Economia da Educação

Aula 15 abril 2015

LISBOA SCHOOL OF ECONOMICS & MANAGEMENT

International Handbook on the Economics of Education
Johnes and Johnes, 2004

chapter 1.
Human capital and rates of return
Psacharopoulos and Patrinos

chapter 4.
Education and economic growth
Stevens and Weale

chapter 6.
The social and external benefits of education

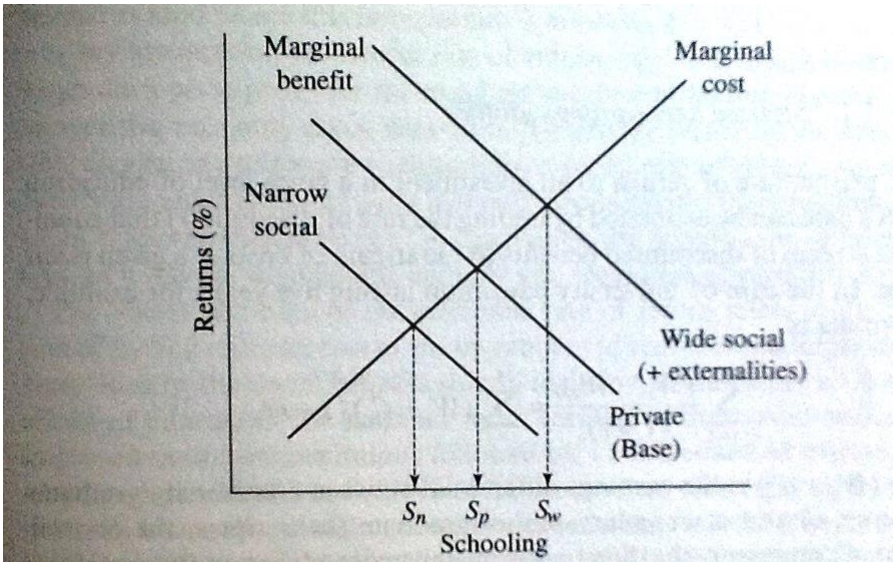


Figure 1.1 Private and social optimum levels of schooling

Table 1.2 Returns to investment in education by level and per capita income (per cent)

Per capita income group	Social			Private		
	Primary	Secondary	Higher	Primary	Secondary	Higher
Low income ($755 or less)	21.3	15.7	11.2	25.8	19.9	26.0
Middle income (to $9265)	18.8	12.9	11.3	27.4	18.0	19.3
High income ($9266 or more)	13.4	10.3	9.5	25.6	12.2	12.4
World	18.9	13.1	10.8	26.6	17.0	19.0

Source: Psacharopoulos and Patrinos (2004).

Table 1.3 *Returns to investment in education by level and region (per cent)*

Region	Social			Private		
	Primary	Secondary	Higher	Primary	Secondary	Higher
Asia*	16.2	11.1	11.0	20.0	15.8	18.2
Europe/Middle East/North Africa*	15.6	9.7	9.9	13.8	13.6	18.8
Latin America/ Caribbean	17.4	12.9	12.3	26.6	17.0	19.5
OECD	8.5	9.4	8.5	13.4	11.3	11.6
Sub-Saharan Africa	25.4	18.4	11.3	37.6	24.6	27.8
World	18.9	13.1	10.8	26.6	17.0	19.0

Note: *non-OECD.

Source: Psacharopoulos and Patrinos (2004).

Table 1.5 *Returns to investment in education by level, full method (per cent)*

Country	Year	Social			Private		
		Prim.	Sec.	Higher	Prim.	Sec.	Higher
Bolivia	1990	13	6	13	20	6	19
China	1993	14	13	11	18	13	15
El Salvador	1990	16	13	8	19	15	10
Ethiopia	1996	15	14	12	25	24	27
Greece	1993		7	6		8	8
Mexico	1992	12	15	11	19	20	16
Nepal	1999	16	8	9	17	9	12
New Zealand	1991		12	10		14	12
Paraguay	1990	20	13	11	24	15	14
Vietnam	1992	14	5	6	11	4	3

Source: See Psacharopoulos and Patrinos (2004).

