Economia da Educação

Apresentação 3 – março de 2015

LISBOA SCHOOL OF ECONOMICS & MANAGEMENT

Medição da eficiência da despesa pública - Metodologia

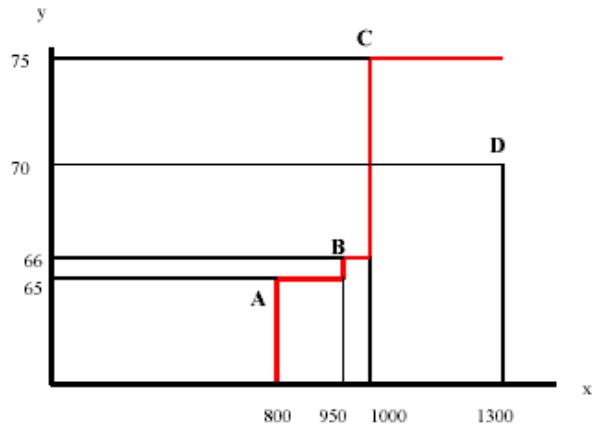
Comparação dos recursos utilizados para aprovisionar certos serviços (**inputs**)…
com os resultados, ou **outputs**.

Estimam-se fronteiras de eficiência
detectam-se os casos de ineficiência.

Segundo passo: explicação das causas da eficiência.

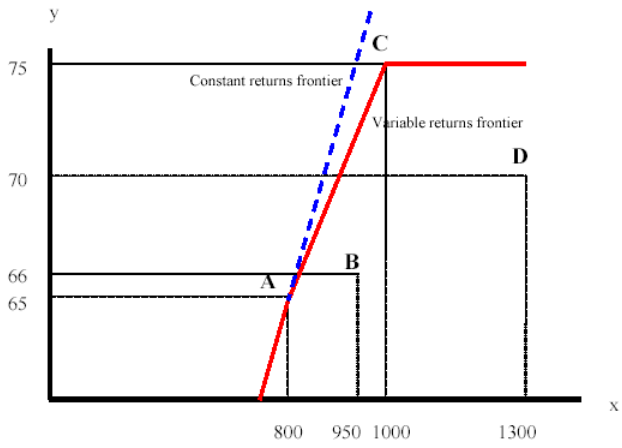
Medição da eficiência da despesa pública - Metodologia

Fronteira FDH, um exemplo



Medição da eficiência da despesa pública - Metodologia

Fronteira DEA, um exemplo



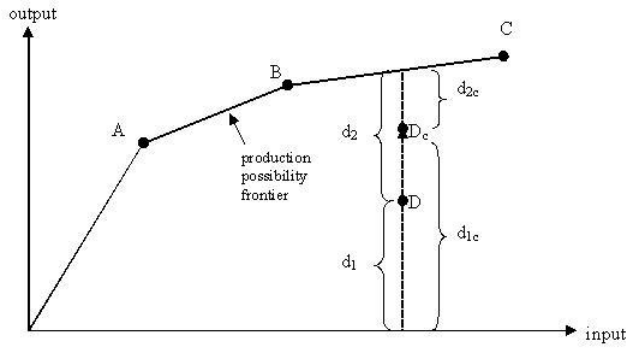
Afonso, Antonio & St. Aubyn, Miguel, 2006.

"Cross-country efficiency of secondary education provision: A semi-parametric analysis with non-discretionary inputs,"

Economic Modelling, vol. 23(3), pages 476-491, May.

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

Medição da eficiência da despesa pública – Uma aplicação à educação



Medição da eficiência da despesa pública – Uma aplicação à educação

Primeiro passo: DEA

$$Max_{\lambda,\delta_i}\ \delta_i$$

$$\text{s.to}\quad \delta_i y_i \le Y\lambda$$

$$x_i \ge X\lambda$$

$$n1'\lambda = 1$$

$$\lambda \ge 0$$

Medição da eficiência da despesa pública – Uma aplicação à educação

Segundo passo: regressão explicativa dos coeficientes de eficiência

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

(1) regressão tobit
(2) regressão "bootstrap"

Medição da eficiência da despesa pública – Uma aplicação à educação

Table 3 – Results for education efficiency (n=25)
2 inputs (teachers-students ratio, hours in school) and 1 output (PISA 2003 indicator)

