.8	1.1	6.3	18.1
Slovak Republic	38.2	5.9	1.0	2.4	3.7	1.0	1.0	5.9	1.1	4.0	12.0
Slovenia	50.8	6.3	1.2	1.7	5.8	0.8	0.7	6.9	1.9	6.7	19.0
Spain	45.9	5.7	1.1	2.2	5.3	0.9	0.6	6.5	1.5	4.8	17.1
Sweden	51.5	7.4	1.5	1.4	4.3	0.3	0.8	7.1	1.1	6.8	20.9
Switzerland	33.9	3.4	1.0	1.7	4.6	0.8	0.2	2.1	0.9	6.1	13.2
Turkey	37.4	6.1	1.5	1.9	4.5	0.4	1.3	4.5	0.9	4.3	11.9
United Kingdom	47.9	5.6	2.5	2.5	2.5	1.0	0.9	7.9	1.0	6.4	17.6

Source: National accounts at a glance, 2014. OECD.

General government expenditure by function, for total OECD

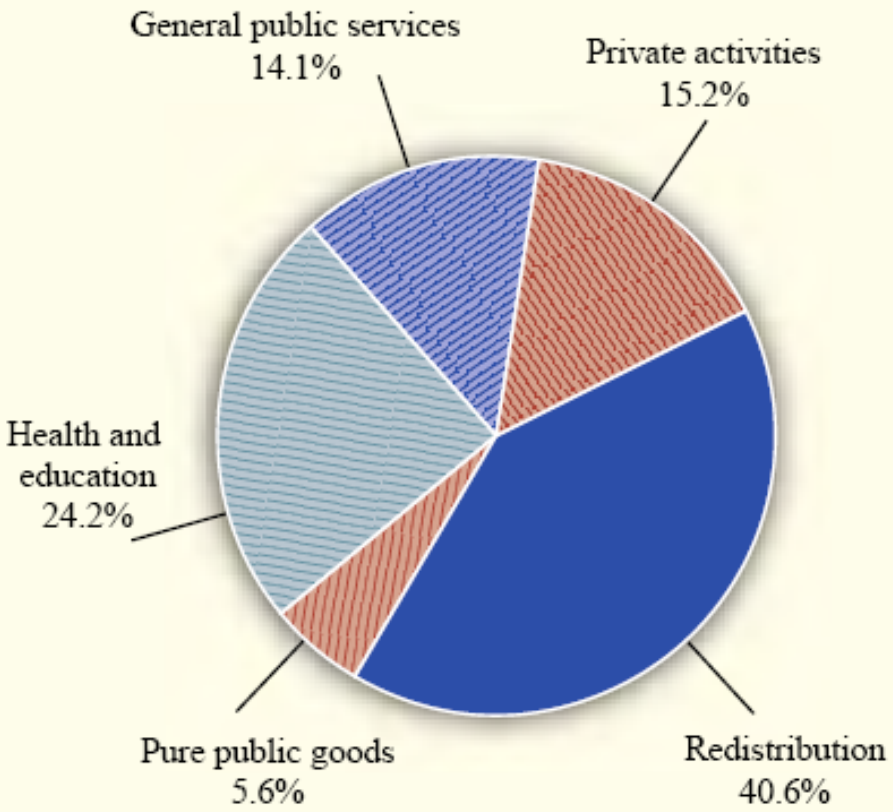
(% of GDP, 2001, 2011)



Source: National accounts at a glance, 2014. OECD.

Chart 2 Aggregated functional breakdown of euro area government expenditure in 2006

(percentages)



Sources: Eurostat, national data and ECB calculations.
Note: Data relate to the Euro 15.

Main functions of government	COFOG categories
A. Redistribution	10 – Social protection
B. Pure public goods	02 – Defence 03 – Public order and safety
C. Health and education	07 – Health 09 – Education
D. General public services	01 – General public services
E. Private activities	04 – Economic affairs 05 – Environmental protection 06 – Housing and community amenities 08 – Recreation, culture and religion

Source: ECB (2009).

General Government revenue (% of GDP)

	1990	2000	2010	2012
BE	45,5	49,0	48,6	51,2
BG		40,7	34,3	34,9
CZ		38,0	39,0	40,1
DK	54,1	55,8	55,1	55,7
DE		46,2	43,6	45,0
EE		35,9	40,8	40,1
IE	39,6	36,0	35,2	34,3
EL	31,0	43,4	40,6	43,9
ES		38,2	36,6	36,3
FR	47,1	50,2	49,5	51,8
IT	41,2	45,0	46,0	48,1
CY		34,7	40,9	41,6
LV	38,3	34,8	35,6	35,1
LT		35,7	33,6	33,7
LU	42,0	43,6	42,0	42,4
HU		44,7	45,4	46,4

	1990	2000	2010	2012
MT		34,4	38,9	40,0
NL	49,6	46,1	46,1	46,2
AT	49,0	50,1	48,1	48,5
PL		38,1	37,6	39,4
PT	32,4	38,3	41,4	41,7
RO		33,9	33,4	33,3
SI		42,8	44,5	44,4
SK		39,9	32,3	32,7
FI	53,6	55,4	53,0	53,6
SE		58,7	52,3	51,4
UK	39,0	40,4	40,2	42,2
US	33,2	35,4	31,4	32,0
JP	33,1	31,0	32,4	34,5
EA-17		46,1	44,8	46,2

Indirect taxes ▷ **Direct taxes** ▷ **SS Contributions** ▷

Source: European Commission Forecast Autumn 2012.

General Government Debt (% of GDP)

	1990	2000	2010	2012
BE	125,6	107,8	95,5	99,9
BG		72,5	16,2	19,5
CZ		17,8	37,8	45,1
DK	62,0	52,4	42,9	45,4
DE		60,2	82,5	81,7
EE		5,1	6,7	10,5
IE	92,0	35,1	92,2	117,6
EL	71,7	104,4	148,3	176,7
ES	42,7	59,4	61,5	86,1
FR	35,2	57,4	82,3	90,0
IT	94,3	108,5	119,2	126,5
CY		59,6	61,3	89,7
LV		12,4	44,5	41,9
LT		23,6	37,9	41,6
LU	4,7	6,2	19,2	21,3
HU		56,1	81,8	78,4

	1990	2000	2010	2012
MT		54,9	68,3	72,3
NL	76,8	53,8	63,1	68,8
AT	56,2	66,2	72,0	74,6
PL		36,8	54,8	55,5
PT	53,3	50,7	93,5	119,1
RO		22,5	30,5	34,6
SI		26,3	38,6	54,0
SK		50,3	41,0	51,7
FI	14,0	43,8	48,6	53,1
SE	41,2	53,9	39,5	37,4
UK	33,0	41,1	79,4	88,7
US	64,4	55,1	99,2	109,6
JP	67,0	140,1	215,3	240,6
EA-17		69,2	85,6	92,9

Sources: European Commission Forecast Autumn 2012.

Dupuit's fundamental principles…

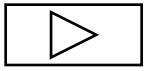
- The performance of the public sector may have far-reaching consequences: the foregoing is associated with the excess burden of distortional taxation (Dupuit and Pigou).

- "…some of the general properties of taxes which it is well to bear in mind in questions concerning public undertakings, since the latter always and necessarily give rise to a tax or a toll." (Dupuit, 1844, pp. 276)

- are:

"*The heavier the tax, the less it yields relatively. The loss of utility increases with the square of the tax.*" (Dupuit, 1844, pp. 281)

Dupuit-Laffer curve



… and Pigou's indirect costs

"**Where there is indirect damage, it ought to be added to the direct loss of satisfaction involved in the withdrawal of the marginal unit of resources by taxation**, before this is balanced against the satisfaction yielded by the marginal expenditure. It follows that, in general, expenditure ought not be carried so far as to make the real yield of the last unit of resources expended by the government equal to the real yield of the last unit in the hands of the representative citizen." Pigou (1947)

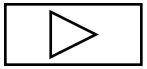
Indirect cost associated with the excess burden of taxation

- Afonso and Gaspar (2007) illustrate numerically that financing through distortional taxation causes excess burden (deadweight loss) magnifying the costs of inefficiency.

- Public finance developments, notably the growth in the size of the government, have increasingly been in the focus of policy debates.

- The EU fiscal framework has increased the awareness of the relevance of fiscal sound behaviour.

- The European Commission and the **Stability and Growth Pact argue for assessing fiscal policy developments also by taking into account the quality of public finances**, especially the efficiency and effectiveness of public spending.



Measuring public sector performance and efficiency

Main questions:

– Are "public" services satisfactory considering the amount of resources allocated to its activity?

– Could one have better results using the same resources?

– Could we have the same results with lower expenses?

– Can we measure cross-country/cross-sector/cross-institution efficiency and determine benchmark units?

– Can we explain measured inefficiency?

  – systemic component,

  – environmental or non-discretionary component.

Measuring performance and efficiency

- Public sector **performance** can be measured via output/outcome indicators:
  - Health, education, infrastructure, income distribution.
  - There is a need for good indicators.

- Public sector **efficiency** relates outcomes to the resources used/inputs:
  - Need for homogenous and matching data (heterogeneity is a limit).

