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Public-sector efficiency and interjurisdictional competition: An empirical investigation

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Working Paper No. 101

**Public-Sector Efficiency and Interjurisdictional Competition -
an Empirical Investigation**

by

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Public-Sector Efficiency and Interjurisdictional Competition - an Empirical Investigation

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This paper investigates the performance and efficiency of the public sector in 74 countries worldwide for the years 1985, 1990, 1995 and 2000. Similar to what is done in Afonso / Schuhknecht / Tanzi (2005, Public Choice), I calculate performance measures for various fields of government policy, including education, health, security or macroeconomic stability. These performance measures are then used as output variables in a non-parametric FDH (free disposable hull) and DEA (data envelopment analysis) approach for the calculation of efficiency scores. Government expenditure is used as input for the evaluation of efficiency. In the last step the efficiency scores are regressed upon variables that describe the environment of government policy. I find that smaller public sectors tend to be more efficient, but the effect is not very sizeable. The same is true for countries that are more globalised. The pattern of (in-)efficiency can be large explained by continent-dummies.

Keywords: Public-Sector Efficiency, Free Disposable Hull, Data Envelopment Analysis

JEL-Classification: C14, H50

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1 Introduction

The provision of public goods and services requires public expenditure that is, in the end, financed by tax revenue. It is hence natural that policymakers and their voters have an interest in using that money as efficient as possible. In many industrialised countries, public-sector efficiency is of high public interest as the ability and willingness to raise tax revenue is subject to constraints. Initiatives to cut public spending while maintaining the level of public goods and services that consumers and producers are used to can be found in many countries, both at the national and subnational level. Or, alternatively, there are demands that the output level is increased given the level of public expenditure. Both kinds of public-sector reform aim to increase public-sector efficiency. Accordingly, there is a need to measure, compare and explain differences in the performance and efficiency of governments internationally.

There is by now an immense number of studies in the literature that measure the efficiency of private firms like banks, insurance companies, electricity providers or farmers using non-parametric techniques to measure efficiency like data envelopment analysis (DEA). Also the efficiency of the public sector and publicly owned firms has been assessed using DEA-methods. Examples are studies about the efficiency of public transport systems, schools and universities, police forces and fire services, jails, libraries and other sub-units of the public sector. [Gattoufi et al. \(2004\)](#) provide a bibliography that covers the years 1951-2001. It lists over 1800 papers in the field of data envelopment analysis.¹

Fewer studies attempt to evaluate the efficiency of the public sector of countries as a whole. This is of course due to enormous difficulties to define a set of indicators measuring inputs and outputs of the public sector that is treated as if it was a production unit. Regardless of all the difficulties, [Afonso et al. \(2005\)](#) made an attempt and evaluate the efficiency of the public sector for 23 industrialised countries.

The goal of this study is twofold: First, it tries to provide a robustness check for the results found in [Afonso et al. \(2005\)](#). In order to do so, the inputs and outputs of the public sector are measured in this study in a similar way. Then efficiency measures (“scores”) are calculated. I use two different samples that cover up to 74 countries and the years 1985, 1990, 1995 and 2000. Secondly, the efficiency scores are used in a regression analysis that tries to explain the pattern of public sector by the intensity of interjurisdictional competition. The idea is that the competition between jurisdiction – in this case: countries – has an influence on the efficiency of the public sectors that uses tax revenue to provide public goods and services. In [Becker \(2005\)](#) it has been argued that the competition for a mobile tax base can lead to less efficiency. The reason there is that the efficiency of the public sector is the result of past investment that is hurt by less tax revenue in the presence of capital mobility. But, from a theoretical point of view, it could also be the other way round: Tax competition can improve the efficiency of the public sector if inefficiencies are caused, for example, by a bureaucracy that does not act in the best interest of its citizens. Then tax competition can have a disciplining effect. Examples of the models with tax competition and “Leviathans” as governments include [Edwards / Keen \(1996\)](#); [Rauscher \(2000\)](#); [Wilson \(2005\)](#).² The theoretical literature as a whole does not come

¹ This bibliography is currently being updated to also cover in addition the years 2002 until 2007. Many thanks to Said Gattoufi for sharing his impressive database. It is planned for the not so far future to publish the bibliographic data on a website and to allow quick overviews of the literature according to different criteria like publication type, keywords and others.

² The Leviathan hypothesis in economics has nothing to do with notion of a Leviathan in mythology or in the bible, where it is a sea monster, identified in different passages with the whale and the crocodile (e.g., Job 41, Ps. 74:14), and with the Devil (after Isa. 27:1). The Leviathan in the economics literature has to do with the book by Thomas Hobbes, who argued that a strong government is necessary to avoid “war of all against all”. In economics,

to a clear conclusion about the efficiency-consequences of tax competition or other forms of interjurisdictional competition. The results by and large depend on the a priori assumptions about the correct characterisation of the public sector, with the two extremes of assuming a benevolent vs a Leviathan government. Therefore this study tries to explore empirically the relationship between public-sector efficiency and the intensity of interjurisdictional competition.

The study is not only similar to [Afonso et al. \(2005\)](#), but also to other cross-country comparisons of public sector-efficiency. Using similar two-stage procedures as I do, [Afonso / Aubyn \(2006b, 2007\)](#) assess the efficiency of health care systems in OECD countries and find that factors like the GDP per capita or socio-economic variables like smoking habits or obesity are important factors explaining the efficiencies of health care. The same authors have also examined the efficiency of education system in the OECD, see [Afonso / Aubyn \(2006a\)](#), and find that the found inefficiencies are strongly related to GDP per capita and parents' educational attainment. [Gupta / Verhoeven \(2001\)](#) look at health care and education in Africa. [Afonso et al. \(2006\)](#) analyse public-sector efficiency of 24 nations from emerging markets in different regions and the European Union, including new members and future candidates. They find that public sector efficiency depends positively on the security of property rights, per capita GDP, the competence of civil servants, and the education level of people.

In terms of the sample that is considered, [Angelopoulos et al. \(2007\)](#) is close to this study. They consider 64 countries and four 5-year time periods 1980-2000 and calculate efficiency measures. As they are interested in the relationship of government size and growth, they incorporate these scores then in a growth regression. They present various growth regressions that include the size of government and in addition an interaction term that involves both the size and the efficiency of the public sector. The size of government and the interaction term both have explanatory power. The authors conclusion is that "what matters to growth is not the size per se, but the size-efficiency mix" ([Angelopoulos et al., 2007](#), p. 12).

This study is organised as follows: The next section describes the use of non-parametric methods like data envelopment analysis (DEA) for the evaluation of the efficiency of production processes. The next section explains how the input and output of the public sector is measured in this study and present the data on the performance of public sector, i.e. the output. Section 4 then presents the efficiency analysis that results in a set of efficiency scores in two different samples. The smaller one contains observations from 32 countries and one year and is analysed using a Free Disposable Hull (FDH) method. For the second sample (74 countries, four 4-year period 1985-2000), a data envelopment analysis (DEA) is carried out. Section 5 then uses the efficiency scores from the larger sample to explore the relationships between efficiency on the one hand and government size and intensity of interjurisdictional competition on the other.

2 A digression on non-parametric efficiency analysis

This section reviews the basic concepts of (non-parametric) efficiency analysis and provides an overview about recent research about methodological problems.

In order to measure the efficiency of a firm (or any other organization that converts inputs into outputs), it is necessary to determine a production frontier against which the efficiency of a firm can be evaluated.³ Modern methods to measure efficiency against a "best practice

a Leviathan is a government that is not legitimate and wastes resources.

³ This section draws on [Coelli et al. \(2005\)](#), a textbook on efficiency and productivity analysis. Where necessary, more specific references are given in the text.

frontier” can be seen as a refinement of ideas already presented in the 1950s, see [Debreu \(1951\)](#); [Koopmans \(1951\)](#); [Farrell \(1957\)](#). Efficiency can be measured in output orientation (maximum attainable output given a level of inputs) or input orientation (minimum input to produce a given level of outputs).⁴

The alternative methods available for efficiency analysis of production processes differ in the way the efficiency frontier is inferred from data about inputs and outputs of a sample of firms. A major distinction is the one between parametric and non-parametric methods.⁵

Parametric efficiency analysis involves the econometric estimation of parametric functions. Whereas the estimation of a production function usually assumes a symmetric error term representing statistical noise, the idea of stochastic frontier analysis is to assume that the error term contains a one-sided component that is due to inefficiency.⁶ The advantage of a frontier analysis is that it accounts for measurement errors and other reasons why an observed production process deviates from the production frontier. Furthermore, conventional statistical tests can be applied. But this advantage is limited since one has to specify the functional form of the production function and make an assumption about the distribution of the two-component error term. From a practical point of view, stochastic frontier analysis is relatively easy to accomplish once the necessary data is available. It is implemented in specialized packages like FRONTIER ([Coelli, 1996](#)). In Stata, `frontier` and `xtfrontier` (for panel data) are well established commands.