Table 4.2 Mincerian returns to education

Income band (1985 US$)	Mean income	Years' education	Mincerian return
Low income (<$610)	$299	6.4	11.2
Lower middle income ($610–$2449)	$1402	8.4	11.7
Upper middle income ($2500–$7619)	$4184	9.9	7.8
High income (>$7619)	$13100	10.9	6.6
World	$2020	8.7	10.1

Table 4.3 Growth of labour quality and its contribution to overall economic growth, 1960–89

	Labour quality improvement	Contribution to growth	Growth of output per capita
Canada	0.74	0.50	2.93
France	0.73	0.49	3.04
Germany	0.41	0.28	2.91
Italy	0.19	0.12	3.74
Japan	1.16	0.79	5.39
United Kingdom	0.38	0.26	2.15
United States	0.59	0.40	2.07

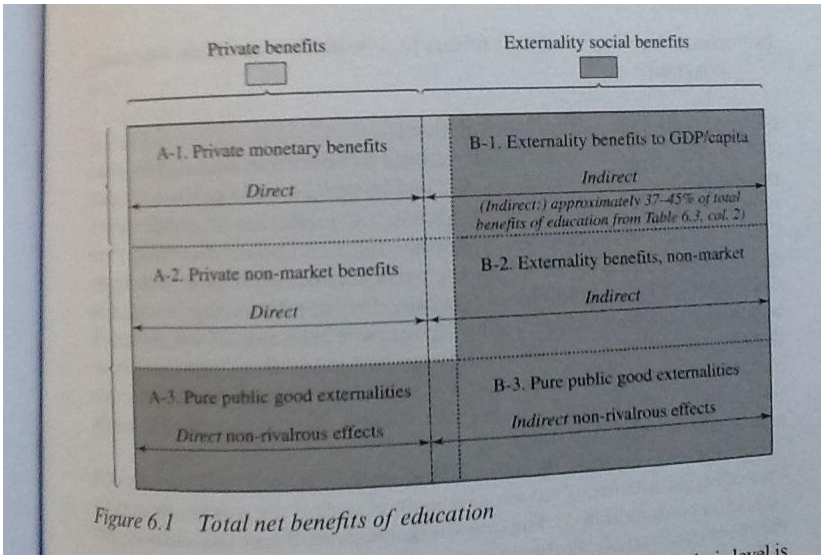
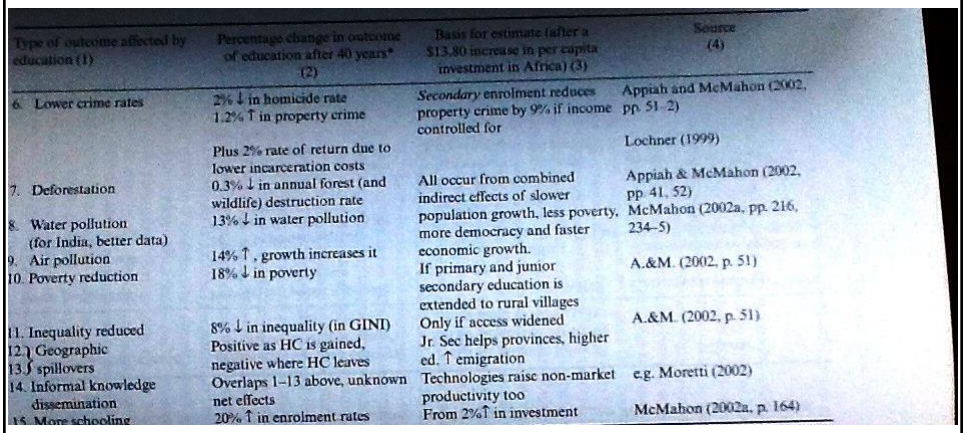


Figure 6.1 Total net benefits of education

Table 6.5 Estimates of total social rates of return including non-market education externalities

