Performance indicators for public spending efficiency in primary and secondary education

Douglas Sutherland

Economics Department, OECD
Background

- Part of ongoing work into public spending efficiency
- This paper develops a set of performance indicators
- Other work on institutional indicators
- Future work to extend to other sectors
Spending

2003 constant prices

- Change in expenditure
- Change in the number of students
- Change in expenditure per student

Index of change (1995=100)

Primary, secondary and post-secondary non-tertiary education

Countries: Germany (1,2), Italy (1,2), Norway, Czech Republic, Sweden, France (3), Canada, Denmark, Finland, Japan, United States, Spain, Mexico, Netherlands, Australia, Slovak Republic, Hungary (1), Portugal (1,2), Ireland, Turkey (1,2), Greece (1), Poland (1,2)
Spending and attainment

Average PISA score (4)

$y = 0.000x + 484.5$

$R^2 = 0.056$
Measurement of efficiency

- Data envelopment analysis
  - Afonso and St Aubyn
  - Simar and Wilson

- Stochastic frontier analysis
Data envelopment analysis

Output

inefficiency

Input
The shape of the frontier

CRS

VRS

NIRS

FDH
Drawbacks with DEA

- Adding variables will reduce measure of inefficiency
  - Parsimonious specification using PISA and Education at a Glance data

- Sensitive to measurement error
  - Examine data for possible outliers
  - Use “bootstrap” to estimate confidence intervals

- Small-sample bias
  - Statistical correction to estimate
Stochastic frontier analysis
A comparison of approaches

Note: DEA is Data envelopment analysis and SFA is Stochastic Frontier Analysis.
Technical efficiency: school-level estimates

- Output: average PISA score
- Inputs: teacher-student ratios, computer availability, socio-economic background of the parents and measure of pupils linguistic background

- Significant differences in estimates of efficiency exist across countries
- Estimates of technical efficiency can vary substantially across schools within some countries
- Evidence points to some schools being too small in a number of countries
School-level results I

A. Input oriented efficiency

Uncorrected estimate
Bias-corrected estimate and 95% confidence intervals
School-level results II

B. Output oriented efficiency

Efficiency

Uncorrected estimate

Bias-corrected estimate and 95% confidence intervals

Norway Iceland Greece United States Hungary Denmark Sweden Canada United Kingdom Belgium–Fr Austria Italy Spain Czech Republic Ireland Portugal Netherlands Australia Poland Belgium Finland Germany Belgium–Fr Japan Turkey Korea
Number of “reference” schools

Note: For a given school, the “reference” schools are schools that produce at least as much output with the same level or fewer inputs.
Salter curves

Bootstrap estimates, non-increasing return to scale, output efficiency

Note: These figures present the estimates of school-level efficiency for each country ordered by the level of efficiency (vertical axis), each school being weighted by the number of students. A fully efficient school would have a score of 1. DEA has been performed using PISA score as output and teaching and computing resources, socio-economic status of students and language background as inputs.
Returns to scale on the frontier

Percentage of schools on the portion of the efficiency frontier with diminishing, increasing or constant return to scale’

Note: DRS: Diminishing return to scale; IRS: Increasing return to scale; CstRS: Constant return to scale. DEA estimates with PISA score as output and teachers student ratio, computer availability, socio-economic and language backgrounds as inputs.

1. Assuming that input inefficiency has been removed.
Potential gains from improving performance

B. Moving the efficiency level to at least the average level

Saving in teaching staff

- Luxembourg
- Finland
- Ireland
- Czech Republic
- Iceland
- Denmark
- New Zealand
- United States
- Germany
- Netherlands
- Spain
- Japan
- Belgium
- Turkey
- Greece

Boost in PISA score

- Finland
- Poland
- Denmark
- New Zealand
- Netherlands
- Belgium
- Austria
- United States
- Portugal
- Slovak Republic
- Turkey
- Iceland
- Belgium
- Hungary
- Belgium
Technical efficiency: country-level estimates

- Outputs: PISA scores and “equity” of performance
- Inputs: Teacher-student ratios and socio-economic background of the students

- Results broadly similar to school-level results
- Generally more confident about relative performance of poor performers
- Some concern about the sample size
School-level and country-level results

A. Input oriented efficiency

B. Country-level efficiency
Technical efficiency: Country-level results

A. Input oriented efficiency
Technical efficiency and attainment

A. Input oriented efficiency

- PISA score
- Countries represented: aus, aut, bel_fl, can, cze, dnv, fin, fra, grc, hun, irl, ita, jpn, lux, mex, nld, nor, pol, prt, svk, esp, swe, swi, swi, tur, gbr, usa, Kor
Cost efficiency estimates

- Can estimate cost efficiency
  - Comparing spending across countries is difficult

- Broadly similar results to technical efficiency
  - Differences reflect teaching compensation?

- Weak link between cost efficiency and PISA scores
Cost efficiency results

B. Output oriented efficiency

Efficiency

Uncorrected estimate

Bias-corrected estimate and 95% confidence intervals

Greece (2) Italy (2) United States, France, Belgium, Luxembourg, Denmark, Austria, Iceland, Germany, Ireland, Spain, France, Sweden, Greece, United Kingdom, Switzerland, Hungary, Australia, New Zealand, Czech Republic, Poland, Japan, Portugal, Slovakia, Mexico.
Cost efficiency and attainment

B. output oriented efficiency