Non-parametric efficiency analysis does not require assumptions about the functional form of the production function. The idea is to calculate the production frontier as the envelope of the observed data using linear programming. Consider a data set of an input, x , and an output, y , for five firms as in Figure 1 where the triangles represent the observed data.

The production set consists of the set

$$\Psi = \{(x, y) \in \mathbb{R}_+^p \times \mathbb{R}_+^q \mid x \text{ can produce } y\}$$

with x, y representing vectors and p (q) being the number of inputs (outputs).⁷ A standard assumption is free disposability. That means that for a given $(x, y) \in \Psi$, all (x', y') with $x' \geq x$ and $y' \leq y$ belong to the production set, where the inequalities between vectors are understood componentwise. If y consist of only one element, Ψ can also be characterised by a function $y = g(x)$ that is called the frontier function or production function. Free disposability implies that $g(x)$ is monotonously nondecreasing in inputs x . Figure 1 is a one-input-one-output example ($p = q = 1$). The functions represented by the solid, dashed and dotted lines are all examples of possible production frontiers.

⁴ An alternative to input- or output oriented measurement is to measure efficiency “non-oriented”. This concept deals with possible reductions of inputs and possible expansion of output of inefficient production units at the same time, see [Färe et al. \(1985, 1994\)](#). It is less popular than input- or output oriented models as it requires the solution of a non-linear program, see [Johnson / Mcginnis \(2006\)](#) and references therein.

⁵ Note that the aim of this study is to evaluate the efficiency (or inefficiency) of the public sector. Hence it would be of no use to estimate production functions with the underlying assumption that all firms are efficient and deviations from the production function are due to random noise. For a clarification of concepts and terms, see the box on page 8.

⁶ I keep the discussion of stochastic frontier analysis relatively short, as I do not use it. See [Coelli et al. \(2005, ch. 9, 10\)](#) for an introduction, and [Kumbhakar / Lovell \(2000\)](#).

⁷ The notation and exposition follows [Cížek et al. \(2005, ch. 12\)](#).

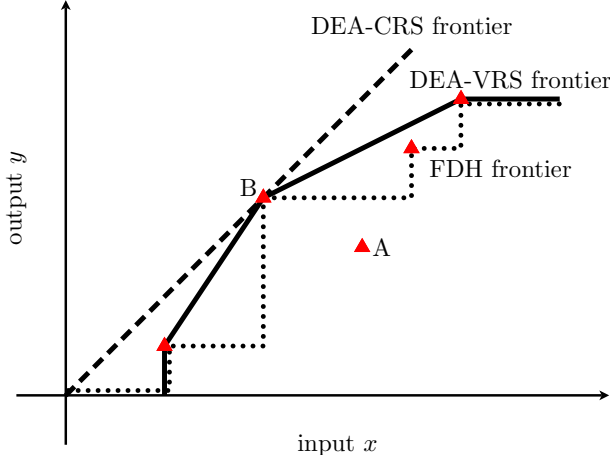


Figure 1: DEA and FDH production frontiers

As can be seen in Figure 1, returns to scale are an important property of the production set when it is used to determine the degree of efficiency. If the production set has constant returns to scale (CRS), only point B is on the efficiency border as the production function is a straight line. With variable returns to scale (VRS), the efficiency frontier envelops the data more tightly and more observations are on the efficiency frontier. Other possible assumptions are non-increasing returns to scale (NIRS) or non-decreasing returns to scale (NDRS).

Non-parametric efficiency analysis can be done either as DEA (Data Envelopment Analysis) or using the method of a FDH (Free Disposable Hull). DEA assumes convexity of the production set (a quasi-concave production function) and free disposability. DEA-methods can be further categorized with respect to the assumption about returns to scale. The seminal paper is [Charnes et al. \(1978\)](#). FDH assumes free disposability but a convex production set and has been suggested first by [Deprins et al. \(1984\)](#). In terms of Figure 1, FDH means that the production frontier is defined as step function.

The aim of both DEA and FDH-analysis is to calculate so called efficiency scores (or efficiency degrees). The calculation is based on distance functions but can also be stated as the solution to a linear programme. Consider a sample of three firms and a production process with one input, x , and one output y . Y is the 1×3 vector of observed outputs, X is the 1×3 vector of observed inputs. Then the calculation of an DEA efficiency score in input orientation, for firm k , with the assumption of constant returns to scale (DEA-CRS), means to solve a linear programme that can be stated as follows:

$$\min_{\{\theta_k, \lambda_1^k, \lambda_2^k, \lambda_3^k\}} \theta_k \quad \text{subject to} \quad (1a)$$

$$\theta_k x_k - \begin{pmatrix} x_1 \\ x_2 \\ x_3 \end{pmatrix} \begin{pmatrix} \lambda_1^k & \lambda_2^k & \lambda_3^k \end{pmatrix} \geq 0 \quad (1b)$$

$$-y_k + \begin{pmatrix} y_1 \\ y_2 \\ y_3 \end{pmatrix} \begin{pmatrix} \lambda_1^k & \lambda_2^k & \lambda_3^k \end{pmatrix} \geq 0 \quad (1c)$$

$$\theta_k, \lambda_1^k, \lambda_2^k, \lambda_3^k \geq 0, \quad (1d)$$

where k is index for the firm under consideration, θ_k is the input orientated efficiency score for

⁸ [Cížek et al. \(2005, sec. 12.1\)](#) define the distance of a point x, y relative to input and output isoquants. I skip this definition, as it is not essential for the understanding.

Definitions of a few key concepts in productivity and efficiency analysis

This box provides definitions of some concepts recurrently used in the analysis of efficiency and productivity of productions processes. This analysis is usually applied to private firms which convert inputs into outputs. But in principle, efficiency and productivity analysis can be applied to all organisations that use inputs in order to produce outputs.

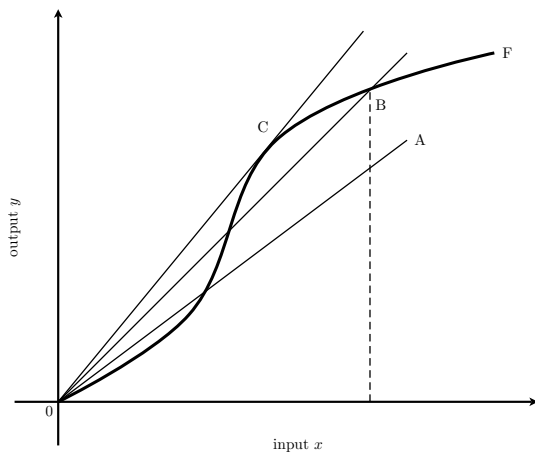


Figure 2: Productivity, efficiency and economies of scale

Productivity is the ratio of outputs over inputs: $\frac{\text{outputs}}{\text{inputs}}$ or $\frac{y}{x}$. In Figure 2, the slope of the solid straight lines measure the productivity of the input-output combinations A, B and C. When there is more than a single input and/or a single output, it is necessary to aggregate inputs and/or outputs into an index in order to calculate the productivity ratio.

Total factor productivity is a measure of productivity that includes all factors of production (labour, capital, land,...). An example of *partial factor productivity* is, for example, labour productivity.

The *production frontier* is the maximum output attainable for a given given input. In Figure 2, this is the solid line OF that reflects the current state of technology of using input x to produce

output y .

A firm that produces *technically efficiently* produces an output that is on the production frontier (points C and B in Figure 2). A firm that is producing beneath the production frontier (like the one marked with point A), is producing inefficiently. Note that the productivities of firms C and B are different.

The *feasible production set* in Figure 2 consist of all combinations of x and y on and below the line OF. An implicit assumption is that inputs and outputs are infinitely divisible.

A question that is separate from that of being efficient is whether a firm produces at its *optimal scale*. Obviously, whether there are economies of scale a firm can possibly exploit by choosing its optimal size depends on the underlying production technology. If the underlying technology is one that exhibits constant returns to scale, there is no optimal firm size and improvements of productivity can never be the result of choosing an optimal scale of production.

Technical change means a change in the state of the technology (over time), i.e. a shift of the production function OF in Figure 2.

The *possible sources of improvements in productivity* of a firm can be: a) higher efficiency by moving closer to the production frontier b) exploitation of scale economies (movement along the efficiency frontier) and c) technical change that improves the output for any given input (movement of the frontier).

Note that a profit-maximising firm that can employ several inputs to produce one (or more) outputs needs to solve the problem of an optimal input-mix. (And, additionally, that of an optimal output-mix, when there is more than one output.) This gives rise to the concept of *allocative efficiency*.

Based on Coelli et al. (2005, ch. 1)

firm k , $\lambda_1^k, \lambda_2^k, \lambda_3^k$ are weights.⁹ Choosing weights in this linear program can be seen as constructing a “hypothetical firm” that serves as the benchmark for firm k and produces on the production frontier. The condition in (1c) constrains the output of this hypothetical firm to be greater or equal to the output of firm k . Condition (1b) then states input of firm k , multiplied with the score θ_k , is smaller or equal to the input of the hypothetical firm. Condition (1d) contains non-negativity constraints. The program (1) needs to be solved for each firm k separately.