Region of the world	Components of total social rates of return to investment in education (investments increasing access and/or improving quality)[1]			
	Conventional monetary social rates of return[2] Fig. 6.1: A1 + B1 (1)	Non-market private returns 80 per cent of col. 1,[3] from Table 6.6 Fig. 6.1: A2 + B2 (2)	Non-market education externalities[4] (indirect effects) Fig. 6.1: B-3 (3)	Total social rates of return (includes non-monetary)[5] (cols 1+2+3) (4)
Africa				
Primary	25.4	20.3	9.1	54.8
Secondary	18.4	14.7	6.6	39.7
Higher	11.3	9.0	4.0	24.3
Latin America				
Primary	17.4	13.9	5.7	37.0
Secondary	12.9	10.3	4.2	27.4
Higher	12.3	9.8	4.0	26.1
Asia				
Primary	16.2	13.0	5.0	34.2
Secondary	11.1	8.9	3.5	23.5
Higher	11.0	8.8	3.4	23.2
OECD				
Primary	8.5	6.8	2.5	17.8
Secondary	9.4	7.5	2.8	19.7
Higher	8.5	6.8	2.5	17.8



Type of outcome affected by education (1)	Percentage change in outcome of education after 40 years* (2)	Basis for estimate (after a $13.80 increase in per capita investment in Africa) (3)	Source (4)
6. Lower crime rates	2% ↓ in homicide rate 1.2% ↑ in property crime Plus 2% rate of return due to lower incarceration costs	*Secondary* enrolment reduces property crime by 9% if income controlled for	Appiah and McMahon (2002, pp. 51–2) Lochner (1999)
7. Deforestation	0.3% ↓ in annual forest (and wildlife) destruction rate	All occur from combined indirect effects of slower population growth, less poverty, more democracy and faster economic growth.	Appiah & McMahon (2002, pp. 41, 52)
8. Water pollution (for India, better data)	13% ↓ in water pollution		McMahon (2002a, pp. 216, 234–5)
9. Air pollution	14% ↑, growth increases it		
10. Poverty reduction	18% ↓ in poverty	If primary and junior secondary education is extended to rural villages	A.&M. (2002, p. 51)
11. Inequality reduced	8% ↓ in inequality (in GINI)	Only if access widened	A.&M. (2002, p. 51)
12. } Geographic	Positive as HC is gained,	Jr. Sec helps provinces, higher	
13. } spillovers	negative where HC leaves	ed. ↑ emigration	e.g. Moretti (2002)
14. Informal knowledge dissemination	Overlaps 1–13 above, unknown net effects	Technologies raise non-market productivity too	
15. More schooling	20% ↑ in enrolment rates	From 2%↑ in investment	McMahon (2002a, p. 164)

Table 6.4 *Estimates of non-market education externalities, simulations of outcomes over 40 years, static plus delayed effects*

Type of outcome affected by education (1)	Percentage change in outcome of education after 40 years* (2)	Basis for estimate (after a $13.80 increase in per capita investment in Africa) (3)	Source (4)
1. Better public health	Positive, but public v. private health effect unknown	Microregressions only, AIDS educ. potential	Grossman & Kaestner (1997)
2. Lower pop. growth	0% in Africa, ↓ elsewhere	↓ fertility but↑ health	
3. Democratization	36% ↑ in democracy (i.e. Freedom House Index up 2.9 (from 3.7) to 6.6 Includes 2.3% for more volunteering: 2% of mkt rate Includes more fin.gifts: 12% give over 3% of their income	Note: this investment of $13.80 per capita raises gross enrolment rate by about 20 percentage points Volunteering and financial giving are at each income level	Democratization: Appiah and McMahon (2002, pp. 50–51, 65–7), data from *Freedom House* (1999, p. 536); volunteering and financial giving: NCES (1995, 1998)
4. Human rights	4% ↑ in human rights, on Freedom House Index		
5. Political stability	3.1% ↑ in political stability, Internat. Country Risk Guide		Appiah & McMahon (2002, p.51)

Public and Private Inputs in Aggregate Production and Growth: A Cross-country Efficiency Approach

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Outline

1. Introduction
2. Literature
3. Methodology
4. Empirical analysis
5. Conclusion

Introduction (1)

The more usual production function approach usually implies:

- i - specifying a production function (e.g. of a Cobb-Douglas variety);
- ii - estimating or calibrating the production function parameters;
- iii - obtaining total factor productivity (TFP) as a Solow residual, the change in production that is not explained by changes in production factors.