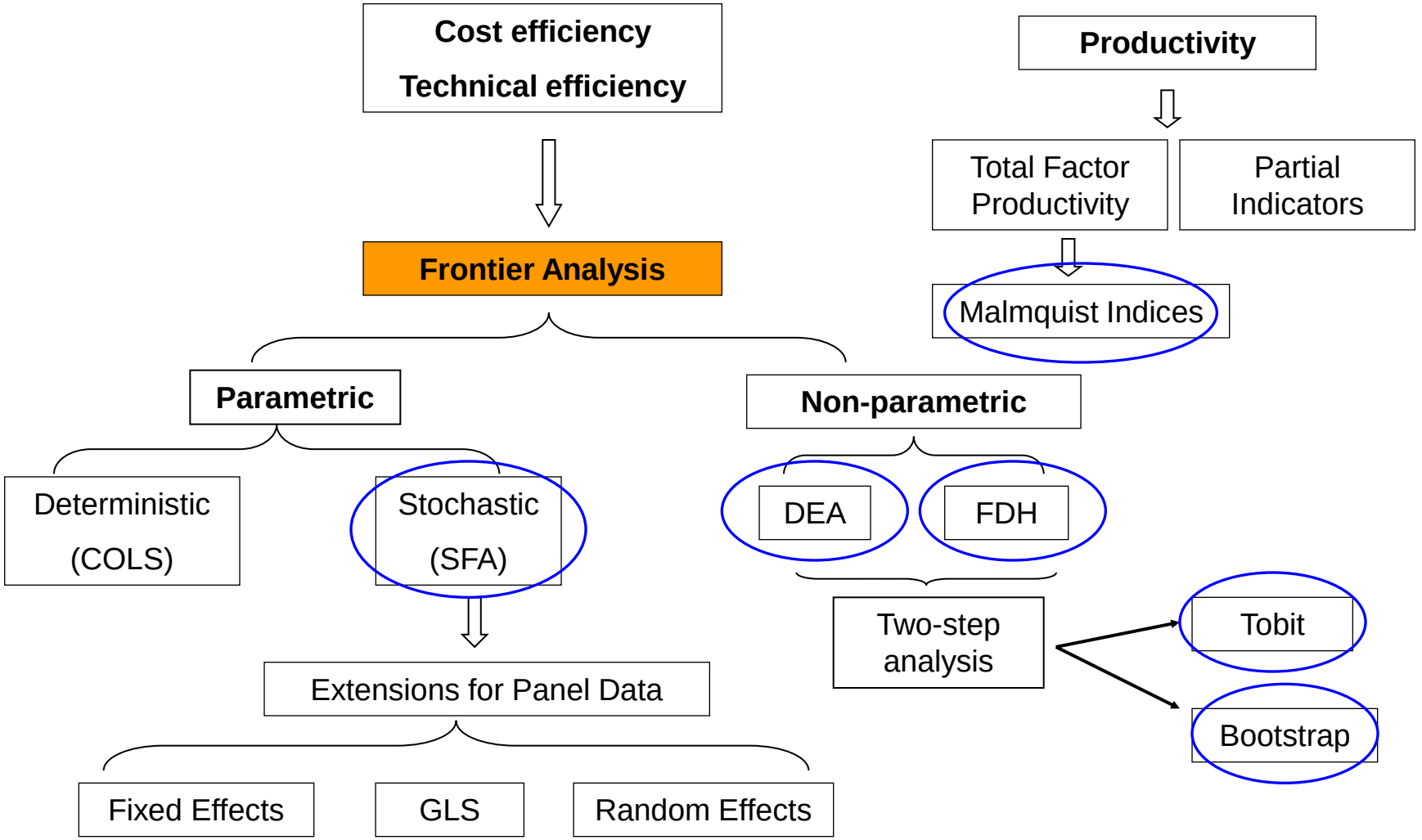
Key issues: **methods** and (homogeneous and "right") **data** to assess performance and efficiency.

- The common "production function" relates inputs (x_i) to output (y):

  $y = F(x_1, x_2)$

- Alternatively: $F(x_1, x_2)$ is a production possibilities frontier
- Note that:
  - **typically there are several outputs, $(y_1, y_2, ...) = F(x_1, x_2, ...)$;**
  - their joint production depends on several inputs
  - and on other "environment" variables.
- Non-parametric methods commonly used in the literature:
  - FDH (Free Disposable Hull), DEA (Data Envelopment Analisys), both;
  - Non-discretionary inputs should be considered;
  - There are some examples of two-step (tobit/bootstrap) analysis.
- Parametric methods: stochastic frontier analysis.

Examples of possible methods



One should be able to:

– i) **estimate output efficiency scores** for EU/OECD countries, sectors, institutions, taking into account the resources employed;

– ii) **explain efficiency scores**, controlling for environment factors (non-discretionary inputs).

Most used methodologies:

- "raw" efficiency scores: **DEA** (Data Envelopment Analysis);
- stochastic frontier;
- explaining inefficiency:
  - **tobit regression**,
  - **bootstrap technique.**

Input and output oriented analysis

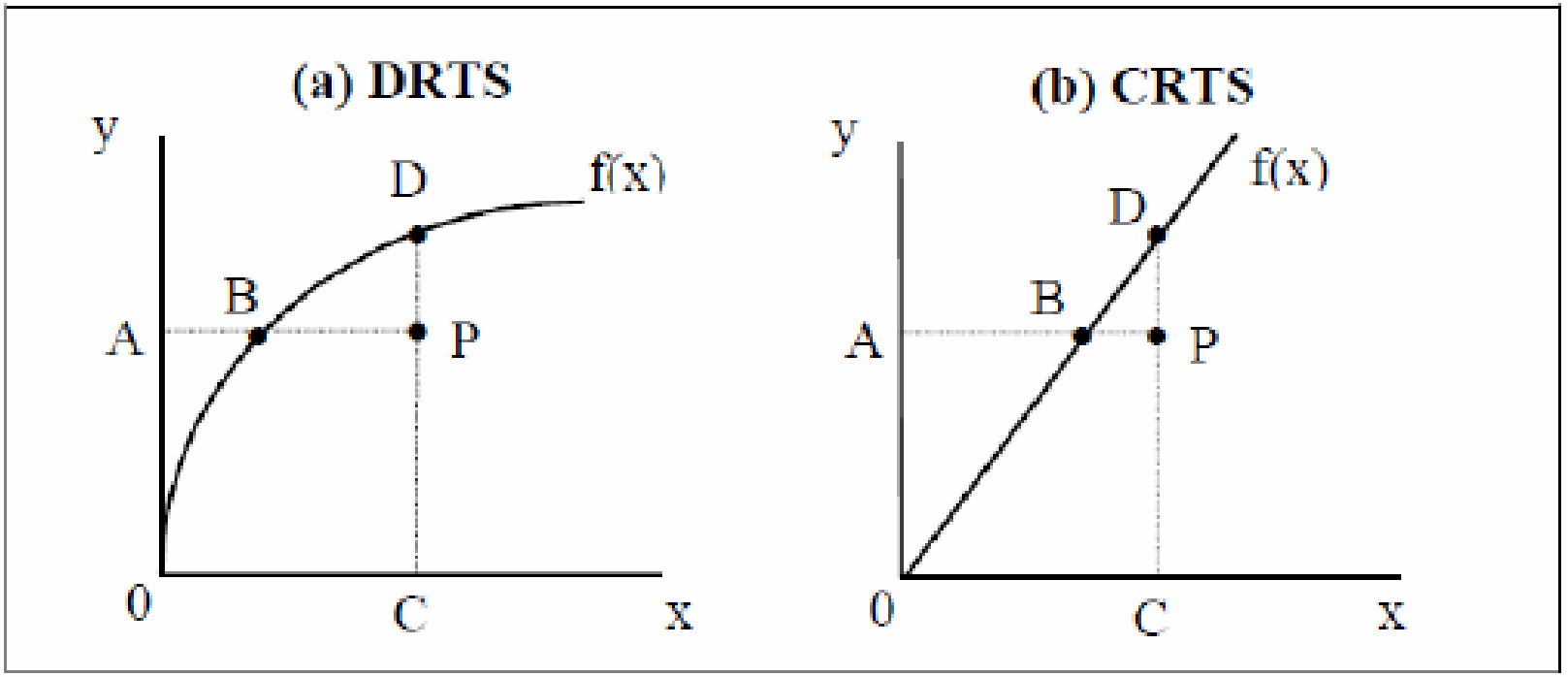
• The purpose of an **input-oriented** study is to evaluate by how much input quantity can be proportionally reduced without changing the output quantities.

• Alternatively, and by computing **output-oriented** measures, one could also try to assess how much output quantities can be proportionally increased without changing the input quantities used.

• The two measures provide the same results under constant returns to scale but give different values under variable returns to scale.

• Nevertheless, both output and input-oriented models will identify the same set of efficient/inefficient decision-making units.