	DEA Output oriented		Peers
Country	VRS TE	Rank	
Australia	1.038	7	Finland
Austria	1.095	14	Finland
Belgium	1.055	8	Finland
Czech Republic	1.068	9	Finland
Denmark	1.093	13	Finland
Finland	1.000	1	Finland
France	1.072	10	Finland
Germany	1.083	12	Finland, Korea
Greece	1.182	21	Finland
Hungary	1.105	15	Finland
Indonesia	1.447	25	Finland, Korea
Ireland	1.079	11	Finland, Korea
Italy	1.151	19	Finland
Japan	1.024	4	Finland, Korea
Korea	1.000	1	Korea
Netherlands	1.037	6	Finland, Korea
New Zealand	1.036	5	Finland, Korea
Norway	1.109	16	Finland
Portugal	1.161	20	Finland
Slovak Republic	1.118	17	Finland
Spain	1.129	18	Finland
Sweden	1.000	1	Sweden
Thailand	1.283	24	Finland, Korea
Turkey	1.260	22	Finland, Korea, Sweden
Uruguay	1.278	23	Finland, Korea
Average	1.116		

Medição da eficiência da despesa pública – Uma aplicação à educação

Table 4 – Censored normal Tobit results
(25 countries)

	Model 1	Model 2	Model 3	Model 1a	Model 3a
Constant	1.295024	1.342502	1.374361	2.614888	2.237114
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Y	-0.825e-5		-0.427e-5		
	(0.000)		(0.012)		
Log(Y)				-0.152062	-0.101269
				(0.000)	(0.000)
E		-0.003566	-0.002574		-0.001903
		(0.000)	(0.000)		(0.001)
$\hat{\sigma}_{\varepsilon}$	0.081428	0.071752	0.062480	0.063324	0.051811
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)

Notes: *Y* – GDP per capita; *E* – Parental educational attainment. $\hat{\sigma}_{\varepsilon}$ – Estimated standard deviation of ε. P- values in brackets.

Medição da eficiência da despesa pública – Uma aplicação à educação

Table 5 – Bootstrap results
(25 countries)

Algorithm 1

	Model 1	Model 2	Model 3	Model 1a	Model 3a
Constant	1.367000	1.395726	1.455587	2.907919	2.347747
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Y	-0.150344e-4		-0.710790e-5		
	(0.000)		(0.001)		
Log(Y)				-0.184488	-0.112575
				(0.000)	(0.000)
E		-0.00523442	-0.00269907		-0.00209274
		(0.000)	(0.000)		(0.001)
$\hat{\sigma}_{\varepsilon}$	0.102022	0.0876502	0.0677879	0.0710499	0.0544861
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)

Algorithm 2

	Model 1	Model 2	Model 3	Model 1a	Model 3a
Constant	1.435993	1.412244	1.455827	3.028311	2.596005
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Y	-0.151096e-4		-0.712013e-5		
	(0.000)		(0.001)		
Log(Y)				-0.191403	-0.135911
				(0.000)	(0.000)
E		-0.00482225	-0.00270063		-0.00178054
		(0.000)	(0.001)		(0.0005)
$\hat{\sigma}_{\varepsilon}$	0.0985940	0.0875667	0.0678872	0.0588680	0.0471327
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)

Notes: *Y* – GDP per capita; *E* – Parental educational attainment. $\hat{\sigma}_{\varepsilon}$ – Estimated standard deviation of ε; P- values in brackets.

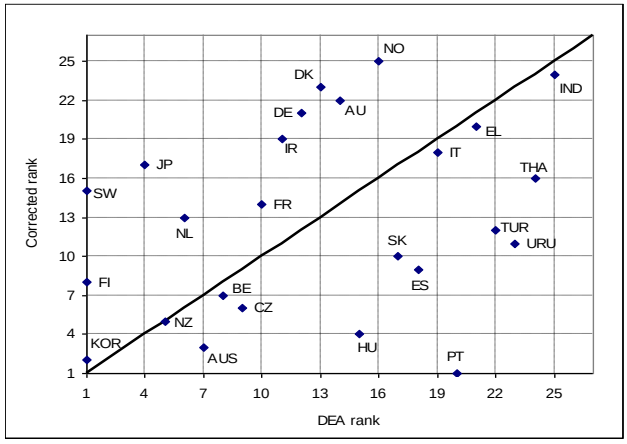
Medição da eficiência da despesa pública – Uma aplicação à educação