As shown, for example, in [Tulkens \(1993, pp. 187-190\)](#) other variants of DEA or FDH efficiency scores are similar linear programs. Accounting for additional restrictions on the production function means to add constraints on the weights λ . The linear program to calculate efficiency scores based on the FDH-step-function is derived by adding the constraints $\lambda_1^k + \lambda_2^k + \lambda_3^k = 1$ and $\lambda_1^k, \lambda_2^k, \lambda_3^k \in \{0, 1\}$, for example.

DEA- and FDH efficiency scores are bounded to be not greater than unity by construction. Their statistical properties (they are estimates of the production frontier) are an active area of research. It is an open question whether the numbers calculated can be seen as an accurate estimation of “true” inefficiency. [Grosskopf \(1996\)](#) is an early survey, that focuses on the relevance statistical inference of DEA/FDH-methods for applied research.¹⁰ [Cherchye / Post \(2003\)](#) discuss newer results in the literature. The discussion in the literature has several persistent topics:

noisy data, outliers The fact that DEA/FDH approaches are non-parametric means that all observed data points are considered to belong to the feasible production set. The frontier is a hull around the observed data, including possible outliers. Hence, it might be necessary to adjust DEA/FDH-estimates of efficiency frontiers for measurement error and other sources of randomness. For the detection of outliers, [Wilson \(1993\)](#) has suggested a detection method that is not based on OLS-residuals. [Simar \(2007\)](#) discusses the problems of several ideas in the literature to account for noisy data and outliers. He also proposes a “stochastic DEA/FDH approach” that performs well both in simulated examples and with real data.

bias The DEA (and also FDH) estimator of the production frontier is “obviously biased” [Gijbels et al. \(1999, p. 221\)](#)”. Consider the estimation of a production frontier, for example DEA-VRS in Figure 1. Add another observation that is above the estimated frontier. In a sample that includes this additional observation, the frontier needed to be adjusted upwards. Note that this problem is different from that of noisy data. It occurs even if the data on inputs and outputs could be considered to be without measurement or specification error. It is less severe the larger the sample is compared to the population. [Coelli et al. \(2005, p. 202\)](#) rightly stress that in the presence of statistical noise an additional bias with an undetermined direction is introduced that cannot be dealt with by bootstrapping-methods.

convergence / curse of dimensionality A very general property of an estimator is its consistency. It has been shown that both DEA and FDH-estimates of the efficiency border are

⁹ The problem can easily be extended to the case of more inputs and more outputs and a larger sample. The calculation of output oriented efficiency scores follows the same idea. See [Coelli et al. \(2005, p. 163\)](#) or any textbook on DEA analysis.

¹⁰ [Seiford \(1996\)](#) describes the evolution of DEA-refinements since [Charnes et al. \(1978\)](#). An issue that received a lot of attention in the literature but is not covered in this section is that of slacks. An input or output slack occurs in a DEA analysis because of the piecewise linearity of the efficiency frontier. Consider a production unit that has been identified as being inefficient. This inefficiency in input-orientation is then measured in comparison to the (piecewise-linear) efficiency frontier. It may happen that the implied possibility of input reduction is understated, see [Coelli et al. \(2005, p. 164\)](#) for an illustration. However, the problem is solely due to the non-smoothness of the estimated efficiency frontier. The larger the sample used in a DEA analysis is, the better is the approximation of a smooth production surface by the piecewise-linear DEA-frontier and the less severe the issue of slacks. [Coelli et al. \(2005, p. 199\)](#) therefore consider the problem of slacks to be exaggerated. See also [Ferrier / Lovell \(1990\)](#).

consistent. But the rate of convergence can be small, where the rate of convergence depends negatively on the number of inputs and outputs used, see [Banker \(1993\)](#); [Park et al. \(2000\)](#); [Kneip et al. \(1998\)](#). Especially for the FDH-method, the distribution of the estimates is known and hence in principle it is possible to infer from estimated efficiency scores to their true value and a confidence band. References can be found, for example, in [Simar / Wilson \(2000b\)](#). But this knowledge about the distribution is limited to asymptotic properties. Most studies that can be found in the literature must be considered to deal with datasets of small sample size. The increasing number of published research on the statistical properties of DEA/FDH estimates in small samples is therefore highly relevant for applied research.

bias correction / bootstrapping One way to correct the bias in a small sample used for DEA/FDH estimation is to apply bootstrap procedures. ([Simar / Wilson, 2000b](#), p. 57) argue that this is the preferred method to correct the bias and calculate confidence intervals. The alternative would be to estimate the parameters of the distribution of FDH/DEA scores. This is problematic as additional noise is introduced. In the case of DEA, the asymptotic results are limited to the one-input one-output case. The procedures suggested in [Simar / Wilson \(1998, 2000a\)](#); [Kneip et al. \(2003\)](#) are implemented in the FEAR package ([Wilson, 2007, 2008a,b](#)). Unfortunately, the implementation is limited to the DEA-method. Moreover, in a recent paper co-authored by the same authors, a new bootstrapping procedure is suggested for the case of a DEA estimation under the assumption of variable returns to scale, see [Kneip et al. \(forthcoming\)](#). It is based on new results about the distribution of the estimator in the case of an arbitrary number of inputs and outputs. This procedure has to my knowledge not yet been implemented in a software package. Overall, bootstrapping might be an alternative to methods based on estimation, especially in small samples. But to date, a common sense about a proper bootstrapping method to be applied in the various applications of DEA/FDH does not exist in the literature, especially as the literature about bootstrapping DEA/FDH-estimates is dominated by only two researchers. So far, also in terms of availability in software packages, bootstrapping is possible in the case of DEA with variable returns to scale. This is a possible cure for the bias caused by sampling variability. For FDH-analysis, [Jeong / Simar \(2006\)](#) suggest not to use bootstrapping for the bias correction, but a “smoothed” version of the FDH-estimator they claim to be unbiased. However, the problem that the DEA estimates suffer from statistical noise in the input- and output-data remains.

2-stage procedures, environmental variables A possibility to account for noise would be to use the efficiency scores as dependent variables in a regression that then allows naturally for an error term. Such a 2-stage procedure is an attempt not only to calculate efficiency score but furthermore to explain them, where statistical noise is one possible explanation.

In the DEA/FDH-literature, two-stage methods have been used to examine the impact of “environmental variables” on the performance of firms. For example, the production of vegetables depends on the general climate conditions. A general problem is whether the explanatory variables in the second-stage should be included in the DEA analysis in the first stage or not. An ad-hoc solution is to include in the first stage the variables that are “traditional inputs” under the control of the management of the firm. The variables that describe (relevant) characteristics of the environment a firm operates in are included in the second-stage, see ([Coelli et al., 2005](#), p.194)¹¹. For the case in which the 2-stage procedure is meant to account for statistical noise of the input-output data, in addition to

¹¹ Introducing environmental variables could also be seen as relaxing the implicit assumption that firm share a common technology ([Simar / Zelenyuk, 2007](#)).

environmental (or “contextual”) variables, the error term demands a certain specification known from the parametric estimation of production frontiers. [Banker / Natarajan \(2008\)](#) specify the error term “*as consisting of three distinct components: a linear function of multiple, possibly correlated, contextual variables; a one-sided inefficiency term; and a two-sided random noise term bounded above*” (p. 49). They also show that the resulting estimate is consistent. Note that the problem arising from a small bias is not addressed by this procedure. As efficiency scores are truncated, a truncated regression rather than an OLS procedure might be necessary.

There are many studies that use Tobit regressions to account for the upper bound of the efficiency scores. But the Tobit model, also known as “censored normal regression”, is applicable only in situations where in principle, observations of the dependent variable are normally distributed, but observation beyond a limit value are not observed, for example because they are censored. In a Tobit model, there are observations where the value of the dependent variable is unknown (censored) but the corresponding value of the independent variable is available. A truncated regression should be used if both dependent and independent variables are missing from the data if they meet a certain criteria. In the case of DEA/FDH estimates, efficiency scores are truncated by construction, not because of censoring. Both observations for dependent and independent variables are available. Hence the truncated regression model, not the Tobit model, correctly accounts for the upper bound of DEA/FDH estimates. See, for example [Maddala \(1992, ch. 8\)](#). See also the appendix of [Simar / Wilson \(2007, pp. 58-59\)](#) for a discussion about the choice between Tobit and truncated regression in the context of DEA analysis and why truncated regressions are to be preferred over Tobit. An alternative would be to use log-transformed efficiency scores in the second-stage, see for example [Banker / Johnston \(1995\)](#); [Puig-Junoy \(1998\)](#).