Constant and variable returns to scale

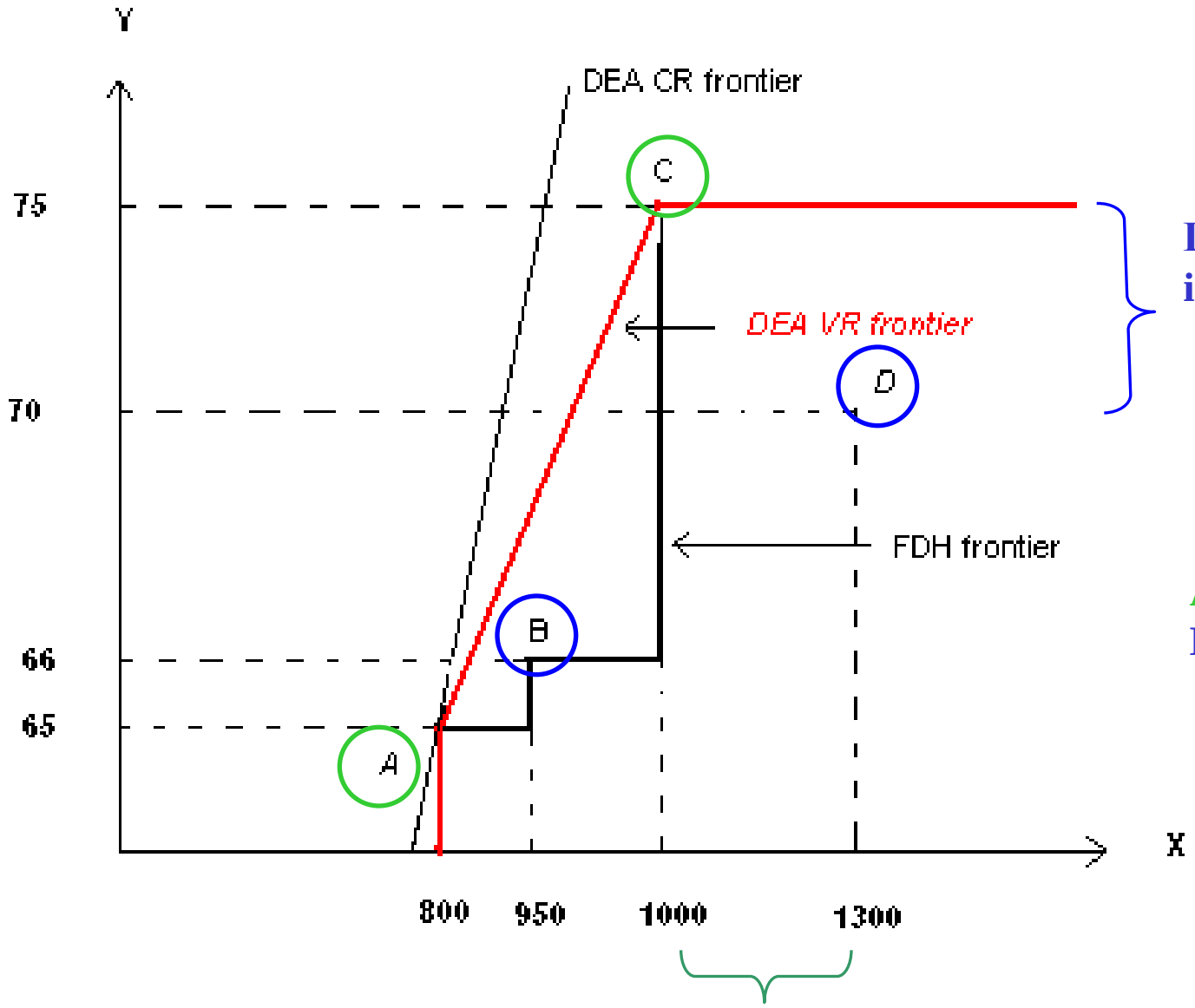


Y=f(X); Y – output; X – input.

CRTS: AB/AP=CP/CD for any inefficient point P.

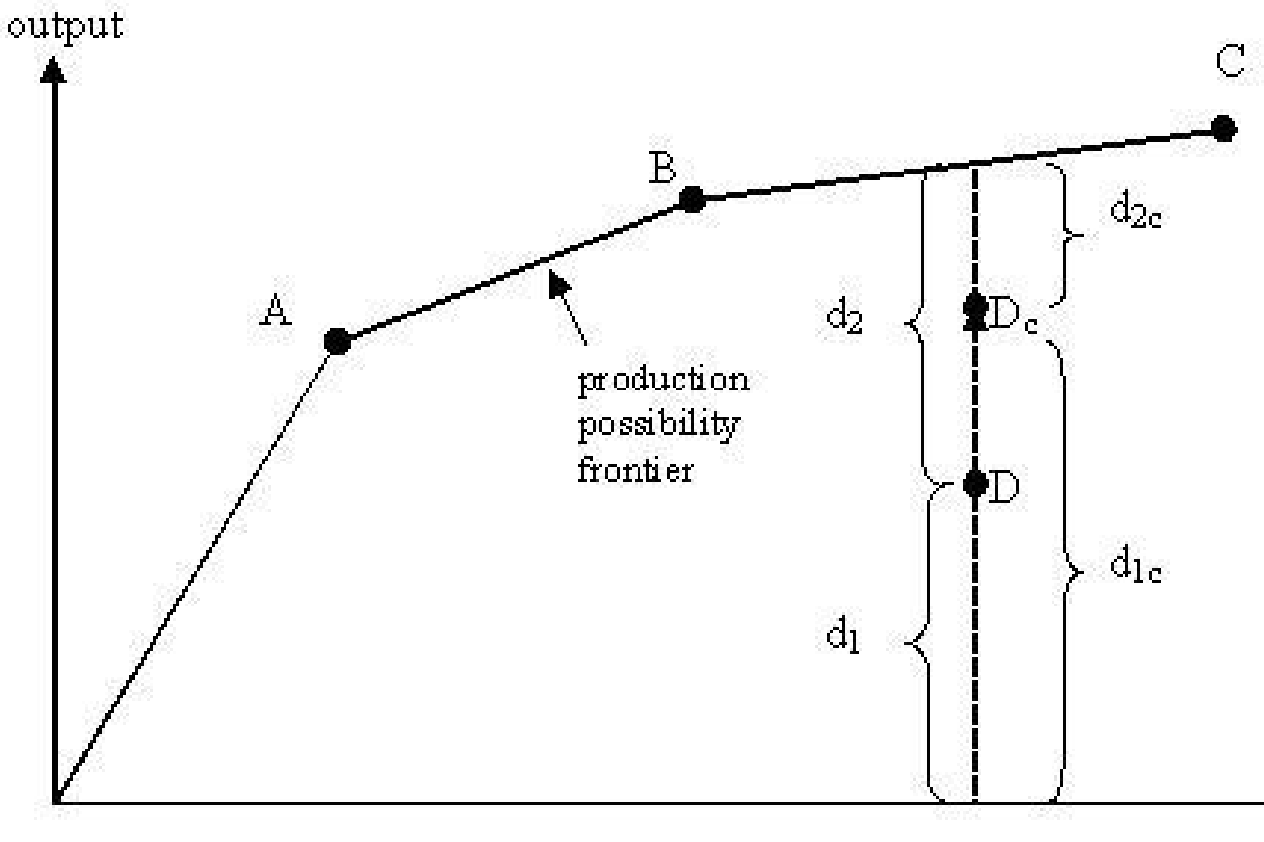
Under CRTS an uniform percentage increase in inputs results in an equal percentage increase in output. Under VRTS (for instance, decreasing) there are less than proportional increases in output. In other words, the ratio of output to input falls as input rises.

DEA and FDH illustration



A, C – efficient;
B, D – less efficient.

Non-discretionary inputs and two-step procedure (1)



D's environment corrected output score= $d_{1c}/(d_{1c}+d_{2c})$

D's output score= $d_1/(d_1+d_2)$

$1 > d_{1c}/(d_{1c}+d_{2c}) > d_1/(d_1+d_2)$, the environment corrected score is closer to the frontier.

Non-discretionary inputs and tobit two-step procedure (2)

Non-discretionary inputs:

Socio-economic differences play a role in determining heterogeneity and influence outcomes (for either schools, hospitals, local governments or countries' achievements in an international comparison).

Two-step approach:

Efficiency scores (δ) are regressed on non-discretionary factor (z):

$$\hat{\delta}_i = z_i \beta + \varepsilon_i$$

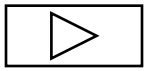
The efficiency scores are not higher than 1 (or always lower than one according to the setup), which allows using a tobit regression approach.

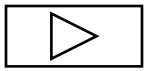
Some literature

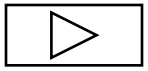
- Van den Eeckhaut, Tulkens and Jamar (1993), efficiency in Belgian **municipalities**.
- De Borger and Kerstens (1996), efficiency of Belgian **local governments**.
- Evans, Tandon, Murray and Lauer (2000), efficiency of national **health** systems.
- Clements (2002), **education** in Europe.
- St. Aubyn (2003), **education** in the OECD.
- Afonso, Schuknecht and Tanzi (2005, 2010), **public sector** in the OECD and in emerging markets.
- Afonso and St. Aubyn (2005a, b), **health** and **education** in OECD.
- Afonso and St. Aubyn (2006, 2007), **health** and **education** in OECD using bootstrap methods.
- Afonso and Fernandes (2006, 2008), Portuguese **municipalities**.
- Afonso and Scaglioni (2007), Italian **regions**.
- Sutherland et al. (2007), **education** in OECD.
- Eugène (2008), **health, education, public order and safety and general public services** in EU15.
- Afonso, Schuknecht and Tanzi (2010), **social spending** and income distribution in the OECD.
- Afonso, Santos (2008), Portuguese **Universities**.
- St. Aubyn et al. (2009), **Universities**.
- St. Aubyn (2008), **law and order** efficiency measurement.
- Geys, Heinemann, and Kalb (2008), German **municipalities**.
- Afonso and St. Aubyn (2010), public and private inputs in aggregate production in OECD.