Table 6 – Corrected output efficiency scores (for Model 3a)

	Bias corrected scores (1)	GDP correction (2)	Education attainment correction (3)	Fully corrected scores (4)=(1)+(2)+(3)	Rank
Australia	1.047	0.037	-0.007	1.077	3
Austria	1.104	0.040	0.030	1.174	22
Belgium	1.063	0.033	-0.001	1.095	7
Czech Republic	1.083	-0.041	0.046	1.087	6
Denmark	1.108	0.048	0.028	1.184	23
Finland	1.037	0.027	0.035	1.100	8
France	1.082	0.028	0.005	1.115	14
Germany	1.104	0.029	0.037	1.170	21
Greece	1.191	-0.015	-0.010	1.167	20
Hungary	1.115	-0.058	0.024	1.082	4
Indonesia	1.528	-0.257	-0.075	1.196	24
Ireland	1.094	0.068	-0.002	1.159	19
Italy	1.160	0.026	-0.028	1.159	18
Japan	1.044	0.032	0.052	1.127	17
Korea	1.075	-0.030	0.023	1.068	2
Netherlands	1.066	0.038	0.009	1.112	13
New Zealand	1.068	-0.007	0.026	1.087	5
Norway	1.131	0.069	0.046	1.246	25
Portugal	1.172	-0.026	-0.080	1.067	1
Slovak Republic	1.131	-0.068	0.045	1.108	10
Spain	1.140	0.000	-0.035	1.105	9
Sweden	1.052	0.024	0.039	1.116	15
Thailand	1.348	-0.146	-0.082	1.120	16
Turkey	1.343	-0.162	-0.072	1.109	12
Uruguay	1.296	-0.134	-0.053	1.109	11
Average	1.143	-0.018	0.000	1.126	

Medição da eficiência da despesa pública – Uma aplicação à educação

Figure 2 – Relative change in efficiency rankings



The Efficiency and Effectiveness of Public Spending on Tertiary Education

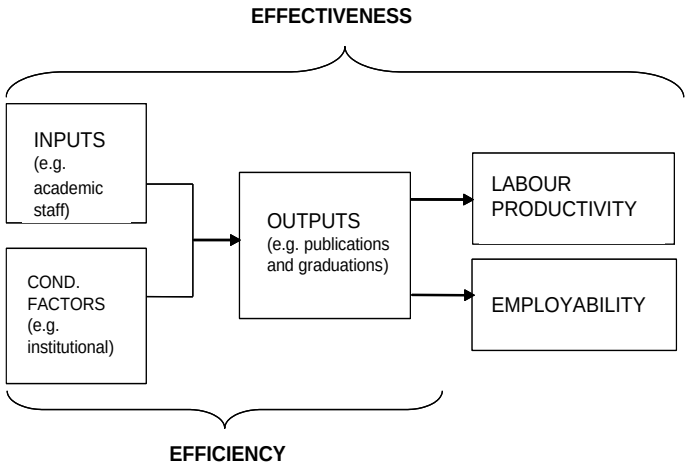
http://ec.europa.eu/economy_finance/publications/publication16267_en.pdf

Miguel St. Aubyn
(with Álvaro Pina, Filomena Garcia and Joana Pais)

ISEG/ULisboa and UECE

Public Spending on Tertiary Education

Concepts, data and preliminary analysis



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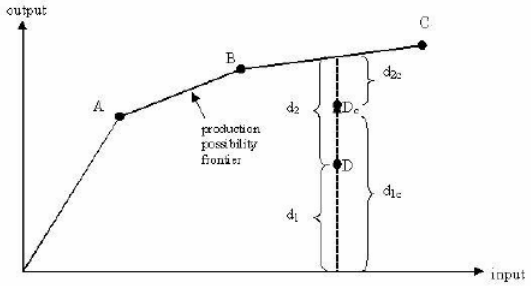
Public Spending on Tertiary Education

Concepts, data and preliminary analysis

FIGURE 1: THE PRODUCTION POSSIBILITY FRONTIER



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Public Spending on Tertiary Education

