EFFICIENCY OF PUBLIC SPENDING IN SUPPORT OF R&D ACTIVITIES

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Assessing efficiency (Farrel, 1957)

- Technical efficiency: Maximum amount of output is produced from a given amount of inputs.
- In this case, the entity producing the output is said to be technically efficient and operates on its production frontier.



Which input / output / outcomes ?



Concepts of efficiency and effectiveness



Which determinants ?---





Data : Sources

- OECD (STAN. ANBERD) & EUROSTAT (S&T indicators)
 - Input:
 - Procurement and subsidies (publicly funded R&D performed in the private sector).
 - R&D performed in the public sector.
 - Output:
 - R&D performed in the private sector.
 - R&D personnel in the private sector.
- Warda (2006)
 - Input:
 - R&D Tax credit (B-index, index of fiscal generosity).
- Fraser institute (2006)
 - Environmental variables.

Data : Coverage (business R&D, EUROSTAT)

geo\time	08	07	06	05	04	03	02	01	00	99	98	97	96	95	94	93	92	91	90	89	88	87	86	85	84	83	82	81
AT					1		1				1					1				1				1	1			1
BE						1	1	1	1	1	1	1	1	1	1	1	1	1		1	1	1	1	1	1	1	1	1
BG					1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1						
СН					1				1				1				1			1			1			1		1
CY					1	1	1	1	1	1	1						1	1										
CZ				1	1	1	1	1	1	1	1	1	1	1														
DE					1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
DK						1		1		1	1	1	1	1		1	1	1	1	1	1	1	1	1	1	1	1	1
ES					1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
FI					1	1	1	1	1	1	1	1		1		1		1		1		1		1		1		1
FR					1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
GR						1		1		1		1	1	1		1		1		1	1		1					1
HR					1	1	1																					
HU				1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1						
IE				1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
IS						1		1		1	1	1		1	1	1	1	1	1	1		1		1		1		1
IT					1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
JP						1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
IT				1	1	1	1	1	1																			
LU						1			1																			
LV				1	1	1	1	1	1	1	1	1	1	1														
MT							1																					
NL						1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
NO						1		1		1		1		1		1		1		1		1		1	1	1	1	1
PL				1	1	1	1	1	1	1	1	1	1	1	1													
PT						1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
RO					1	1	1	1	1	1	1	1	1	1	1	1												
RU					1	1	1	1	1	1																		
SE						1		1		1		1		1		1		1		1		1		1		1		1
SI				1	1	1	1	1	1	1	1	1	1	1	1	1												
SK				1	1	1	1	1	1	1	1	1	1	1	1	1												
TR							1	1	1	1	1	1	1	1	1	1	1	1	1									
UK					1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1		1		1
US						1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1

6th issue!

Method	Strengths	Weaknesses	
1. Comp	osite performance indicators		
	Evaluation of public spending in its entirety	• Not suited to assess the efficiency of particular policies e.g. health, education, R&D policies	
2. Data E	invelopment Analysis (DEA)		
	 Allow one to directly compare the efficiency of countries (ranking) No need to define the relative importance of the various 	 Heavy reliance on the accuracy of the data Difficult to distinguish between 	outliers!
	inputs employed and output produced (due to the absence of weights or prices attached to each outcome)	output and outcomesEfficiency scores attributed to inputs	
	• No need to specify a functional relationship between inputs and outputs	while other factors may also contribute	
	• Not subject to simultaneous bias and/or specification errors	• Frontier depends from the set of countries considered (Inefficiences	no enougn
	Allow to deal with the simultaneous occurrence of multiple inputs and outputs	can be underestimated)	
3. Stocha			
	• Error term with 2 components: conventional error term + term representing deviation from frontier (relative inefficiency)	 Assume functional form for the production function Assume distributional form of the 	no enough
	Allow for hypothesis testing, confidence intervalAllow to explain inefficiency	technical efficiency termSingle output dimension	
		• Frontier depends from the set of countries considered (Inefficiences can be underestimated)	

Past studies on public R&D efficiency

- No studies at the macro-level based on non-parametric methods !
- Afonso et al. (2006): Several studies using either FDH or DEA find significant inefficiencies of the public sector (health, education) in many countries.
- David et al. (2000): Review of econometric studies on the effects of publicly-financed R&D expenditure in the private sector.
 - At the meso- and macro levels: Complementarity rather than substitution (crowding out) between publicly- and privately-financed R&D-expenditure. Yet, complementarity overestimated due to crowding out effects (higher wages).
 - Studies at the micro or plant level are more mitigated. Studies focusing on US data find evidence of a substitution effect while for non US countries, a complementarity effect seems to predominate.
- Guellec and van Pottelsberghe (2003): Complementarity between public funds to support R&D in the private sector. R&D expenditure performed in the public sector, in particular in the defense sector, appears to crowd out private R&D.