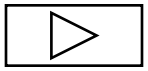
Illustrative examples

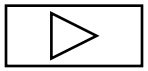
Public sector cross-country efficiency analysis

Overall public sector 

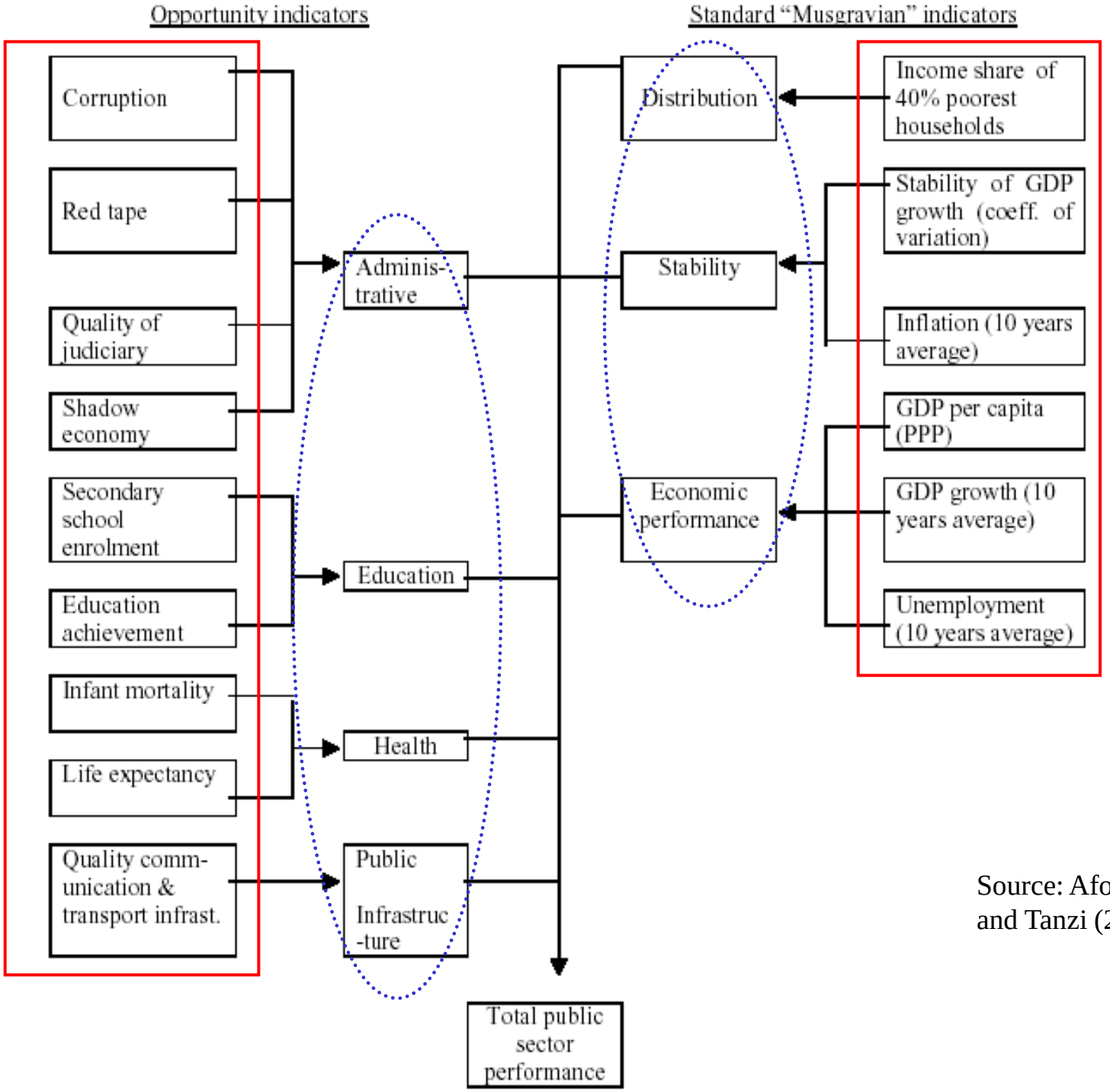
Secondary education 

Health 

Tertiary education 

Municipalities 

Overall public sector (1)



PSP

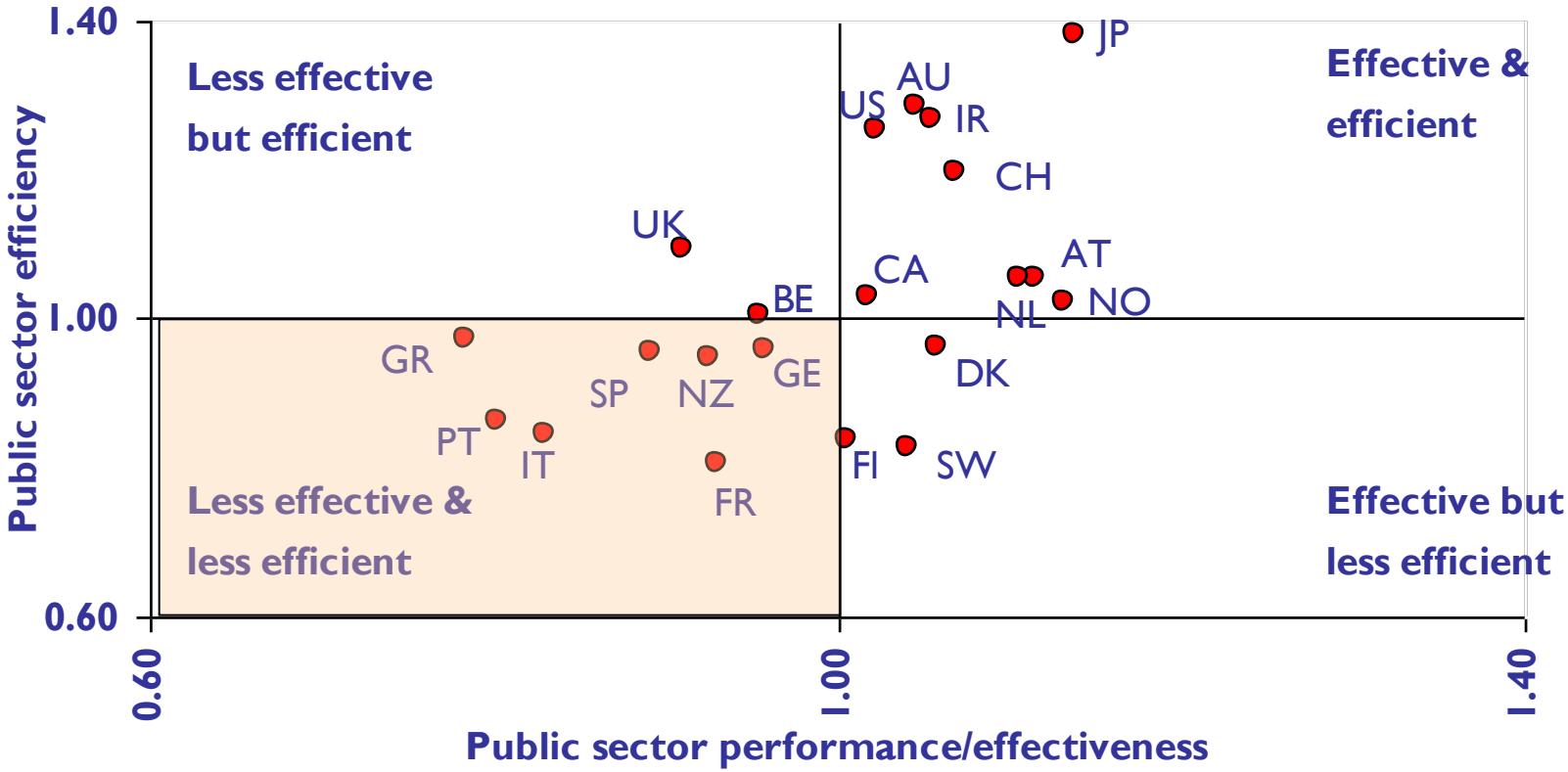
Source: Afonso, Schuknecht and Tanzi (2005).

Country	Input efficiency		Output efficiency	
	Score	Rank	Score	Rank
Australia	0.99	4	0.92	7
Austria	0.67	17	0.92	8
Belgium	0.66	19	0.79	18
Canada	0.75	12	0.84	13
Denmark	0.62	21	0.87	11
Finland	0.61	22	0.83	14
France	0.64	20	0.77	20
Germany	0.72	16	0.79	17
Greece	0.73	14	0.65	23
Iceland	0.87	7	0.90	10
Ireland	0.96	5	0.93	6
Italy	0.66	18	0.68	22
Japan	**1.00**	**1**	**1.00**	**1**
Luxembourg	**1.00**	**1**	**1.00**	**1**
Netherlands	0.72	15	0.91	9
New Zealand	0.83	9	0.81	15
Norway	0.73	13	0.93	5
Portugal	0.79	11	0.70	21
Spain	0.80	10	0.78	19
Sweden	0.57	23	0.86	12
Switzerland	0.95	6	0.94	4
United Kingdom	0.84	8	0.80	16
United States	**1.00**	**1**	**1.00**	**1**
Average	0.79		0.85	
EU15 average	0.73		0.82	
Non-EU15 average	0.89		0.92	
Small governments 1/	0.98		0.96	
Medium governments 1/	0.81		0.82	
Big governments 1/	0.65		0.83	
EU 15 2/	0.72		0.78	
Euro area 2/	0.70		0.78	

Public sector overall efficiency, 2000

Source: Afonso, Schuknecht and Tanzi (2005).