Concepts, data and preliminary analysis

TABLE 1: COUNTRIES TO BE CONSIDERED IN THE STUDY

Country Name	Country Code	Country Name	Country Code
Austria	AT	Italy	IT
Belgium	BE	Japan	JP
Bulgaria	BG	Lithuania	LT
Cyprus	CY	Latvia	LV
Czech Republic	CZ	Malta	MT
Germany	DE	Netherlands	NL
Denmark	DK	Poland	PL
Estonia	EE	Portugal	PT
Greece	EL	Romania	RO
Spain	ES	Sweden	SE
Finland	FI	Slovenia	SI
France	FR	Slovak Republic	SK
Hungary	HU	United Kingdom	UK
Ireland	IE	United States	US

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Public Spending on Tertiary Education

Concepts, data and preliminary analysis

Input measurement:

- The number of full-time equivalent academic staff (professor, associate professor, assistant professor, instructor, lecturer, or the equivalent of any of these academic ranks)
- The total number of students is the other input we included

  (Students who do not achieve graduation are an indicator of waste in education, as time, labour, capital, and expectations were spent without a measurable outcome)
- The total cost of the tertiary educational system

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Public Spending on Tertiary Education

Concepts, data and preliminary analysis

Output measurement:

Teaching activities:

- number of graduates
- scaled by a "recruiter view country indicator" and a "peer view country indicator"

  Source: THES (Times Higher Education Supplement) – QS (Quacquarelli Symonds) World University Rankings

Research output:

- number of publications and their impact

We have computed a citation index to weight the number of publications.

Source: The Web of Science database, The Thomson Corporation

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Public Spending on Tertiary Education

Concepts, data and preliminary analysis

Exogenous and environment factors:

- Universities' organisation and funding schemes

  Oliveira Martins et al. (2007). These authors constructed a composite indicator from a questionnaire. Low values are associated to input rigidity, supply restrictions, and absence of accountability and high values linked to input flexibility, no supply restrictions, and high accountability.

- Quality of secondary education

  It is possible that better quality in secondary education affects efficiency in tertiary education. PISA scores is a measure of secondary education quality.

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Public Spending on Tertiary Education

Concepts, data and preliminary analysis

Outcomes to be considered

i) Are increasing tertiary education spending levels affecting in a positive way labour productivity or total factor productivity?

ii) How does efficiency in tertiary education promote employability? Namely, does efficiency explain the gap between graduates' unemployment rate and that of people with secondary education only?

iii) And how does efficiency in spending affect the relationship between tertiary education spending and labour productivity?

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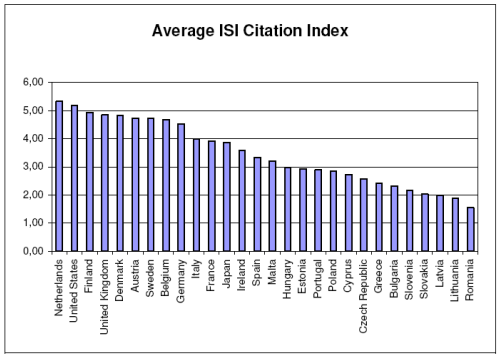
Public Spending on Tertiary Education

Concepts, data and preliminary analysis

TABLE 3: DECOMPOSITION OF THE PRODUCTION OF ARTICLES 2005

	Articles per 1000 Inhabitants	Articles per Academic Staff	Academic Staff per 1000 Inhabitants
Austria	0.87	0.47	1.85
Belgium	0.96	0.56	1.71
Bulgaria	0.09	0.05	1.75
Cyprus	0.24	0.15	1.57
Czech Rep	0.30	0.21	1.47
Estonia	0.50	0.19	2.65
Finland	1.26	0.37	3.42
France	0.34	0.19	1.76
Germany	0.59	0.30	1.96
Greece	0.54	0.28	1.91
Hungary	0.31	0.15	2.10
Ireland	0.78	0.34	2.31
Italy	0.49	0.33	1.48
Japan	0.40	0.48	0.83
Latvia	0.10	0.07	1.48
Lithuania	0.19	0.07	2.77
Malta	0.14	0.08	1.67
Netherlands	0.96	0.44	2.18
Poland	0.24	0.11	2.16
Portugal	0.42	0.21	2.02
Romania	0.06	0.06	1.10
Slovakia	0.20	0.10	2.05
Slovenia	0.72	0.46	1.55
Spain	0.49	0.20	2.47
Sweden	1.52	0.42	3.66
UK	0.92	0.59	1.55
US	0.53	0.28	1.87

FIGURE 10



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Public Spending on Tertiary Education