[Simar / Wilson \(2007\)](#) criticise two-stage FDH/DEA-methods as being improper: “*A [...] serious problem in all of the two-stage studies that we have found arises from the fact that DEA efficiency estimates are serially correlated. Consequently, standard approaches to inference – used in all but two of the studies we have seen that employ the two-stage approach – are invalid.*” The serial correlation is related to the small-sample bias already discussed. Changing the position relative to the efficiency frontier of one observation is likely to have an influence on the estimated efficiency of other observations. Not surprisingly, [Simar / Wilson \(2007\)](#) propose a bootstrap method that has been used in [Afonso / Aubyn \(2006a,b\)](#).

inefficiency and perfect competition DEA/FDH methods aim to describe the inefficiency of some firms relative to an efficiency frontier. This means that markets somehow are not competitive as inefficient producers would be sorted out otherwise.¹² The deviations from optimal production are an interesting information by itself. [Varian \(1990\)](#) suggests to use those deviations as a measure for the goodness-of-fit. They can also be used to think about the reasons (market-failures) that allow inefficient firms to survive, an idea already contained in [Farrell \(1957\)](#).

Summing up, DEA/FDH-tools for productivity and efficiency analysis have been widely used for a long time. But only recently have the statistical foundations been subject to closer inspection. There is no free lunch. The advantage of DEA/FDH-methods being non-parametric comes at the cost that it is much more difficult to understand the statistical properties of estimates of the

¹² A possible explanation for inefficient firms to survive can be found in a model with heterogeneous firms, differentiated products and trade. See [Melitz \(2003\)](#) for a very influential model in which the exposure to trade is a key determinant for driving inefficient firms out of the market.

production frontier and individual scores of (in)efficiency. A DEA/FDH estimator that accounts for noise and is unbiased and allows to calculate confidence bands even in small samples is not (yet) available. For applied research this means the usual caveat applies that results based on DEA/FDH should be interpreted with caution.¹³

Another point is that recent techniques are not well implemented in standard Software packages. There is a wide variety of specialized tools for DEA- and, to a lesser extent, FDH-analysis. See [Barr \(2004\)](#) for a comparison. The tool chosen for this study is **FEAR** provided at no cost by Paul Wilson ([2007](#); [2008a](#); [2008b](#)) as it is well documented and implements some of the bootstrap methodologies mentioned above.¹⁴

In this study, both FDH- and DEA-methods are used. The next section presents the data that is used to measure inputs and outputs. Then an FDH-analysis of a sample of 32 countries will be presented and the results compared to those of [Afonso et al. \(2005\)](#). DEA-methods, including bootstrapping, are used in a larger sample of 74 countries and a time span of 15 years (1985, 1990, 1995, 2000) where sufficient data about inputs and outputs could be collected. In a last step, the DEA-scores of efficiency are used as the dependent variable in a regression that aims to explore the pattern of public-sector efficiency across the 74 countries in the sample.

3 Measuring output and input of public-sector production

Efficiency analysis of any production process is based on the measurement of inputs and outputs. In case of a firm that hires workers and rents capital and other inputs and sells its products in product markets, it is, in principle, possible to observe prices and quantities of inputs and outputs or cost and revenue. For the public sector, it is not straightforward to define what the output of the production process is. Furthermore it is difficult to measure prices and quantities, especially on the output side.

The three major problems of input and output measurement in the public sector are: prices, quantities, quality. The public sector typically provides non-market goods and services, hence prices are usually not observed. As far as information about prices is available, these prices are not the result of demand and supply on competitive markets but set by the public sector. Quantities are easier to observe, but data like the number of lectures given at universities is usually not available, in particular not for cross-country studies that include non-OECD countries. Furthermore, information about the quality of public services can usually be found in case studies of very specific sub-units of the public sector for only a few countries.¹⁵ Given these

¹³ There are also attempts to develop alternative nonparametric estimators of production frontiers. See, for example, [Cazals et al. \(2002\)](#); [Martins-Filho / Yao \(2007\)](#).

¹⁴ **FEAR** is distributed as an package for R, an open-source statistical program that is widely used ([R Development Core Team, 2008](#)). However, the source code of **FEAR** is not open and it is not possible to adjust **FEAR** according to individual needs. Note that is straightforward to write a package for Stata that allows to calculate DEA/FDH-scores and efficiency frontiers. See [Baum \(2008, pp. 52-54\)](#).

¹⁵ Several statistical offices, responsible for the national accounts, explored whether quality-adjusted output measurement could be routinely done at least for some public sector activities like education. In Germany, the Federal Statistical Office (Statistisches Bundesamt) seems to be sceptical, see [Mayer \(2001\)](#) and [Statistisches Bundesamt \(2003\)](#). For the revisions in the United Kingdom in the aftermath of the Atkinson Review ([Atkinson, 2005](#)), see [UK Centre for the Measurement of Government Activity, Office for National Statistics \(2005\)](#). On the other hand, there are a number of projects in several countries and within the World Bank. A relatively recent development in this respects is the Worldwide Governance Indicators (WGI) project, see [Kaufmann et al. \(2008\)](#). In version VII, the governance indicators cover a wide range of countries and the period 1996-1997, see their website www.govindicators.org for recent developments in this project. Within the World Bank System, another rating is the Country Policy and Institutional Assessment (CPIA). It

difficulties especially on the output side, one has been willing to accept very crude measures of public sector production.

In this study, the public sector of a country is understood as a production unit that aims to provide good policy outcomes in several policy fields using tax revenue as an input. The performance of public policy is measured by variables that reflect whether a country's public sector is successful, for example, in providing health care. The measured success is then interpreted as an output measure. The inputs will be measured by public expenditure.

3.1 Output measurement: public-sector performance

The five policy fields and the variables that measure how good a public sector performs (how much output it produces) considered in this study are listed below. Summary statistics and data sources can be found in the appendix. The internal names of variables are those that are typeset in a typewriter font.

administrative quality How good is the quality of the administration? I measure this aspect of public policy by several indices contained in the *Economic Freedom of the World* published by the Fraser Institute (Gwartney / Lawson, 2007). The variables used are: *Structure and security of property rights* (efw_area2), *Access to sound money* (efw_area3), *Regulation of credit, labor, and business* (efw_area5).

education The ability of the public sector to provide education is measured by its success to provide at least elementary education for every citizen (*percentage of no schooling in the total population, adults of age 25 or older*, balee_lu) and higher education for as many people as possible (*percentage of secondary school complete in the total population, adults of age 15 or older*, balee_lsc15). The data is taken from Barro / Lee (2001).

health care The output of the health care system is measured by *life expectancy at birth* (life_exp).

infrastructure One of the major activities of the public sector is to provide infrastructure. The variables used in this study to measure infrastructure are *Air transport, registered carrier departures world-wide* (airtrans_rcdw_rel) and *Telephone mainlines* (tel_mainl), both per 1000 people.

economic stability & performance The performance of the public sector to stabilise the economy and to promote economic growth is measured by the following variables: The moving average of the annual inflation rate (inf_gdpdefl_ma), the coefficient of variation of inflation (inf_var), the moving average of real GDP per capita (pwt_cgdp_ma), the moving average of the growth rate of real GDP per capita (pwt_grgdpch_ma) and the coefficient of variation of the real GDP per capita (gdp_var). The data is taken from the Penn World Tables (PWT) and the World Development Indicators (WDI), see the appendix for further details.

evaluates the quality of a country's policies and institutional arrangements in four clusters (economic management, structural policies, policies for social inclusion and equity and public sector management and institutions). They are prepared since the 1970s, but the first year for which the numbers are published is 2005. Furthermore, it does not cover developed countries in the world and the variation in the data is not very strong. They are used internally to allocate IDA-resources among eligible countries. Hence, it is likely that the numbers are not immune against the influence of lobbying and political negotiations. The IDA (International Development Association) is one of the lending channels of the World Bank, tailored to the poorest countries in the world.

It is obvious that the selected variables provide only a crude measure of the success of public sector activities. The selection has been carried out following several guidelines. As one of the goals of this study is to check the robustness of the results in Afonso et al. (2005), I tried to maintain important aspects of their approach to the measurement of public-sector performance and efficiency. Hence, the policy fields are roughly the same as in their paper. Secondly, I tried to use similar variables for the measurement of the outcomes of public policy in the different policy fields. On the other hand, an important goal was to include as many observations, i.e. countries and years, as possible in the analysis. The core of the paper by Afonso et al. (2005) is an FDH-analysis with 23 countries for the year 2000. For the year 1990, an index for public-sector performance is calculated in addition. A potential problem with the analysis of Afonso et al. (2005) is that 23 observations are by far too few observations to overcome the curse of dimensionality problem mentioned above (see page 9). On the basis of these principles – comparability with Afonso et al. (2005) and as many observations as possible given the constraint of data availability – in mind, a panel data set containing all countries has been created, with observation from the 1950s until 2005. Then possible variables measuring the public sectors output and public expenditure have been selected, where missing values for each candidate variable reduce the panel to less years and countries. For example, the inclusion of the Gini index to measure the success of redistributive public policies makes the sample shrink considerably.¹⁶ In order to keep the sample reasonably large, many variables that are possibly better indicators of public-sector performance had to be discarded.¹⁷