We use an alternative production possibility frontier (PPF) approach:

- Efficiency scores show how far a country is from the frontier, given the inputs it is using in production;
- TFP changes are computed as the composite effect of efficiency score and PPF changes;
- PPF is estimated using i) a non-parametric method and ii) a parametric method:
  - Non-parametric: Data Envelopment Analysis (DEA)
  - Parametric: Stochastic Frontier Analysis (SFA)

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Introduction (2)

This paper

Production and growth in industrialised countries (1970-2000)

GDP per employee depends on:

- Private capital per employee;
- Public capital per employee;
- Human capital per employee;
- Governance.

Human capital:

- average years of schooling of the working age population.

Governance:

- quality of institutions and economic policies;
- is measured by an index (World Bank).

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Literature (1)

DEA has been used recently to assess cross-country efficiency:

- In education and health (Afonso and St. Aubyn, 2005, 2006);
- For overall public sector efficiency (Afonso et al., 2005).

Malmquist TFP computations to GDP and GDP growth:

- Kumar and Russell (2002) and Krüger (2003), output and physical capital per worker;
- Henderson and Russell (2005) added human capital as an input;
- Delgado-Rodríguez and Álvarez-Ayuso (2008) private and public capital;
- Additional aplications/discussions of Malmquist index: Färe et al. (1994), Ray and Desli (1997), and Färe, Grosskopf and Norris (1997).

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Literature (2)

Applications of stochastic frontier analysis (SFA) to infer efficiency changes in aggregate production across countries

• Mastromarco and Ghosh (2008), 57 developing countries, 1960-2000. Efficiency or total factor productivity is driven by technology diffusion interacting with human capital.

• Osiewalski and Steel (2000) for Western economies, Poland and Yugoslavia. Stochastic frontier for aggregate production, considering capital and labour as production factors and decompose growth between 1980 and 1990 into input growth, technical growth and efficiency growth.

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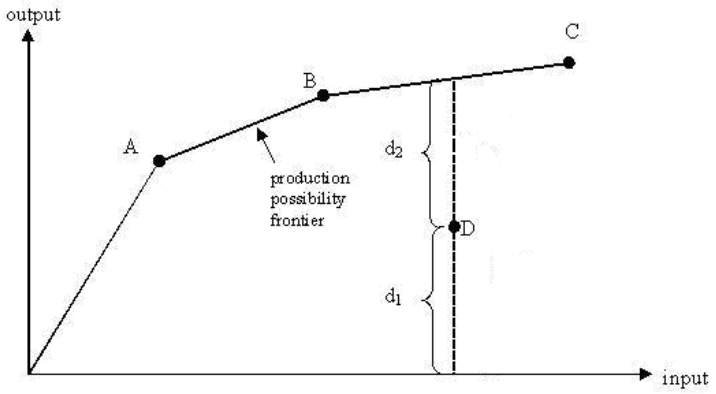
Methodology (1)

Data Envelopment Analysis



A, B and C are efficient units. Scores are equal to 1.
D is not efficient. (output) Score [= $d_2/(d_1+d_2)$] is smaller than 1.

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Methodology (2)

Data Envelopment Analysis

$$Max_{\delta,\lambda}\ \delta$$

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

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

$$n1'\lambda = 1$$

$$\lambda \geq 0$$

Output-oriented specification.

y - column vector of outputs,

x - column vector of inputs,

X - input matrix,

Y - output matrix.

$1/\delta$ - efficiency score ($1/\delta <= 1$).

Note: δ 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.