Efficiency Assessment

TABLE 4: VARIABLES IN THE TWO-STAGE PROCEDURE

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

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Public Spending on Tertiary Education

TABLE 14: SFA ESTIMATION RESULTS
(DEPENDENT VARIABLE: COST IN PERCENTAGE OF GDP)

	Coefficient	Standard-Error	*t*-ratio
Cost function:			
constant	-1.194	36.37	-0.03283
lwgrad	0.2581	0.04353	5.929
lwpub	0.2707	0.02717	9.961
Inefficiency:			
constant	4.843	36.35	0.1332
staff policy	-0.01002	0.007332	-1.367
evaluation	-0.03954	0.01373	-2.880
funding rules	-0.06146	0.01816	-3.394
PISA2000	-0.007158	0.009246	-7.742
$\hat{\sigma}_\varepsilon^2$	0.03601	0.004052	8.888
γ	0.09920		
LR statistic (γ=0)	59.67		

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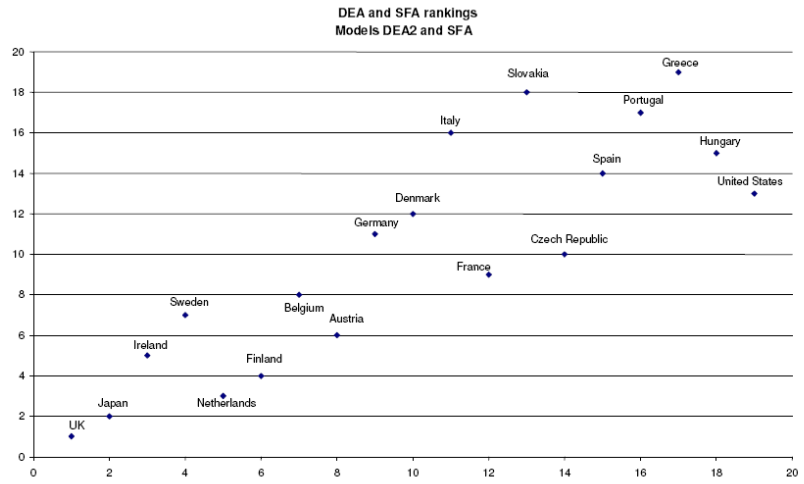
Public Spending on Tertiary Education

Efficiency Assessment



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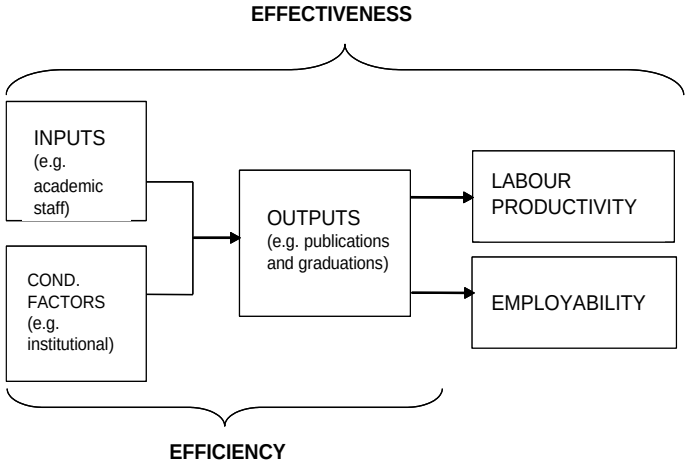
Public Spending on Tertiary Education

Effectiveness Assessment: the Approach



Public Spending on Tertiary Education

Effectiveness (I): Labour Productivity

Dep. variable: L productivity growth 1998-2005
(difference between country *i* and US)

		spending	spending* DEA1	spending* DEA2	spending* SFA
lprod98 (initial levels)	coef.	-0.510***	-0.527***	-0.486***	-0.371***
	P-val.	0.000	0.000	0.000	0.002
GFCF (% GDP)	coef.	0.819	0.936	1.187*	0.236
	P-val.	0.233	0.169	0.082	0.734
spending (% GDP) or spending*efficiency	coef.	3.538	4.138	7.053**	2.719
	P-val.	0.211	0.102	0.034	0.624
Obs		26	26	23	17
R^2		0.735	0.741	0.710	0.584

(GFCF and spending: 1998-2005 averages)

Spending often becomes significant when adjusted for efficiency
(NB: US and Japan excluded)