In order to permit a comparison of public-sector performance across the five policy fields mentioned above, I follow Afonso et al. (2005) and calculate “Public-Sector Performance (PSP) Indicators” for each field. These indicators are calculated by centering each variable around the mean of all observations and all years and then using a unweighted average of all variables per policy field as PSP-index. The average outcome per policy field then is measured with an index value of unity. The PSP-index for a country that performs better than the average is greater than one and vice versa. Finally, an overall PSP index is calculated as the mean of the sub-indices for each country and year. More formally, consider $i \in \{1, 2, \dots, n\}$ countries, $j \in \{1, 2, \dots, m\}$ policy areas, $y \in \{1985, \dots, 2000\}$ years and $k \in \{1, 2, \dots, l\}$ variables x_{ijyk} measuring the success of public policy in country i in area j and year y . Then the index measuring the success of country i in policy area j in year y is defined as

$$PSP_{j iy} = \frac{\sum_{k=1}^l \frac{x_{ijyk}}{\bar{x}_{jk}}}{l}, \quad (2)$$

where

$$\bar{x}_{jk} = \frac{\sum_{y=1985}^{2000} \sum_{i=1}^n x_{ijyk}}{4 \cdot n}$$

is the mean of variable x_{ijyk} over all countries and the four years in the sample. $\frac{x_{ijyk}}{\bar{x}_{jk}}$ stands for the k 'th variable in policy area j , centered around the mean. The result is a panel dataset for n countries, over the year 1985 until 2000, with PSP-indices for the five policy areas and an PSP-index covering all policy areas, calculated as the average of PSP1-PSP5.¹⁸ The numbers

¹⁶ UNU-WIDER (2008) is an very useful attempt to collect and consolidate national data on income distribution. However, for the purpose of this study, not enough observations are available.

¹⁷ See, for example, Afonso / Aubyn (2006a) for a cross-country study about education provision and Afonso / Aubyn (2006b, 2007) for a similar study about national health care systems. Restricting a study to a specific public sector activity and to a subset of countries (usually the OCED) improves data availability noticeably.

¹⁸ Taking a simple average as an overall PSP-index ignores that different policy fields could be valued differently in different societies. This is ignored in the calculation of the overall PSP-index. It is therefore an output measure

are reported below.¹⁹ Note that this approach allows to compare the PSP score across countries and across time.

This approach of measuring the output of public sector activities has the advantage that it is possible to construct a large data set of output measures. But of course there are numerous problems. Obviously, policy targets in a field like education are more complex than simply increasing the number of degrees that an educational system produces. In health care, the aim is not only to increase the life expectancy. However, the choice of variables depends crucially on data availability. For this study, where the sample covers both developed and developing countries, variables were chosen in a way that provides enough potential variability for all countries in the sample. An implicit assumption is that the actual policy targets can be approximated by the variables chosen. Furthermore, the definition of the five policy fields is somehow arbitrary. For example, internal and external security have been left out although they are classic issues the public sector takes care of. This is less problematic as long as it is possible to match the policy fields on the input side. As long as the purpose of the expenditure used for the input measurement matches the policy field, leaving parts of the activities of the public sector is possible. It must be kept in mind, however, that the measurement of public-sector performance and efficiency covers only the policy fields listed above. It could well be that a country that performs badly in all areas looked at in this study performs well in other areas.

3.2 Input measurement: public expenditure

The input side of the production process in the five policy areas is measured by public expenditure. Ideally, each PSP-index is matched with functional expenditure data that is spent with the purpose to improve public policy in the same area. The availability of national expenditure data, disaggregated by purpose of spending and consolidated to account for lower than national levels of government, is very limited. For this study, the time series from the IMF Government Finance Statistics, Historical Series (consolidated government²⁰) (IMF, 2006) and the Penn World Tables (PWT) (Heston et al., 2006) have been used.²¹ The expenditure data used to match the PSP-indices in the several policy areas is:

expenditure policy area 1 - administrative quality Expenditure of the government on goods and services (`exp_imf_econ1_real`).²²

expenditure policy area 2 - education Expenditure of the government on education affairs and services (`exp_imf_4_real`).

expenditure policy area 3 - health care Expenditure of the government on health affairs and

that is based on a common standard applied to all countries, where a low output in a particular country could simply reflect that the output is not valued a lot. See footnote 29.

¹⁹ Where necessary, the variables have been recoded such that higher values reflect better outcomes. An example is the variable *percentage of no schooling in the total population*. See the appendix for details.

²⁰ The “consolidated government” expenditure data covers all national and subnational government layers.

²¹ The *IMF-GFS historical* series is in local currency. For the purpose of this study, the data has been converted in expenditure measured in percent of GDP and then multiplied with the the real gross domestic product per capita from the PWT, measured on International Dollar in current prices (International Dollar in Current Prices) (`pwt_cgdp`). Note that this version of the real GDP is comparable across countries, but not over time, see Summers / Heston (1991, p. 347) for a discussion about the relative merits of using different variants of PWT GDP data. The appendix contains a few notes about the usage of *IMF-GFS historical* series.

²² The appendix contains detailed definitions of the variables. Note that the *IMF-GFS historical* series contains both expenditure data that is categorised by function and by economic type. The expenditure data from the *IMF-GFS historical* series and from the Penn World Tables are not comparable, as they are compiled following different conventions (IMF (1986) vs. United Nations (2001)).

services (`exp_imf_5_real`).

expenditure policy area 4 - infrastructure Capital expenditure of the government. This expenditure category is used as an approximation of public investment (`exp_imf_econIV_real`).

expenditure policy area 5 - economic stability & performance Total expenditure and lending minus repayments (`exp_imf_econI_real`). The amount of total spending can be seen as a proxy for the government activities to stabilise the economy and to promote economic growth.

expenditure overall public-sector performance The IMF-GFS historical expenditure data is very limited in coverage. Therefore, I use another measure of public expenditure that covers all policy areas 1-5 and is based on the Penn World Tables only (Real government expenditure per capita, `exp_gov_pwt_pc_real`).²³ It covers final consumption expenditure as defined in the System of National accounts (SNA, see [United Nations \(2001\)](#)) and therefore excludes social transfers.²⁴ The SNA contains a broad and a narrow definition of government final consumption. The Penn World Tables are based on the broad definition that includes, for example, individual consumption goods and services like education and health care.²⁵

For the efficiency analysis to be presented below, the moving averages (current year and the four preceding years) of the six expenditure variables have been used to account for business-cycle effects. The expenditure data has been converted to real expenditure in international dollars according to the conventions in the Penn World Tables. The usage of expenditure data as a proxy for input implicitly assumes that input prices are equal across countries. This is a strong assumption but the Penn World Tables try to account for that.

The real expenditure data used is measured in per capita terms. [Afonso et al. \(2005\)](#) use expenditure data measured in percent of GDP. But in a sample where the GDP differs substantially, this is not a valid approach. A poor country that devotes, say, 10 percent of GDP to some activity commands over less real resources than a rich country that spends 10 percent of GDP to the same activity.²⁶

Obviously, the expenditure data available for this study on the one hand and the policy targets that are taken as a measure for the results of public spending on the other hand do not match perfectly. Although reasonable expenditure data is available for the policy areas of education and health care, rather crude expenditure categories need to be used for the other areas. This problem is prevalent in this study and also in [Afonso et al. \(2005\)](#). The expenditure categories

²³ It has been calculated as `pwt_rgdp1 · pwt_kg`. As this variable is used for comparisons over time, the real GDP based on a Laspeyre-Index needs to be used ([Summers / Heston, 1991](#), p. 347).

²⁴ A warning might be appropriate. As the data from the Penn World Tables follows the conventions of the SNA, that by itself is somehow special in its treatment of government expenditure (broad vs. narrow definition), the numbers from the Penn World are substantially lower than those published frequently in the media or in studies that deal with smaller samples like the OECD countries. The numbers of the government share given in the Penn World Tables are substantially lower than those frequently seen, see [IMF, Fiscal Affairs Department \(1995\)](#) for an example. They exclude expenditure for social security. They include government military expenditures that are part of governmental capital formation. The treatment of the public sector in the System of National accounts ([United Nations, 2001](#)) is rather complicated and sometimes confusing. A description of national accounting standards on an international level, such as [Brümmerhoff \(2007\)](#) for Germany, is missing.

²⁵ [United Nations Economic and Social Council \(2004\)](#) contains a useful discussion about the distinction of broad vs. narrow government consumption. The “serious defect” in applying the broad definition consistently mentioned in [United Nations Economic and Social Council \(2004, p. 6\)](#) has been corrected in the current version of the PWT.

²⁶ However, the results turned out to be roughly the same using expenditure data in percent of GDP.

used in this study are roughly the same in their paper, with the exception that redistribution as a policy field is not looked at in this study. Accordingly, the measure for overall public expenditure does not contain social transfers as well.

For the efficiency analysis presented below, one has to keep in mind that surprising results can first of all be caused by measurement error and misspecification on the input or on the output side. It is difficult to argue whether the PSP-indices used in this study systematically overestimate or underestimate the “true performance”. Also note that the preferences of citizens in the different countries are not taken into account. But even in a hypothetical country where citizens do not care much about the five policy areas that are under closer inspection in this study, there should be an interest that the public sector operates close to the efficiency border. However, when interpreting public-sector performance indices and efficiency scores, one should not confuse the utility derived from publicly provided goods and services, or the “happiness” of people, with the issue how well the public sector performs in terms of output.