Illustrative evidence on public sector performance and efficiency (considering general government spending)



Good performance (two right-hand side quadrants), include
lower efficiency/higher spending (Finland, Sweden, and Denmark) and
higher efficiency/lower spending (Austria, Japan, Ireland, US).

Source: Adapted from Afonso, Schuknecht and Tanzi (2005).

Secondary education (1)

Table 1 – Public expenditure on education, 2001
(% of total expenditure in each level)

	Pre-primary education	Primary and secondary education	Tertiary education	All levels of education
Australia	68.9	84.4	51.3	75.6
Austria	79.3	96.3	94.6	94.4
Belgium	96.6	95.0	84.1	93.0
Czech Republic	91.8	92.1	85.3	90.6
Denmark	81.7	98.0	97.8	96.1
Finland	91.0	99.1	96.5	97.8
France	95.9	93.0	85.6	92.0
Germany	62.3	81.1	91.3	81.4
Greece	na	91.4	99.6	94.2
Hungary	90.6	93.1	77.6	89.0
Iceland	na	95.3	95.0	91.7
Indonesia	5.3	76.3	43.8	64.2
Ireland	33.2	95.3	84.7	92.2
Italy	97.0	98.0	77.8	90.7
Japan	50.4	91.5	43.1	75.0
Korea	48.7	76.2	15.9	57.1
Mexico	86.7	87.2	70.4	84.6
Netherlands	98.2	95.1	78.2	90.9
Norway	na	na	96.9	95.9
Portugal	na	99.9	92.3	98.5
Slovak Republic	97.4	98.5	93.3	97.1
Spain	83.4	93.3	75.5	87.8
Sweden	100.0	99.9	87.7	96.8
Switzerland	na	84.8	na	na
Thailand	97.8	na	82.5	95.6
Tunisia	na	100.0	100.0	100.0
Turkey	na	na	95.8	na
United Kingdom	95.7	87.2	71.0	84.7
United States	68.1	93.0	34.0	69.2
Uruguay	81.3	93.5	99.5	93.4
Mean	78.3	92.2	79.3	88.2
Median	86.7	93.3	85.3	91.9
Minimum	5.3	76.2	15.9	57.1
Maximum	100.0	100.0	100.0	100.0
Standard deviation	24.3	6.8	21.8	10.8
Observations	23	27	29	28

Source: OECD.

DEA, education efficiency, inputs (hours per year in school and teachers per 100 students), output (PISA 2000 indicator)

Country	Input oriented		Output oriented		Peers Input/output	CRS TE
	VRS TE	Rank	VRS TE	Rank		
Australia	0.788	13	0.975	6	Sweden, Finland, Korea/Japan	0.784
Belgium	0.689	17	0.935	8	Sweden, Korea/Japan	0.682
Czech Republic	0.879	6	0.922	10	Sweden, Korea/Japan, Finland	0.849
Denmark	0.857	11	0.916	11	Sweden, Korea/Japan	0.823
Finland	**1.000**	**1**	**1.000**	**1**	Finland/Finland	0.981
France	0.761	14	0.934	9	Sweden, Korea/Japan	0.736
Germany	0.893	5	0.897	14	Sweden, Korea/Japan	0.824
Greece	0.716	16	0.848	16	Sweden, Korea/Japan	0.637
Hungary	0.801	12	0.899	12	Sweden/Japan	0.762
Italy	0.727	15	0.872	15	Sweden, Korea/Japan	0.671
Japan	**1.000**	**1**	**1.000**	**1**	Japan/Japan	0.943
Korea	**1.000**	**1**	**1.000**	**1**	Korea/Korea	1.000
New Zealand	0.877	8	0.979	5	Sweden, Korea/Japan, Finland	0.874
Portugal	0.879	7	0.841	17	Sweden/Japan, Finland	0.781
Spain	0.876	9	0.898	13	Sweden/Japan, Finland	0.831
Sweden	**1.000**	**1**	**1.000**	**1**	Sweden/Sweden	1.000
United Kingdom	0.860	10	0.973	7	Sweden, Finland, Korea/Japan	0.860
Average	0.859		0.935			0.826

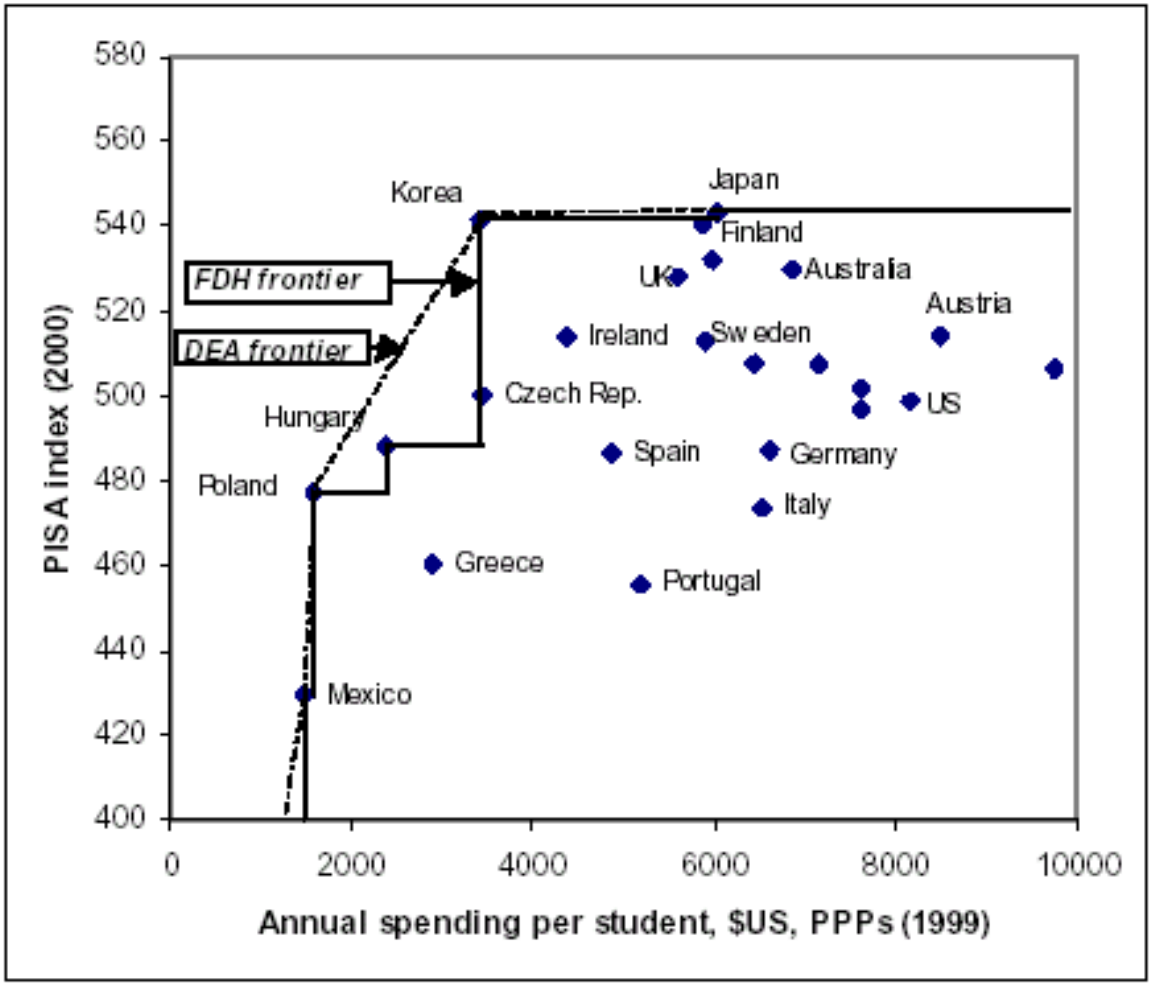
"wasted" resources=1-0.859=14.1%

CRS TE – constant returns to scale technical efficiency.
VRS TE – variable returns to scale technical efficiency

Source: Afonso and St. Aubyn (2005a).

Results from DEA

inputs - hours per year in school (2000); teachers per 100 students (2000);
output - PISA 2000.



DEA is more stringent than FDH.

Source: Afonso and St. Aubyn (2005b).