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Methodology (3)

Stochastic Frontier Analysis

$$\ln y_{it} = F(X_{it}, \beta) + \eta_{it} + \varepsilon_{it}$$

$$\eta_{it} = \theta z_{it}$$

i – country, t – time period;
y_{it} – output, GDP per worker;
X_{it} – vector of inputs, private and public capital per worker and human capital;
β – set of production function parameters to be estimated;
ε_{it} – normally distributed random error;
η_{it} – non-negative efficiency effect, assumed to have a truncated normal distribution;
z_{it} – non-discretionary factors (the governance indicators) that explain inefficiency;
θ – set of efficiency parameters to be estimated.

$$\gamma = \frac{\sigma_\eta^2}{\sigma_\eta^2 + \sigma_\varepsilon^2}$$

a likelihood ratio statistic tests if γ=0, i.e., that there are no random inefficiency effects.

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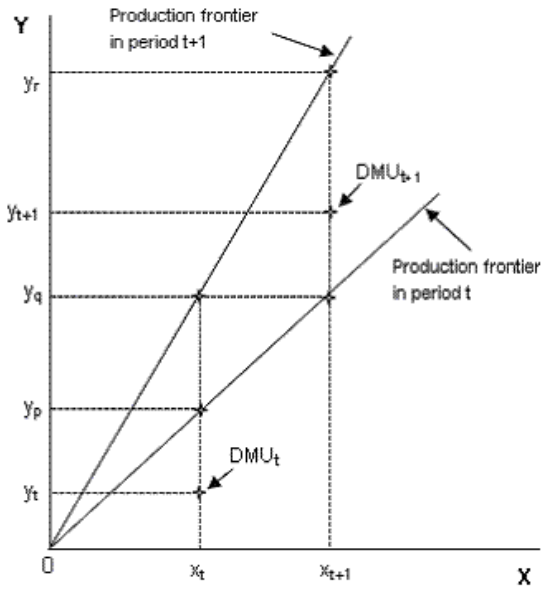
Methodology (4)

Malmquist Productivity Index (constant returns to scale example)



Efficiency change index

$$E = \frac{y_{t+1} / y_r}{y_t / y_p}$$

Technology change index

$$T = \left[\frac{y_{t+1} / y_q}{y_{t+1} / y_r} \times \frac{y_t / y_p}{y_t / y_q} \right]^{1/2}$$

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Empirical analysis (1)

Data

Original series	Ameco codes
Gross Domestic Product at 2000 prices, thousands national currency 1/	1.1.0.0.OVGD
Net capital stock at 2000 prices: total economy 1/	1.0.0.0.OKND
Employment, persons: all domestic industries (National accounts) 1/	1.0.0.0.NETD
GDP purchasing power parities, Units of national currency per PPS (purchasing power standard) 1/	1.0.212.0.KPN
Human capital (average years of schooling of the working age population)	2/
Government net capital stock, volume	3/
Private total net capital stock, volume	Our computation
Government effectiveness 4/	

1/ Series from the European Commission AMECO database.
2/ Cohen and Soto (2007).
3/ Kamps (2006).
4/ Kaufmann et al. (2008), World Bank.

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Empirical analysis (2)

Data on governance

• Kaufmann, Kraay, and Mastruzzi (2008) provide six indicators for six different dimensions of governance:
  - voice and accountability,
  - political stability and absence of violence,
  - government effectiveness,
  - regulatory quality,
  - rule of law,
  - control of corruption.

• We use the indicator "government effectiveness" taking the average from 1996 to 2000.

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Empirical analysis (3)

DEA/Malmquist

VRS technical efficiency scores
(output: GDP per employee; inputs: private and public capital, human capital)