Summary of results Comparison of efficiency scores obtained from SFA vs. DEA



Summary of results Comparison of DEA efficiency scores: R&D expenditures vs. personnel



Summary of results Comparison of DEA efficiency scores: R&D expenditures vs. personnel



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Summary of results Determinants of efficiency scores Comparison of SFA and DEA methods

Me	ethod	/panel		DEA/panel	
0	utput	R	Р	R	Р
Determinants					
Country groupings					
World regions					
EU15		-	+		+
Rest of Europe		-	-		
High industrialized countries		-	-	-	
Other		-	-		
Internal market and Euroland					
IM			+		
Euro		-			
per capita					
Medium				+	+
High		-	-		
Regulatory conditions					
Size of government		-	-	+	
Legal structure and security of property righ	ts	-		-	
Access to sound money				+	+
Freedom to trade					
Regulation					+

Notes:

R = R&D expenditures; P = R&D personnel; The sign '-' refers to a negative impact of the determinant on inefficiency, i.e. a positive impact on efficiency, and conversely for the sign '+'; Only the signs of the variables that were significant (at the 10% at least) are reported.

Summary of results Impact of administrative, institutional and business determinants on DEA efficiency scores - Panel data TOBIT regression

					Log-Like-			
Dependent Variable: DEA unpredicted efficiency scor	es based	on ln(BE	ERD)	# obs.	lihood.	LR	test	
Administrative and institutional R&D enhancing factors								
More effective control of public spending growth	-0.005	(0.045)		21	4.8	Т		
Anchoring the budget process in a medium-term perspective	0.016	(0.035)				Т		
Reduced budget fragmentation and increased transparency	-0.013	(0.018)				Т		
Share of enterprises receiving public funding for innovation	-0.002	(0.004)		46	6.4		3.1	**
Business R&D enhancing factors								
Summary Innovation Index ()	-0.404	(0.199)	**	31	-1.98	Т		
Public procurement advertised								
in the Official Journal as a % of	0.024	(0.008)	***	43	58.3		22.6	***
Public procurement advertised								
in the Official Journal as a % of total public procurements	0.005	(0.001)	***	42	57.8		21.5	***
Industry university links (business funded R&D								
performed in other sector than the business one)	-0.001	(0.001)		113	38.4		48	***
Basic R&D performed in the private sector								
in % of total business R&D	0.016	(0.013)		46	-4.2		11.1	***
Share in % of researchers, scientists & engineers								
In the private sector as a % of total active population	-0.126	(0.117)		50	13.8		7.1	***
Share in % of researchers, scientists & engineers								
In the total business R&D personnel	-0.001	(0.003)		50	13.2		8.5	***
Share of Public Credit Appropriation in the defence sector	0.001	(0.001)		84	49.5		43.7	***
Strength of the IPR system								
Full sample	0.030	(0.006)	***	65	34.4		19.2	***
EU15 and most industrialized countries	-0.037	(0.003)	***	41	47.2		24.8	***
New EU Member States and rest of the World	0.132	(0.013)	***	23	8.71		3.62	**
Share in % of high-tech sectors								
in total manufacturing value added	-0.008	(0.004)	*	35	15.3	Т		

Notes:

Annual dummies included; standard errors in parentheses for generalized Tobit pooled regression; ***(**, *) denote a significance level of 1% (5%, 10%).

Are results suitable to draw conclusions ?

DEA and SFA results are not always comparable due to:

- different assumptions underlying the estimations (which cannot be tested)
- data limitations (# of obs., particularly for SFA)
- potential endogeneity of determinants

Macroeconomic country data may not necessarily be sufficient to judge about inefficiencies without a detailed case-by-case study

But:

- Rankings of countries, i.e. three groups, in terms of efficiency levels are more or less similar across methods
- Importance of a well functioning system for securing intellectual property
- Top performing countries, Japan, Switzerland and the United States actually rely on very different public R&D strategies
- No unique public strategy that determines high efficiency levels EFFICIENCY OF PUBLIC SPENDING TO SUPPORT R&D

Thank you for your attention !

Questions