Expenditure on health	Total expenditure, % of GDP		Public expenditure, % of total expenditure		Total health expenditure per capita US$ PPP	
	1995	2003	1995	2003	1995	2003
Australia	8.3	9.3	66.7	67.5	1745	2699
Austria	8.5	7.5	69.7	67.6	1973	2302
Belgium	8.4	9.6	..	..	1820	2827
Canada	9.2	9.9	71.4	69.9	2051	3001
Czech Republic	6.9	7.5	92.7	90.1	873	1298
Denmark	8.2	9.0	82.5	83.0	1848	2763
Finland	7.5	7.4	75.6	76.5	1433	2118
France	9.5	10.1	76.3	76.3	2033	2903
Germany	10.6	11.1	80.5	78.2	2276	2996
Greece	9.6	9.9	52.0	51.3	1253	2011
Hungary	7.5	8.4	84.0	72.4	676	1269
Iceland	8.4	10.5	83.9	83.5	1858	3115
Ireland	6.8	7.4	71.6	78.0	1216	2451
Italy	7.3	8.4	71.9	75.1	1535	2258
Japan	6.8	7.9	83.0	81.5	1538	2139
Korea	4.2	5.6	35.3	49.4	538	1074
Luxembourg	6.4	6.9	92.4	89.9	2059	3705
Mexico	5.6	6.2	42.1	46.4	382	583
Netherlands	8.4	9.8	71.0	62.4	1826	2976
New Zealand	7.2	8.1	77.2	78.7	1247	1886
Norway	7.9	10.3	84.2	83.7	1897	3807
Poland	5.6	6.5	72.9	69.9	417	744
Portugal	8.2	9.6	62.6	69.7	1079	1797
Slovak Republic	5.8	5.9	91.7	88.3	543	777
Spain	7.6	7.7	72.2	71.2	1198	1835
Sweden	8.1	9.4	86.6	85.2	1738	2703
Switzerland	9.7	11.5	53.8	58.5	2579	3781
Turkey	3.4	7.4	70.3	70.9	185	513
United Kingdom	7.0	7.7	83.9	83.4	1374	2231
United States	13.3	15.0	45.3	44.4	3654	5635
Mean	7.7	8.7	72.5	72.5	1494.8	2340
EU 15 average	8.1	8.8	69.9	69.9	1644.1	2525

Health expenditure

OECD, 2003:
8.7 % of GDP, of which 72.5% is public spending.

Source: Afonso and St. Aubyn (2007).

Health inputs and outputs summary

Table 2 – Summary statistics of the input and output data

	Mean	Standard deviation	Minimum	Maximum	
Life expectancy (in years) 1/	77.5	2.8	68.4 (TUR)	81.5 (JAP)	Outputs
Infant mortality rate (deaths per 1000 live births) 2/	4.5	6.5	2.4 (ICE)	36.3 (TUR)	Outputs
Potential years of life lost (All causes - <70 year,/100 000) 2/	4083	981.2	2917 (JAP)	7056 (HU)	Outputs
Practising physicians, density per 1000 population 2/	2.8	0.8	1.4 (TUR)	4.4 (GRC)	Inputs
Practising nurses, density per 1000 population 2/	8.0	3.4	1.6 (KOR)	14.7 (IRE)	Inputs
Acute care beds, density per 1000 population 2/	4.2	1.8	1.0 (MEX)	9.1 (JAP)	Inputs
MRI units, per million population 2/	6.8	6.4	0.2 (MEX)	32.3 (JAP)	Inputs

Source: OECD.

Notes: 1/ Average for 2000 and 2003. 2/ Average for 2000-2003.
TUR – Turkey; JAP – Japan; ICE – Iceland; HU – Hungary; GCR – Greece; KOR – Korea; IRE – Ireland; MEX – Mexico.

Infant survival rate (ISR) = [1000-infant mortality rate]/[infant mortality rate]

Principal component analysis (PCA) for health analysis

- PCA reduces the dimensionality of multivariate data
- Afonso and St. Aubyn (2007) in the case of health in OECD
  - apply PCA to the 4 input variables;
  - use the first 3 principal components as the 3 input measures (they explain around 88% of the variation);
  - applied PCA to the three output variables;
  - selected the 1st principal component (it accounts for around 84% of the variation);
- This reduces the problem to 1 **output – 3 inputs** (helpful since, as as a general rule of thumb, there should be at least 3 units for each input and output)

Health output efficiency results – DEA

Table 5 – DEA output efficiency results for health efficiency in OECD countries, 3 inputs (PCA on doctors, nurses, beds and MRI) and 1 output (PCA on life expectancy, infant survival rate, and potential number of years of life not lost)

Country	VRS TE	Rank	Peers	Rank 2
Australia	1.101	10	Canada, Sweden, Korea, Finland	10
Austria	1.304	15	Sweden, Japan	15
Canada	1.000	1	Canada	6
Czech Republic	1.592	18	Japan, Sweden	18
Denmark	1.368	16	Korea, Japan, Sweden, Finland	16
Finland	1.000	1	Finland	4
France	1.106	11	Sweden, Spain	11
Germany	1.282	14	Sweden, Japan	14
Hungary	4.386	21	Sweden, Japan, Korea	21
Italy	1.143	12	Sweden, Japan	12
Japan	1.000	1	Japan	2
Korea	1.000	1	Korea	3
Luxembourg	1.372	17	Korea, Japan, Sweden	17
Poland	1.876	19	Spain, Korea	19
Portugal	1.083	9	Korea, Spain	9
Slovak Republic	2.667	20	Korea, Sweden, Japan	20
Spain	1.000	1	Spain	4
Sweden	1.000	1	Sweden	1
Switzerland	1.166	13	Sweden, Japan	13
United Kingdom	1.070	8	Canada, Sweden, Korea, Finland	8
United States	1.000	1	United States	7
Average	1.406			

Note: VRS TE - variable returns to scale technical efficiency. Rank 2 – ranking taking into account the number of times the efficient countries are peers of inefficient countries.

Note: in this example inefficient values are higher than unity.

With the same inputs, on average, output could increase.

Source: Afonso and St. Aubyn (2007).

OECD countries: DEA inputs and outputs and exogenous factors

Inputs	Outputs (in *per capita* terms)	Non-discretionary variables
Model DEA1:	Weighted graduates	Selection of students
Academic Staff	Weighted published articles	Budget autonomy
Students		Staff policy
(in per capita terms)		Output flexibility
Model DEA2:		Evaluation
Spending in PGD institutions		Funding rules
(in percentage of GDP)		PISA results

Source: St. Aubyn et al. (2008).

TABLE 6: DATA ENVELOPMENT ANALYSIS
MODEL DEA 1 (PHYSICALLY MEASURED INPUTS), OUTPUT ORIENTED

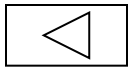
	Period 1 - 1998-2001			Period 2 - 2002-2005		
	Coefficient	Ranking	Peers	Coefficient	Ranking	Peers
Austria	0.761	11	Netherlands, UK	0.962	9	Denmark, Japan, Netherlands
Belgium	0.839	10	Netherlands, UK	0.972	8	Denmark, Japan, UK
Bulgaria	0.313	26	Ireland, Japan, UK	0.343	25	Ireland, Japan, UK
Cyprus	1.000	1	Cyprus	0.277	28	Japan, Sweden
Czech Republic	0.298	27	Ireland, Japan, UK	0.352	23	Ireland, Japan, UK
Denmark	0.874	9	Netherlands, Sweden, UK	1.000	1	Denmark
Estonia	0.460	17	Ireland, Japan, UK	0.366	22	Ireland, Japan, UK
Finland	1.000	1	Finland	0.996	7	Ireland, Sweden, UK
France	0.566	16	Ireland, Japan, UK	0.599	11	Ireland, Japan, UK
Germany	0.649	12	Japan, Netherlands, Sweden	0.660	10	Japan, Netherlands, Sweden
Greece	0.273	28	Japan, UK	0.294	27	Ireland, Sweden, UK
Hungary	0.323	24	Ireland, Japan	0.333	26	Ireland, Japan, UK
Ireland	1.000	1	Ireland	1.000	1	Ireland
Italy	0.627	13	Japan, UK	0.506	14	Japan, UK
Japan	1.000	1	Japan	1.000	1	Japan
Latvia	0.346	23	Ireland, Japan, UK	0.469	17	Japan, UK
Lithuania	0.368	21	Ireland, Japan	0.398	19	Ireland
Malta	0.429	19	Ireland, Japan	0.480	16	Ireland, Japan, UK
Netherlands	1.000	1	Netherlands	1.000	1	Netherlands,
Poland	0.431	18	Ireland, Japan	0.482	15	Ireland, Japan, UK
Portugal	0.365	22	Ireland, Japan, UK	0.376	21	Ireland, Japan, UK
Romania	1.000	1	Romania	0.545	13	Japan, UK
Slovakia	0.316	25	Ireland, Japan	0.346	24	Ireland, Japan
Slovenia	0.593	15	Japan, UK	0.414	18	Japan, UK
Spain	0.382	20	Finland, Ireland, UK	0.382	20	Ireland, Japan, UK
Sweden	1.000	1	Sweden	1.000	1	Sweden
United Kingdom	1.000	1	UK	1.000	1	UK
United States	0.598	14	Netherlands, UK	0.550	12	Denmark, UK

Source: St. Aubyn et al. (2008).

• Always at the production possibility frontier (or very close to it): Ireland, Japan, Sweden, the UK, and the Netherlands.
• Essentially due to excellent scientific production (Sweden, Finland, and the Netherlands), the graduation output (Ireland), both counts (UK).
• Countries highly inefficient: Bulgaria, Spain, Hungary, the Czech Republic, Slovakia, Estonia, Portugal, and Greece.

• **Variables that can influence output scores**:
  - selection of students, PISA outcomes, budget autonomy, staff policy, output flexibility, evaluation, and funding rules (qualitative variables, a high score, close to the maximum of 10, reflects more intensity on that particular characteristic, the minimum score is 0).

Source: St. Aubyn et al. (2008).