	1970	Peers	1980	Peers	1990	Peers	2000	Peers
Australia	0.932	FI, CA, NL	0.937	CA, US, PR	0.924	CA, BE, PT	0.970	DK, IR, PT
Austria	0.897	CA, US, JP, PT	0.905	DK, US, PT	0.854	US, BE, PT	0.817	US, IT, BE
Belgium	1.000	BE	1.000	BE	1.000	BE	1.000	BE
Canada	1.000	CA	1.000	CA	1.000	CA	1.000	CA
Germany	0.846	BE, CA	0.906	BE, PT	0.891	IT, BE	0.814	DK, BE, US
Denmark	0.999	US, NL, PT	1.000	DK	1.000	DK	1.000	DK
Spain	1.000	ES	1.000	ES	1.000	ES	0.943	IT, PT, IR
Finland	0.812	ES, BE, CA	0.852	ES, BE, PT	0.864	BE, CA, ES	0.915	BE, US, IR
France	0.942	ES. US, IT, CA	0.935	US, IT	0.941	IT, US	0.920	NO, IT, US
UK	0.825	US, IT, ES, PT	0.858	PT, US, DK	0.898	BE, US, PT	0.968	DK, IR, PT
Greece	0.915	US, IT, ES, PT	0.884	BE, ES, IT	0.782	ES, CA, PT	0.749	PT, IR, IT
Ireland	0.744	US, CA, JP, PT	0.737	US, BE, PT	0.765	BE, US, IT	1.000	IR
Italy	1.000	IT	1.000	IT	1.000	IT	1.000	IT
Japan	1.000	JP	0.984	DK, PT	0.877	DK, US, PT	0.775	US, DK
Netherlands	0.912	US, IT, PR	0.919	BE, US, IT	0.869	US, IT, BE	0.871	IR, US, PT
Norway	0.882	BE, CA	0.917	BE. US	0.955	IT, US	1.000	NO
Portugal	1.000	PR	1.000	PT	1.000	PT	1.000	PT
Sweden	0.929	BE, CA	0.900	BE, ES	0.975	CA, PT	0.881	BE, IR
USA	1.000	US	1.000	US	1.000	US	1.000	US
Average	0.928		0.933		0.926		0.928	
Countries on the frontier	7		7		7		8	

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Empirical analysis (4)

Table 2 – Malmquist efficiency, technology, and total factor productivity change indices (Output-oriented): 1970-2000 (output; GDP; inputs: private and public capital, human capital)

	1970-1980			1980-1990			1990-2000			1970-2000		
	EC	TC	TFP	EC	TC	TFP	EC	TC	TFP	EC	TC	TFP
Australia	1.061	0.922	0.979	0.988	0.980	0.968	1.138	0.963	1.096	1.061	0.955	1.013
Austria	1.032	0.924	0.953	0.980	1.012	0.992	0.954	1.041	0.993	0.988	0.991	0.979
Belgium	1.000	1.009	1.009	1.000	1.059	1.059	1.000	1.042	1.042	1.000	1.036	1.036
Canada	1.000	0.952	0.952	0.954	0.991	0.945	1.139	0.935	1.065	1.028	0.959	0.986
Germany	1.111	0.967	1.074	0.999	1.039	1.037	1.028	0.993	1.021	1.045	0.999	1.044
Denmark	1.063	0.913	0.970	1.000	0.967	0.967	1.000	1.057	1.057	1.021	0.977	0.997
Spain	1.046	1.040	1.089	1.000	1.014	1.014	0.913	1.044	0.954	0.985	1.033	1.017
Finland	1.032	0.995	1.026	0.989	1.023	1.012	1.174	1.005	1.180	1.062	1.008	1.070
France	0.994	1.027	1.021	0.970	1.063	1.032	1.040	1.020	1.061	1.001	1.036	1.038
UK	1.098	0.919	1.009	1.070	0.960	1.027	1.115	0.972	1.084	1.094	0.950	1.040
Greece	0.992	1.055	1.047	0.869	1.020	0.887	0.961	1.083	1.040	0.939	1.053	0.988
Ireland	1.063	0.968	1.028	1.038	1.057	1.098	1.312	1.064	1.396	1.131	1.029	1.164
Italy	1.000	1.099	1.099	1.000	1.066	1.066	1.000	1.016	1.016	1.000	1.060	1.060
Japan	0.981	0.878	0.861	0.894	0.975	0.871	0.883	1.054	0.931	0.918	0.966	0.887
Netherlands	1.036	0.987	1.023	0.949	1.065	1.011	1.008	1.038	1.046	0.997	1.029	1.026
Norway	1.056	0.994	1.050	1.030	1.052	1.084	1.180	1.024	1.208	1.087	1.023	1.112
Portugal	1.000	0.958	0.958	1.000	0.945	0.945	0.947	0.948	0.897	0.982	0.950	0.933
Sweden	0.943	1.002	0.945	1.068	0.989	1.056	1.051	0.990	1.041	1.019	0.994	1.012
USA	1.029	0.959	0.987	1.028	1.026	1.054	1.000	1.058	1.058	1.019	1.014	1.033
Average	1.027	0.976	1.007	0.990	1.015	1.055	1.038	1.017	1.058	1.019	1.003	1.021

Notes: EC – Efficiency Change; TC – Technology Change; TFP – Total Factor Productivity change (TFP=EC*TC).