3.3 Public-sector performance in two different samples

The subsequent analysis is done with two different samples. The first sample contains 32 countries in a cross section for the year 1990. These are the countries where expenditure data for all five policy areas is available. The second sample contains 74 countries and the years 1985, 1990, 1995 and 2000. A list of all countries together with their abbreviated names can be found in Table A8 in the appendix (page 37). The smaller sample is used in a FDH-analysis. I refer to it as the “FDH-sample” in the following. The results are then compared to those of [Afonso et al. \(2005\)](#). The larger sample contains the input and output data for an DEA efficiency analysis that employs the bootstrap and two-stage estimation techniques discussed earlier (section 2). It is henceforth referred to as “DEA-sample”.

Public-sector performance results (FDH-sample)

Table 1 reports summary statistics for the output measurement for the smaller sample. All PSP-indices have a mean of unity (by construction). The variation of the sub-indices differs across the five policy areas, with the subindex for health care having a very low variability. This reflects that the health care index is composed of only one variable (life expectancy) that has a mean of seventy years and a standard deviation of seven years (See the codebook in the appendix, Table A9.). The detailed results for the Public-Sector Performance can be found in the appendix (Table A12)

Variable	Mean	Std. Dev.	Min.	Max.	N
PSP area 1: Administrative Quality	1.000	0.223	0.646	1.346	32
PSP area 2: Education	1.000	0.474	0.195	2.123	32
PSP area 3: Health	1.000	0.101	0.758	1.102	32
PSP area 4: Infrastructure	1.000	0.902	0.014	2.919	32
PSP area 5: econ. stability & performance	1.000	0.416	0.131	1.710	32
overall PSP	1.000	0.370	0.465	1.667	32

Table 1: Summary statistics for the PSP indices in the FDH-sample

Figure 3 plots the overall Public-Sector Performance Index (the average of PSP1-PSP5) as a function of the KOF Index of Globalisation, an index that measures the economic, political and

cultural globalisation of a country (Dreher, 2006; Dreher et al., 2008). The plot seems to suggest that more globalized countries perform better in terms of public good and services provision. But this is of course not a statement about causal relationships. In the regression analysis presented below, globalisation will be used as a proxy for the intensity of interjurisdictional competition. The idea that interjurisdictional competition might have a positive impact on public-sector efficiency is then explored more carefully, see section 5.

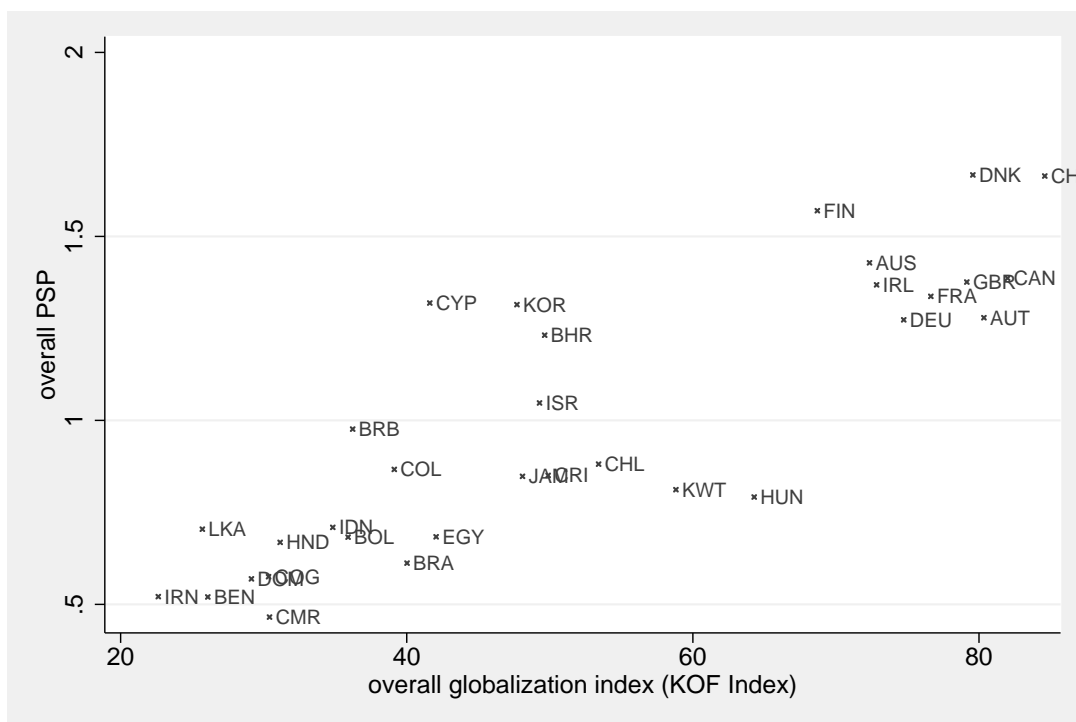


Figure 3: Public-sector performance and globalization (FDH-sample).

Public-sector performance Results (DEA-sample)

The performance indices have been calculated separately for the DEA-sample. This is necessary as the PSP-indices are relative measures that are sensible to sample selection. Table 2 reports summary statistics. The pattern of the standard deviation is similar to the one for the FDH-sample, suggesting that it is a result of the choice of variables, not one that is sample-dependent.

Variable	Mean	Std. Dev.	Min.	Max.	N
PSP area 1: Administrative Quality	1.000	0.241	0.328	1.514	296
PSP area 2: Education	1.000	0.530	0.077	2.688	296
PSP area 3: Health	1.000	0.142	0.575	1.196	296
PSP area 4: Infrastructure	1.000	1.101	0.007	5.833	296
PSP area 5: econ. stability & performance	1.000	0.581	-0.780	3.023	296
overall PSP	1.000	0.444	0.244	2.244	296

Table 2: Summary statistics for the PSP indices in the DEA-sample, 1985-2000

The DEA-sample contains four observation per country. The way the PSP-indizes are calculated implies that comparisons across time and across countries are possible. A country can

be compared against itself in different years. A closer inspection of the full list of all results – see the appendix, Table A13 – reveals that the public-sector performance has improved for most countries over time, relative to the average performance over all countries and all years. This is mainly due to improvements in area 5 (economic stability and performance), see Figure A11 in the appendix.²⁷

An overview about the geographical scope of the DEA-Sample is provided in Figure 4 showing a world map of Public-Sector Performance for the year 1990. The darker the colour of an area is, the better the performance of the public sector. Countries on the same continent tend to have similar values for public-sector performance. In Europe and North America, for example, most countries have PSP-indices in the upper quartile.

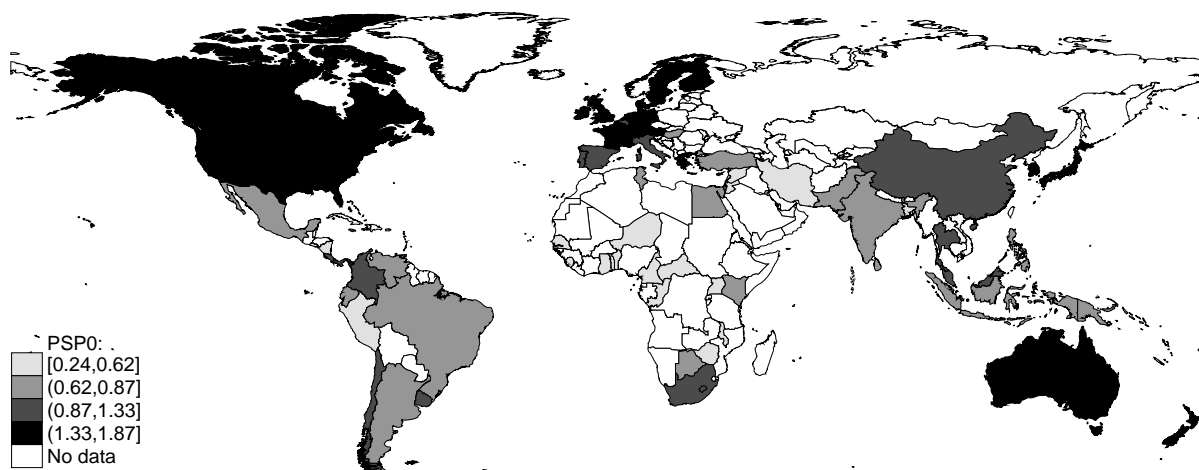


Figure 4: A world map (with blanks) of public-sector performance. (DEA-sample, 1990)

4 Efficiency analysis

A well performing public sector benefits the citizens of a country and supports production in the private sector. On the other hand, the inputs used in the public sector are lost for private consumption or as an input in private production. It is therefore important to include public expenditure in an evaluation of the public sector. This is done in the next step of the analysis, again separately for the two samples.

4.1 FDH-Analysis in the small sample

One goal of this study is to provide an robustness check for the results in [Afonso et al. \(2005\)](#). In their paper, a sample of OECD countries is analysed using an FDH efficiency estimator. Their

²⁷ All PSP-indices seem to have a trend, albeit this is difficult to judge with only four observations in the time dimension.

results suggest that countries that are small in terms of public expenditure use resources more efficiently than those with a bigger government. The robustness check will be done in a slightly larger sample, for a different year, with roughly the same policy fields. The technique is an FDH efficiency analysis in both studies.