Public Spending on Tertiary Education

Effectiveness (I): Labour Productivity

Capital deepening (K/L growth) and TFP

(drivers of L productivity in growth accounting framework)

- Capital deepening instead of GFCF reinforces significance of efficiency-adjusted spending
- Efficiency-adjusted spending (but not actual spending) often with positive impact on 1998-2005 TFP growth

(NB: only 14 EU countries – limited availability of capital stocks)

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Public Spending on Tertiary Education

Effectiveness (II): Employability

Dep. variable: U25-64ter minus U25-64sec

		DEA1	DEA2	SFA
POP25-64ter / POP25-64sec	coef.	0.023***	0.025***	0.024***
	P-value	0.002	0.001	0.001
U25-64	coef.	-0.633***	-0.718***	-0.660***
	P-value	0.000	0.000	0.000
efficiency	coef.	0.003	-0.016*	-0.043**
	P-value	0.811	0.068	0.047
Obs		26	23	17
R^2		0.810	0.812	0.759

(variables other than efficiency scores: 1998-2007 averages)

Efficiency often found to minimize graduates' relative unemployment risk
(NB: US and Japan excluded; spending insignif., actual or efficiency-adjusted)

Impact of efficiency reinforced for 25-29 dependent variable (roughly those studying in the years used for efficiency computation – 1998 to 2005)

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Public Spending on Tertiary Education

Conclusions

1. Inefficiency in spending is an important issue when it comes to public tertiary education.

An important group of countries was found to be operating under inefficiency conditions irrespective of the methods used. These were not only South and Eastern European countries, but also some of the more populous EU member states (France, Germany, and Italy). Also the US public tertiary education sector was found to be very far from efficiency.

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Public Spending on Tertiary Education

Conclusions

2. Tertiary education systems in a core group of countries in Europe are clearly more efficient.

The UK and to a lesser extent the Netherlands appear at the top of the efficiency ranking irrespective of method or models used. On the other hand, some countries tend to be consistently placed at the bottom league (the Czech Republic, Greece, Portugal, and Slovakia).

Public Spending on Tertiary Education

Conclusions

3. Tertiary education efficiency is related to institutional factors and also to the quality of secondary education.

The quality of secondary education (PISA) is consistently correlated to country efficiency scores.

Other factors are institutional:

- Funding rules. When funding depends more on outputs and less on historical attributions or inputs, efficiency tends to increase.
- Evaluation systems. Efficiency tends to be higher in countries where institutions are publicly evaluated by stakeholders and/or independent agencies.
- Staff policy. Institutions' autonomy to hire and dismiss academic staff and to set their wages is correlated with higher efficiency.

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Public Spending on Tertiary Education

Conclusions

4. Efficient spending matters for labour and total factor productivity.

There is a positive correlation between tertiary education spending corrected by efficiency scores and labour and total factor productivity. This suggests that the link between resources used in tertiary education and broader outcomes like productivity goes through efficiency. This is evidence in favour of the greater importance of efficiency in higher education spending, as it is not only a matter of public finance but also a way of promoting innovation and growth.

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Public Spending on Tertiary Education

Conclusions

5. Efficient spending matters for employability.

We found that the employability of graduates increases where tertiary education is more efficient. The difference in unemployment rates among graduates and among those with secondary education depends positively on country efficiency scores. This evidence is stronger when young graduates are considered.

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Public Spending on Tertiary Education

Conclusions

6. Some countries specialise in teaching and others in research.

More specialised in research: Nordic countries, Austria, Belgium, the Netherlands.

More specialised in teaching: Ireland, France, the East European countries.

The United Kingdom was found to be efficient on both accounts.

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Public Spending on Tertiary Education

Conclusions

6. Some countries specialise in teaching and others in research.

More specialised in research: Nordic countries, Austria, Belgium, the Netherlands.

More specialised in teaching: Ireland, France, the East European countries.

The United Kingdom was found to be efficient on both accounts.

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Public Spending on Tertiary Education

Conclusions

Broad policy recommendations:

- Spending increases, if they occur, have to be carefully managed and should go hand in hand with institutional reforms.

- Institutional reform of tertiary educational systems should focus on the following points:
  - promoting accountability of tertiary education institutions
  - increasing competition, by rising the institutions' autonomy in what concerns staff policy, namely in its ability to hire and dismiss and to set wages;
  - designing financial schemes that relate funding to the institutions' performance in output terms.

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