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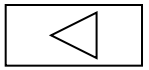
COFOG

Classification of the Functions of Government (COFOG)

Categories	Sub-categories
01 General public services	01.7 Public debt transactions
02 Defence	
03 Public order and safety	
04 Economic affairs	
05 Environmental protection	
06 Housing and community amenities	
07 Health	07.1 Medical products, appliances and equipment
	07.2 Outpatient services
	07.3 Hospital services
08 Recreation, culture and religion	
09 Education	09.1 Pre-primary and primary education
	09.2 Secondary education
	09.3 Post-secondary non-tertiary education
	09.4 Tertiary education
10 Social protection	10.1 Sickness and disability
	10.2 Old age
	10.4 Family and children
	10.5 Unemployment

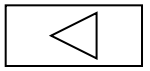
Source: ECB (2009).



Corrective arm of the SGP *

Mentions that the Commission and the Council, when assessing and deciding upon the existence of an excessive deficit, shall take into account "developments in the medium-term budgetary position (in particular, fiscal consolidation efforts in 'good times', debt sustainability, public investment and the overall quality of public finances)". (see also EC, 2008)

* Regulation of the European Council, N.º 1467/97 of 7 July 1997, modified by Regulation N.º 1056/2005 of 27 June 2005, on speeding up and clarifying the implementation of the excessive deficit procedure.



Indirect taxes (% of GDP)

	1990	2000	2010	2012
BE	11,5	12,9	12,8	13,0
BG		13,8	14,9	15,6
CZ		10,8	11,1	11,7
DK	16,4	17,0	16,7	17,0
DE		10,6	11,0	11,4
EE		12,3	13,9	14,3
IE	14,0	13,0	11,5	11,1
EL	11,6	13,8	12,3	13,3
ES		11,4	10,5	9,6
FR	14,4	15,2	14,9	15,5
IT	10,3	14,6	14,0	15,0
CY		12,2	15,4	14,7
LV	19,4	12,4	11,3	11,9
LT		12,6	11,8	11,8
LU	10,3	13,5	11,9	12,2
HU		16,6	17,0	17,8

	1990	2000	2010	2012
MT		12,3	13,5	14,3
NL	10,3	11,7	12,1	11,5
AT	15,2	14,6	14,5	14,3
PL		12,6	13,6	13,5
PT	11,8	13,0	13,4	13,7
RO		12,2	11,9	12,8
SI		15,7	14,3	14,4
SK		12,5	10,1	9,8
FI	15,0	13,5	13,4	14,0
SE		15,9	17,8	18,4
UK	11,6	13,3	12,7	13,4
US	7,4	7,2	7,3	7,3
JP	7,8	8,5	8,3	8,6
EA-17		12,9	12,7	13,0

Source: European Commission Forecast Autumn 2012.

Direct taxes (% of GDP)

	1990	2000	2010	2012
BE	15,2	17,0	15,5	16,7
BG		6,8	5,1	5,0
CZ		7,9	6,9	7,3
DK	28,9	30,3	29,6	30,0
DE		12,8	10,9	11,8
EE		7,7	6,8	6,8
IE	12,9	13,2	10,7	12,6
EL	5,0	9,7	7,9	10,1
ES		10,3	9,5	10,2
FR	7,9	12,0	10,6	11,8
IT	13,8	14,3	14,6	15,5
CY		11,1	11,1	12,4
LV	11,1	7,3	7,4	7,7
LT		8,4	4,7	4,6
LU	14,7	14,9	14,4	14,1
HU		9,8	8,0	6,9

	1990	2000	2010	2012
MT		9,1	13,0	12,9
NL	15,0	11,6	11,9	11,4
AT	11,4	13,1	12,7	13,3
PL		7,2	6,9	7,2
PT	7,0	9,5	8,8	9,5
RO		7,0	6,1	6,0
SI		7,3	8,2	7,2
SK		7,4	5,4	5,7
FI	17,3	21,1	16,0	16,3
SE		22,5	19,2	18,7
UK	16,5	16,5	15,5	15,3
US	12,8	15,1	10,8	12,3
JP	13,0	8,7	7,8	8,5
EA-17		12,8	11,5	12,4

Source: European Commission Forecast Autumn 2012.

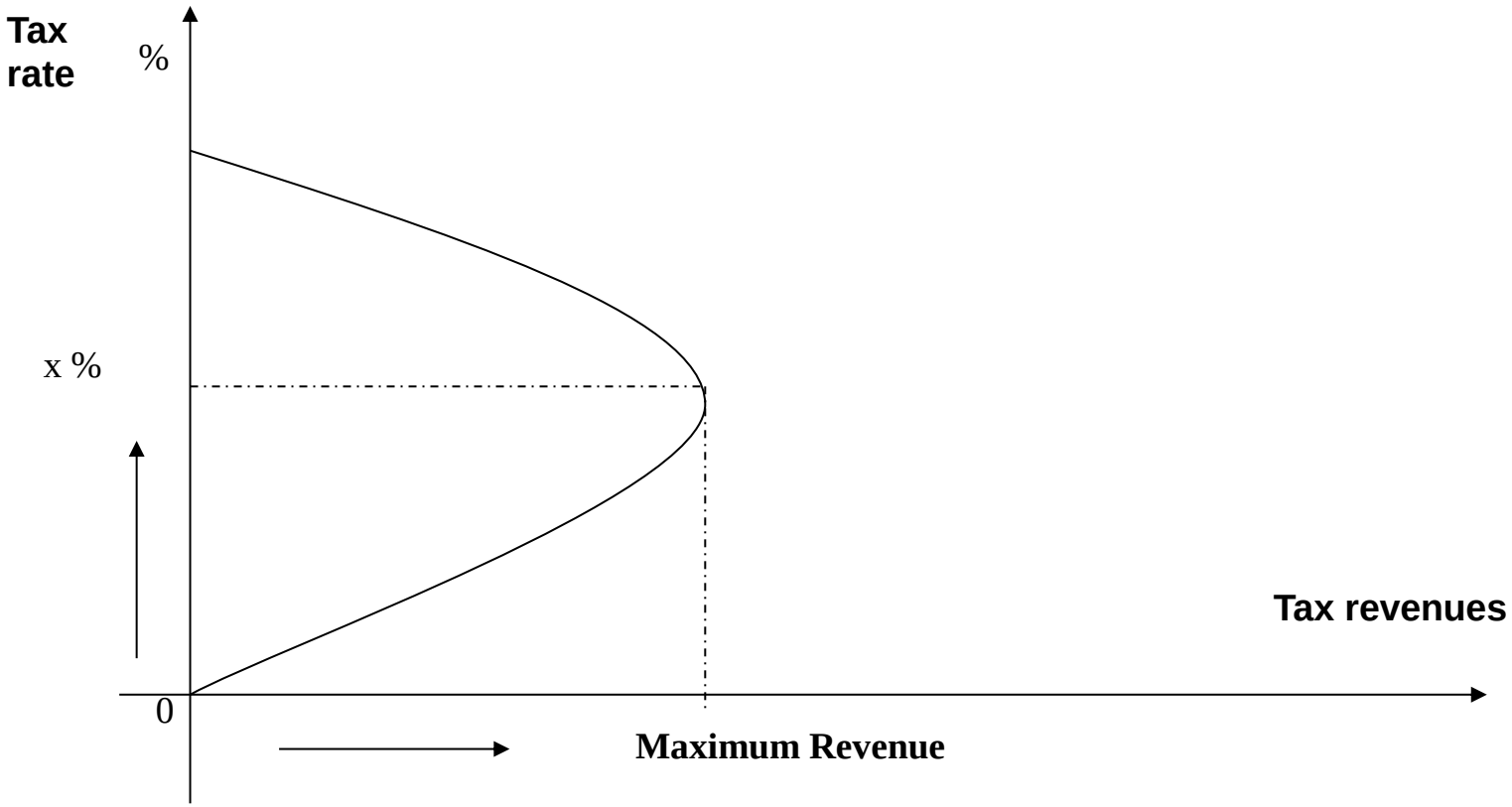
Social security contributions (% of GDP)

	1990	2000	2010	2012
BE	15,7	16,0	16,5	17,0
BG		10,8	7,0	7,3
CZ		15,1	15,2	15,6
DK	1,7	2,6	1,9	1,9
DE		18,6	16,9	16,9
EE		11,0	13,3	12,2
IE	7,0	5,6	7,3	5,9
EL	10,5	12,6	13,4	12,8
ES		12,9	13,4	13,2
FR	20,1	17,9	18,6	19,0
IT	14,0	12,3	13,7	13,9
CY		6,6	8,9	9,3
LV	3,7	10,2	8,6	8,7
LT		9,3	10,7	10,7
LU	10,9	10,9	11,9	12,3
HU		13,4	12,2	13,4

	1990	2000	2010	2012
MT		7,5	7,3	7,5
NL	16,5	16,4	14,8	15,9
AT	15,3	16,8	16,3	16,3
PL		12,9	11,1	12,4
PT	8,7	10,6	12,2	11,7
RO		11,4	9,5	8,6
SI		14,4	15,4	15,6
SK		14,2	12,5	12,2
FI	12,7	12,1	12,8	12,6
SE		13,1	8,7	7,6
UK	7,3	7,6	8,4	8,4
US	7,2	7,2	6,9	6,2
JP	7,9	9,8	11,9	12,1
EA-17		15,8	15,6	15,8

Source: European Commission Forecast Autumn 2012.