I will calculate efficiency scores for each policy area separately. Figure 5 illustrates the FDH-method for the policy field 4 (education). Input is measured in real expenditure per capita, output by the PSP-index. The production frontier is constructed as a step function as shown in the figure. I calculate the efficiency score in output-orientation, meaning that the input is held constant. For example, the FDH-score for Cyprus (CYP) is calculated as quotient of the actual output of Cyprus divided by the output of its “peer”, Korea. Korea produces a higher output with less inputs.²⁸ As an overall efficiency score, I will use the average of the efficiency scores of the five policy fields (`fdh_av`).²⁹ The results are reported in Table 3.

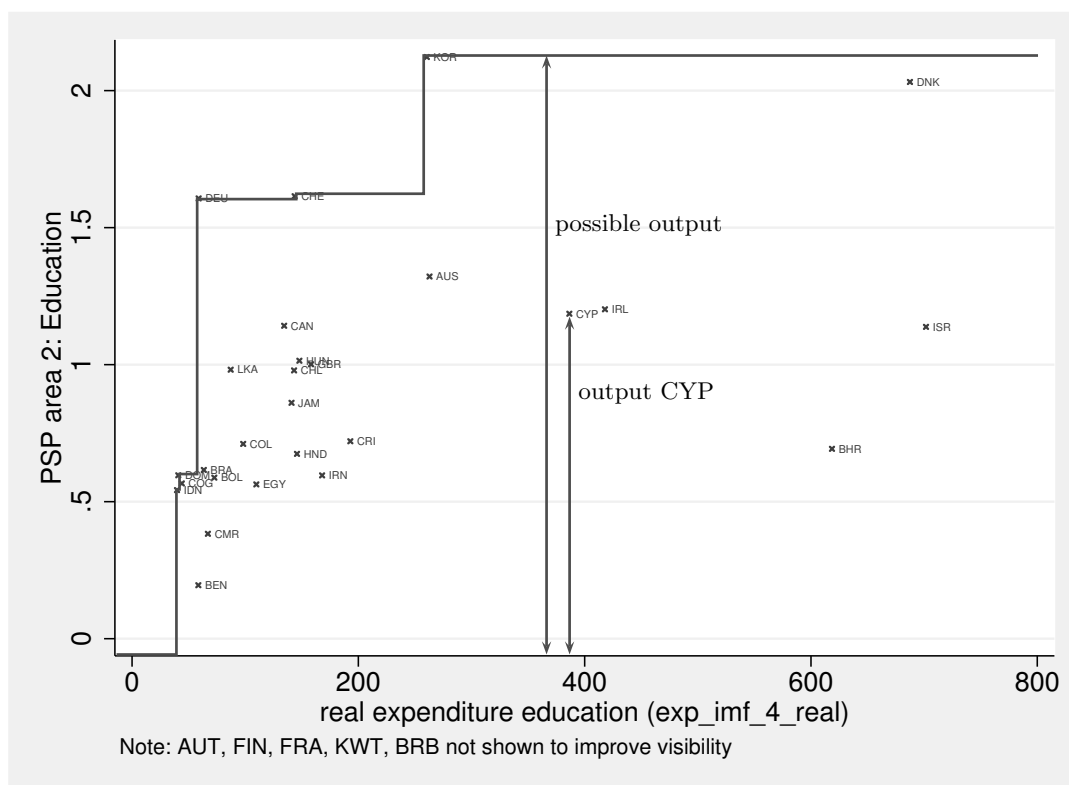


Figure 5: An illustration of the FDH-efficiency analysis

²⁸ Note that in the example, Cyprus could not only produce more output given its input. It could also reduce its input and still produce as much as Korea. This is an example of a slack, see footnote 10.

²⁹ This means that all five policy areas receive an equal weight in the overall efficiency score. I also calculated an FDH-efficiency score that takes PSP0 as an output measure and `exp_gov_pwt_pc_real` as an input measure. The results did not differ substantially, indicating that the weights attached to the different policy fields are not driving the results in the FDH-sample. Another possibility – different from assuming equal weights as I have done – to attach weights that reflect the relative importance of the different policy areas would be to rely on survey, as has been done for a study about health care system by the World Health organisation. See [Smith / Street \(2005, p. 409\)](#) and references therein.

Table 3: Public-sector efficiency for the FDH-sample. The table shows the FDH-scores for the five subareas (fdh1-5) separately and the mean of fdh1-5 as fdh_av. The table is sorted by fdh_av.

country		year	fdh1	fdh2	fdh3	fdh4	fdh5	fdh_av
CHE	Switzerland	1990	0.97	1.00	1.00	1.00	0.87	0.97
DNK	Denmark	1990	0.96	0.96	1.00	1.00	0.82	0.95
CAN	Canada	1990	1.00	0.71	1.00	1.00	0.76	0.89
KOR	Korea. Rep.	1990	0.90	1.00	1.00	0.42	1.00	0.86
FIN	Finland	1990	0.95	0.91	0.97	0.87	0.60	0.86
IRL	Ireland	1990	1.00	0.57	0.96	1.00	0.74	0.85
GBR	United Kingdom	1990	0.93	0.62	0.98	0.63	1.00	0.83
AUS	Australia	1990	0.96	0.62	0.99	0.72	0.83	0.83
BOL	Bolivia	1990	0.79	0.37	0.89	1.00	1.00	0.81
DEU	Germany	1990	0.93	1.00	0.97	0.42	0.71	0.81
IDN	Indonesia	1990	1.00	1.00	0.94	0.04	1.00	0.80
FRA	France	1990	0.93	0.52	0.99	0.57	0.91	0.79
CYP	Cyprus	1990	0.77	0.56	1.00	0.60	0.97	0.78
AUT	Austria	1990	0.95	0.65	0.98	0.46	0.77	0.76
BHR	Bahrain	1990	0.85	0.33	0.93	0.68	0.83	0.72
CHL	Chile	1990	1.00	0.61	0.98	0.17	0.64	0.68
COL	Colombia	1990	0.74	0.44	0.96	0.19	1.00	0.67
BRA	Brazil	1990	0.64	0.38	0.89	1.00	0.32	0.65
CRI	Costa Rica	1990	1.00	0.45	0.98	0.23	0.56	0.64
COG	Congo. Rep.	1990	0.76	1.00	1.00	0.07	0.40	0.64
JAM	Jamaica	1990	0.77	0.53	0.96	0.33	0.53	0.62
BRB	Barbados	1990	0.77	0.44	0.96	0.28	0.65	0.62
DOM	Dominican Republic	1990	0.72	1.00	0.95	0.08	0.34	0.62
ISR	Israel	1990	0.49	0.54	0.99	0.43	0.64	0.62
BEN	Benin	1990	0.87	0.12	0.94	0.06	1.00	0.60
HND	Honduras	1990	0.89	0.42	1.00	0.10	0.56	0.59
LKA	Sri Lanka	1990	0.74	0.61	1.00	0.02	0.49	0.57
HUN	Hungary	1990	0.72	0.63	0.93	0.12	0.41	0.56
EGY	Egypt. Arab Rep.	1990	0.83	0.35	0.87	0.04	0.67	0.55
KWT	Kuwait	1990	0.52	0.47	0.97	0.24	0.35	0.51
CMR	Cameroon	1990	0.98	0.24	0.83	0.02	0.13	0.44
IRN	Iran. Islamic Rep.	1990	0.71	0.37	0.91	0.07	0.13	0.44

On average, Switzerland has the most efficient public sector, followed by Denmark. The countries that are ranked best according to the average efficiency measure can also be found on the production frontier in several policy fields (FDH-score of 1). An interesting result is that the ranking based on public-sector performance (PSP) is similar - countries that provide high levels of public goods and services tend to have relatively efficient public sectors. A high output level is not an indicator for inefficiency.

But what about the “small is beautiful” result of Afonso et al. (2005)? Figure 6 plots the efficiency score as a function of the government share of real GDP per capita (*pwt_cg*).³⁰ The government shares of the three most efficient countries according to the FDH-analysis – Switzerland, Canada and Denmark – cannot be characterised as being small. In the group of countries with an average FDH-score above 0.8, there are countries with a public sector of different size, most of them close to the median size. At least according to the results in this study, the association of the “smallness” of the public sector with its efficiency is not justified.