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Empirical analysis (5)

Change in output is decomposed into the change TFP and the quantitative change in the inputs

$$\Delta Output = \Delta TFP \times \Delta Input$$

	1970-1980			1980-1990			1990-2000			1970-2000		
	ΔGDP	ΔTFP	ΔInput	ΔGDP	ΔTFP	ΔInput	ΔGDP	ΔTFP	ΔInput	ΔGDP	ΔTFP	ΔInput
Australia	1.189	0.922	1.215	1.121	0.968	1.158	1.199	1.096	1.094	1.598	1.013	1.578
Austria	1.387	0.924	1.456	1.233	0.992	1.243	1.205	0.993	1.214	2.061	0.979	2.106
Belgium	1.356	1.009	1.344	1.209	1.059	1.141	1.163	1.042	1.116	1.906	1.036	1.839
Canada	1.065	0.952	1.118	1.098	0.945	1.162	1.151	1.065	1.081	1.346	0.986	1.365
Germany	1.304	0.967	1.215	1.127	1.037	1.087	1.045	1.021	1.024	1.536	1.044	1.471
Denmark	1.198	0.913	1.235	1.189	0.967	1.229	1.202	1.057	1.137	1.710	0.997	1.715
Spain	1.440	1.040	1.322	1.259	1.014	1.242	1.077	0.954	1.128	1.951	1.017	1.919
Finland	1.337	0.995	1.303	1.271	1.012	1.256	1.295	1.180	1.098	2.200	1.070	2.056
France	1.315	1.027	1.288	1.223	1.032	1.185	1.139	1.061	1.074	1.833	1.038	1.766
UK	1.207	0.919	1.196	1.166	1.027	1.135	1.260	1.084	1.162	1.771	1.040	1.703
Greece	1.345	1.055	1.284	1.023	0.887	1.153	1.196	1.040	1.150	1.645	0.988	1.665
Ireland	1.451	0.968	1.412	1.370	1.098	1.248	1.434	1.396	1.027	2.850	1.164	2.448
Italy	1.365	1.099	1.242	1.262	1.066	1.184	1.162	1.016	1.144	2.003	1.060	1.889
Japan	1.462	0.878	1.698	1.273	0.871	1.462	1.135	0.931	1.219	2.113	0.887	2.382
Netherlands	1.228	0.987	1.201	1.112	1.011	1.100	1.118	1.046	1.069	1.527	1.026	1.488
Norway	1.277	0.994	1.216	1.253	1.084	1.156	1.266	1.208	1.048	2.025	1.112	1.821
Portugal	1.289	0.958	1.346	1.206	0.945	1.277	1.209	0.897	1.348	1.880	0.933	2.016
Sweden	1.131	1.002	1.197	1.164	1.056	1.102	1.281	1.041	1.230	1.687	1.012	1.667
USA	1.087	0.959	1.101	1.133	1.054	1.075	1.187	1.058	1.122	1.461	1.033	1.414

Note: ΔInput=ΔGDP/ΔTFP.

Empirical analysis (6)

Decomposing the increase in the inputs into the 3 types of capital, imposing the restriction

$$\Delta Input_i = a_1 PrivK_i + a_2 PubK_i + (1 - a_1 - a_2) HK_i$$

Table 5 – Decomposition of the change in total input

	Private capital	Public capital	Human capital	R-square	N
1970-1980	0.277 ***	0.276 ***	0.446	0.77	19
	(3.63)	(4.50)			
1980-1990	0.733 ***	-0.025	0.293	0.79	19
	(11.65)	(-0.37)			
1990-2000	0.652 ***	0.185 ***	0.165	0.89	19
	(11.82)	(0.183)			
1970-2000	0.556 ***	0.116	0.328	0.80	19
	(6.93)	(1.61)			

Note: t-statistics in brackets.