- **There is a level of taxation for which tax revenues are maximised.** ("The heavier the tax the less it yields relatively", Dupuit, 1844).



Country	PISA (2003) 1/	Hours per year in school, 2000-2002 2/	Teachers per 100 students, 2000-2002 3/	GDP per capita, 2003 (USD) 4/	Parental education attainment, 2001-2002 5/	Public-to-total expenditure ratio 2001-2002 6/
Australia	526.15	1023.7	8.0	29143. 4	61.1	84.6
Austria	498.35	1072.5	10.0	29972. 5	81.9	96.0
Belgium	517.59	1005.0	10.5	28396. 1	64.6	94.4
Brazil	379.84	800.0	5.5	7767. 2	57.3	
Czech Republic	511.16	867.0	7.5	16448. 2	90.5	91.9
Denmark	499.65	860.0	7.8	31630. 2	80.5	97.9
Finland	545.90	807.0	7.3	27252. 2	84.7	99.3
France	509.34	1037.0	8.1	27327. 2	67.9	93.0
Germany	502.53	886.0	6.6	27608. 8	85.6	80.8
Greece	461.67	1064.0	10.1	19973. 2	59.4	91.6
Hungary	494.06	925.0	8.7	14572. 3	78.6	92.9
Iceland	501.57	821.9	na	30657. 3	61.0	95.2
Indonesia	374.55	1274.0	5.5	3364. 5	22.7	76.4
Ireland	505.54	896.3	7.0	36774. 8	63.7	95.7
Italy	474.31	1020.0	9.8	27049. 9	49.4	97.9
Japan	531.79	875.0	6.7	28162. 2	94.0	91.6
Korea	541.29	867.0	5.1	17908. 4	77.8	78.5
Mexico	393.56	1166.9	3.3	9136. 2	15.6	86.7
Netherlands	523.87	1066.9	6.1	29411. 8	69.9	94.8
New Zealand	524.68	952.6	6.1	21176. 9	79.6	na
Norway	492.23	826.8	9.6	37063. 4	90.8	99.2
Poland	492.81	na	6.8	11622. 9	47.9	na
Portugal	470.29	881.7	11.5	18443. 5	20.0	99.9
Russian Federation	469.61	989.0	8.9	9195. 2	na	na
Slovak Republic	488.49	886.3	7.4	13468. 7	90.3	98.1
Spain	483.75	907.2	8.6	22264.	45.3	93.1
Sweden	509.50	740.9	7.3	26655. 5	86.8	99.9
Switzerland	514.99	887.0	na	30186. 1	87.3	86.9
Thailand	422.73	1167.0	5.6	7580. 3	19.0	97.8
Tunisia	365.70	890.0	4.6	7082. 9	na	100.0
Turkey	426.54	841.3	5.7	6749. 3	24.7	na
United States	486.67	na	6.5	37352. 1	88.5	91.5
Uruguay	426.35	913.0	6.9	8279. 9	35.1	93.5
Mean	480.82	942.5	7.4	21202.3	63.9	92.8
Minimum	365.70	740.9	3.3	3364.5	15.6	76.4
Maximum	545.90	1274.0	11.5	37352.1	94.0	100.0
Standard deviation	48.87	122.0	1.9	10168.7	24.6	6.5
Observations	33	31	31	33	31	28

Data for education analysis

Source: OECD.

DEA (input oriented)

$$MIN \ _{\theta,\lambda}\theta_i$$

$$\text{s. to} \quad -y_i + Y\lambda \geq 0$$

$$\theta_i x_i - X\lambda \geq 0$$

$$n1'\lambda = 1$$

$$\lambda \geq 0$$

y - column vector of outputs,
x - column vector of inputs,
X - input matrix,
Y - output matrix.
θ - efficiency score ($\theta <= 1$).

$\theta < 1$, inefficiency
$\theta = 1$, efficiency

Note: θ is the measure of efficiency, given by the ratio between the weighted average of the outputs (y) produced and the weighted average of the inputs (x) used. See Coelli et al. (1998) for more details.

Results from 2nd step health Tobit

Table 6 – Censored normal Tobit results (19 countries)

	Model 1	Model 2	Model 3	Model 4
Constant	-3.2574	9.0162	-1.1185	9.9146
	(0.000)	(0.029)	(0.092)	(0.009)
Y	-4.38E-05		-4.44E-05	
	(0.000)		(0.000)	
Log(Y)		-1.2476		-1.1546
		(0.000)		(0.000)
E			-0.1060	-0.0891
			(0.010)	(0.034)
O	0.0895	0.0783	0.0946	0.0841
	(0.000)	(0.001)	(0.000)	(0.000)
T	0.1708	0.1453	0.1463	0.122
	(0.000)	(0.000)	(0.000)	(0.001)
$\hat{\sigma}_\varepsilon$	0.5677	0.5600	0.4759	0.5088
	(0.000)	(0.000)	(0.000)	(0.000)

Notes: *Y* – GDP per capita; *E* – Educational level; O – Obesity; T – Tobacco consumption. $\hat{\sigma}_\varepsilon$ – Estimated standard deviation of ε. P- values in brackets.

Source: Afonso and St. Aubyn (2007).

Note: in this example inefficient scores (δ) are higher than unity.

$$\Delta Y, \Delta E \Rightarrow \nabla \delta \Rightarrow \Delta \text{ efficiency}$$

$$\Delta O, \Delta T \Rightarrow \Delta \delta \Rightarrow \nabla \text{ efficiency}$$

Some stylised facts for the local government sector

	Classification level	Number of municipalities 1/	Area (sq km, 2001) 1/	Area share in total area (%) 1/	Resident population (2001) 2/	Population per sq km	Resident population, share in total population (%) 2/	Average spending per capita (2001) 1/
Portugal *	NUTS-0	278	88 785	100.00	9 869 343	111	100.00	795.40
Alentejo	NUTS-2	47	27 218	30.66	535 753	20	5.43	982.71
Algarve	NUTS-2	16	4 987	5.62	395 218	79	4.00	1128.78
Centro	NUTS-2	78	23 660	26.65	1 783 596	75	18.07	812.04
LVT	NUTS-2	51	11 643	13.11	3 467 483	298	35.13	683.40
Norte	NUTS-2	86	21 277	23.96	3 687 293	173	37.36	682.34
Max		86	27 218	30.66	3 687 293	20	37.36	1128.71
Min		16	4 987	5.62	395 218	298	4.00	682.34

* Mainland.
1/ "Finanças locais: aplicação em 2001", DGAL, electronic edition at: http://www.dgaa.pt/publicacoes/financas_municipais/2001/FM_2001%20OK.pdf
2/ INE, 2001, "Recenseamento Geral da População e Habitação – 2001" (Definitive Results).

Regional average values for municipal result indicators (2001)

Region	Social services (Y1)	Basic Education (Y2)		Cultural services (Y3)	Sanitation (Y4)		Territory organisation (Y5)	Road infrastructures (Y6)
		School buildings per capita (Y21)	Education enrolment (Y22)		Water supply (Y41)	Waste collection (Y42)		
Alentejo	0.257	0.023	0.626	1.149	1005.26	5639.66	83.26	0.020
Algarve	0.217	0.012	0.570	1.203	4280.19	18428.31	251.19	0.027
Centro	0.233	0.030	0.624	0.944	1864.24	8137.29	175.28	0.023
LVT	0.180	0.014	0.535	1.157	7811.96	36114.49	270.00	0.011
Norte	0.182	0.029	0.621	0.896	2708.06	18125.03	235.51	0.018
Min	0.180	0.012	0.535	0.896	1005.26	5639.66	83.26	0.011
Max	0.257	0.030	0.626	1.203	7811.96	36114.49	270.00	0.027

Source: Afonso and Fernandes (2008).

Regional summary values for LGOI (Local Government Output Indicator) - 2001

	Alentejo	Algarve	Centro	LVT	Norte
Average	1.00	1.00	1.00	1.00	1.00
Minimum	0.61	0.65	0.58	0.50	0.43
(municipality)	(Portel)	(Tavira)	(Belmonte)	(Azambuja)	(Trofa)
Maximum	1.73	1.65	2.92	3.49	3.44
(municipality)	(C.Vide)	(Monchique)	(Coimbra)	(Lisboa)	(Porto)
Standard deviation	0.26	0.30	0.44	0.49	0.47

Source: Afonso and Fernandes (2008).

DEA efficiency results

Region	N. of DMUs	Efficient DMUs		Average efficiency scores	
		N. of DMUs (municipality)	% of DMUs in the region	Input oriented	Output oriented
Alentejo	47	4 (Santiago Cacém, Évora, Castelo de Vide, Portalegre)	8.5	0.654	0.610
Algarve	16	3 (Faro, Olhão, Monchique)	18.8	0.608	0.681
Centro	78	3 (Aveiro, Coimbra, Figueira da Foz)	3.9	0.237	0.353
LVT	51	3 (Lisboa, Caldas Rainha, Sintra)	5.9	0.606	0.479
Norte	86	4 (Braga, Vizela, Gondomar, Porto)	4.7	0.567	0.397
Mainland	278	3 (Miranda do Corvo, Seia, Gondomar)	1.1	0.225	0.246

Source: Afonso and Fernandes (2008).