Empirical analysis (7)

SFA

Table 6 – Stochastic frontier estimation results (with time trend)

	Coefficient	Standard-error	t-statistic
Production function			
Constant	0.744	0.418	1.78
lnPrivK	0.538	0.133	4.04
lnPubK	0.118	0.053	2.23
HK	0.014	0.009	1.69
Trend	0.047	0.024	1.95
Inefficiency			
Constant	0.080	0.287	0.28
$\hat{\sigma}_\varepsilon^2$	0.935		
γ	0.744	0.418	1.78
LR-statistic (γ=0)*	2.44		
N. of observations	76		
N. of cross-sections	19		

* The LR statistic critical value at 10% for a mixed chi-square distribution with 2 degrees of freedom is 3.808, according to the tabulation of Kodde and Palm (1986).

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Empirical analysis (8)

Table 7 – SFA efficiency scores (with time trend)

	1970	1980	1990	2000	Average	Ranking (average)
Australia	0.921	0.896	0.867	0.922	0.901	8
Austria	0.856	0.851	0.839	0.820	0.842	13
Belgium	0.963	0.969	0.977	0.974	0.971	2
Canada	0.979	0.956	0.904	0.932	0.943	3
Germany	0.821	0.820	0.825	0.800	0.817	16
Denmark	0.936	0.915	0.923	0.966	0.935	4
Spain	0.969	0.945	0.932	0.877	0.931	6
Finland	0.799	0.810	0.791	0.913	0.828	15
France	0.909	0.879	0.874	0.871	0.883	9
UK	0.820	0.815	0.841	0.896	0.843	12
Greece	0.877	0.805	0.704	0.725	0.778	19
Ireland	0.729	0.709	0.748	0.970	0.789	18
Italy	0.920	0.944	0.944	0.928	0.934	5
Japan	0.916	0.854	0.810	0.747	0.832	14
Netherlands	0.893	0.859	0.853	0.874	0.870	11
Norway	0.851	0.828	0.854	0.960	0.873	10
Portugal	0.948	0.930	0.898	0.841	0.904	7
Sweden	0.860	0.794	0.766	0.829	0.812	17
USA	0.977	0.964	0.974	0.983	0.975	1
Correlation with Malmquist DEA TE scores	0.956	0.901	0.791	0.860	0.894	

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Empirical analysis (9)

Table 8 – Efficiency and government effectiveness (1990-2000)

Dependent variable	Constant	Government effectiveness	R-square	N
Technical efficiency change	0.844 *** (8.35)	0.112 ** (2.04)	0.20	19
TFP change	0.891 *** (8.37)	0.100 (1.65)	0.14	19
SFA efficiency change	0.095 (1.42)	0.071 * (1.87)	0.17	19

Note: t-statistics in brackets.

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Summary of results

Main empirical findings:

i) Both private capital and human capital are important for growth, and they contribute in a significant manner to output accumulation;
ii) Public capital contribution is as positive, and significant from a statistical point a view;
iii) A governance indicator, a non-discretionary input, helps explaining inefficiency.

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Conclusion (1)

Remarks on methodology:

i) Deterministic and stochastic estimation methods provided similar results and conclusions;
ii) Non-parametric and parametric results coincide rather closely on the countries movements vis-à-vis the possibility frontier and on their relative distances to the frontier;
iii) The number of countries that can be nominated as efficient was rather stable throughout the period, with six or seven countries usually on the frontier (Belgium, Canada, Spain, Italy, Japan, Portugal, and the USA).

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Conclusion (2)

Policy implications, policy may matter for growth by three different channels:

i) Public investment (but macroeconomic analysis can be no substitute for the careful evaluation of each public project on its own merits);
ii) Governance (government effectiveness);
iii) Human capital formation (some countries, e. g. Portugal and Spain), are probably limited in their growth prospects by their relative human capital scarcity.

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