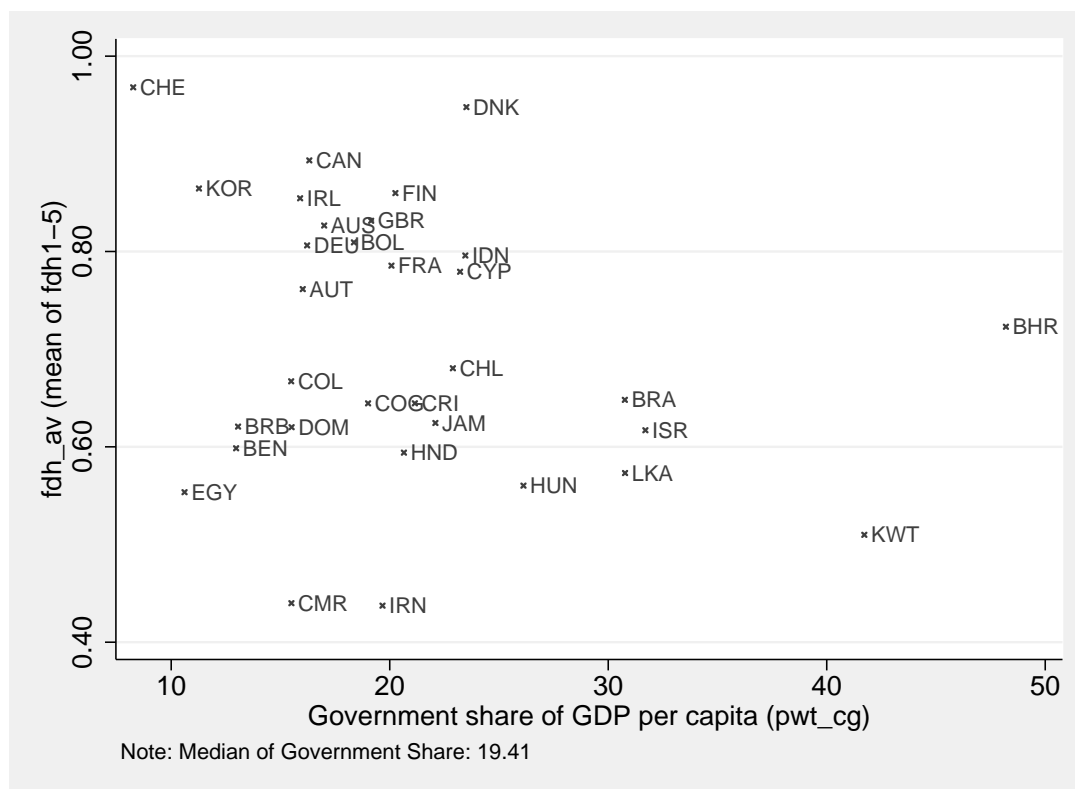


Figure 6: Efficiency of the public sector and government size. (FDH-sample)

According to Bjørnskov et al. (2007, p. 267), there are two polar views in the economics profession about the size of the public sector. According to the authors, the “neoclassical view” claims that “governments play unambiguously positive roles for individuals’ quality of life, while the theory of public choice has been developed to understand why governments often choose excessive involvement in – and regulation of – the economy, thereby harming their citizens’ quality of life.” If the latter view is correct, it would be welfare-improving if the government is decreased. One would then expect that smaller governments are more efficient, as they interfere less in the economy and less real resources can be wasted by politicians. Labelling the theory of public choice as being antagonistic to the neoclassical theory as in the quotation above is

³⁰ The government share of real GDP per capita in the Penn World Tables is calculated based on nominal expenditure taking the price level of government consumption into account. It could also be labelled “real government share”. See Knowles (2001) and Dowrick (2005) for a review and a discussion of the PWT, including a warning that the government share of poor countries might be overstated due to the calculation based on international prices. However, the variable *pwt_cg* can be seen as representing the real resources devoted to government activities. Because of the Balassa-Samuelson effect, the nominal exchange rate is undervalued in terms of purchasing power for poor countries. The government consumption typically consists to a large extent of non-traded goods and services. Therefore, the government share in the PWT for poor countries is systematically higher than that found in national accounts.

misleading. However, in the literature, there are the two mutually exclusive assumptions of benevolent governments and governments that are seen as the result of a political process and are not necessarily benevolent. The results in this study do not suggest that smaller governments are less wasteful. Hence, it does not provide support for the assumption of non-benevolent governments that should be disciplined, the smaller, the better.³¹

In the next section, the sample is increased and the method of efficiency analysis changed from FDH to DEA with bootstrapping. These efficiency scores will then be used in a regression to explore possible explanations for the diversity of efficiency-scores across countries empirically.

4.2 DEA-Analysis with bootstrapping in the larger sample

It is possible to increase the sample from 32 to 74 countries by using the overall Performance index PSP0 as the single output measure and the final consumption expenditure of the government as the single input measure.³² The DEA approach assuming variable returns to scale is used to analyse efficiency in the larger sample.³³

Variable	Mean	Std. Dev.	Min.	Max.	N
Year	1992.500	5.600	1985.000	2000.000	296
DEA score	0.622	0.164	0.145	1.000	296
bias	0.030	0.050	0.008	0.742	296
DEA score (bias corrected)	0.592	0.155	0.138	0.966	296

Table 4: Summary statistics for the DEA efficiency scores

Table 4 reports summary statistics for the DEA efficiency scores. The calculation of the DEA-scores follows a similar procedure than that for the calculation of the FDH-scores. The difference is that the efficiency frontier is not a step-function (see Figure 1 and the discussion in section 2). The output-orientation is maintained.

The bias-corrected DEA-score is the result of applying the bootstrapping procedure described in [Simar / Wilson \(2000a\)](#) and implemented in the software package **FEAR**, see the reference on page 12. DEA (and FDH) efficiency measurement is sensitive for the inclusion of individual observations. Each DEA efficiency score is relative to those of all other observations in the sample. In a nutshell, the bootstrapping procedure repeatedly draws subsamples from the 256 observations and corrects for the bias caused by the inclusion of an observation. A bias correction is calculated for each observation, additional to a confidence interval.

³¹ [Bjørnskov et al. \(2007\)](#) claim that they contribute to the resolution of the question which of the two assumptions is more realistic. They find in a regression analysis that people in countries with a smaller government are happier.

³² I checked in the smaller FDH-sample whether the better match of inputs and outputs that is possible in the smaller sample makes a big difference compared with the simpler approach used here. The results did not differ much. This can be seen as a robustness check whether abandoning detailed functional expenditure data has a big impact on the results.

³³ Variable returns to scale is assumed because for a production process like the one considered here, stronger assumptions like constant returns to scale cannot be justified by other empirical or theoretical studies. DEA with variable returns to scale fits the data almost as tightly as the FDH-approach.

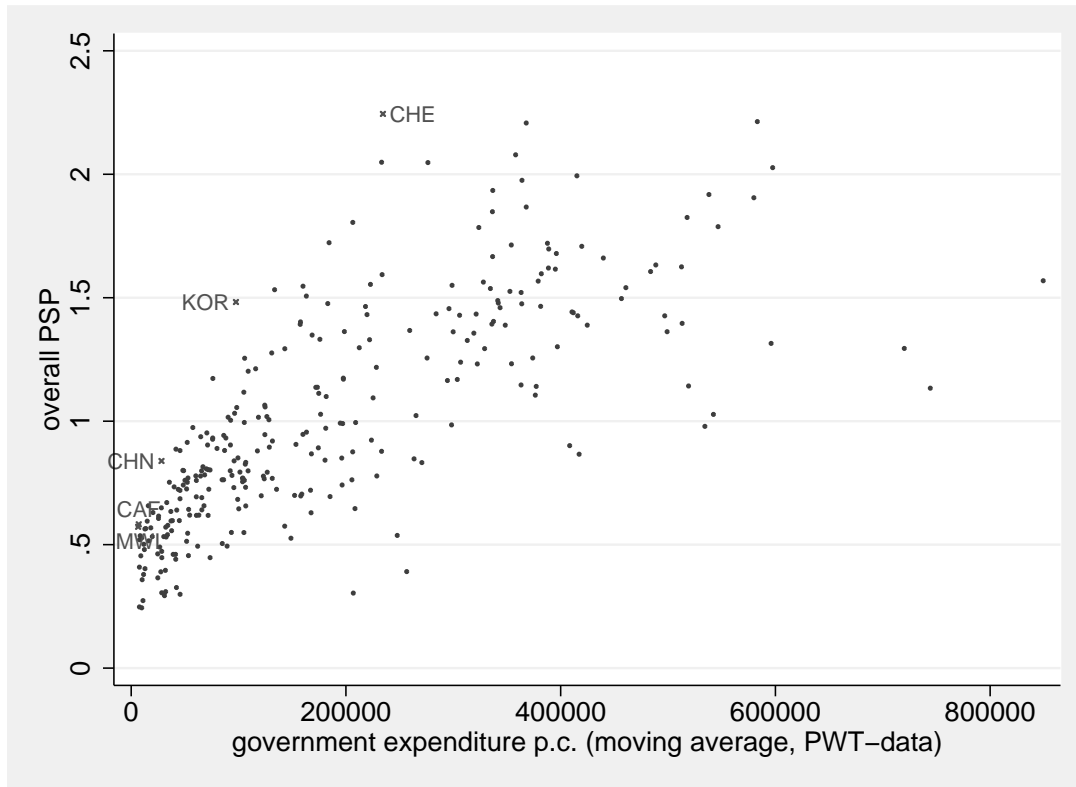


Figure 7: The efficiency frontier (DEA-sample, 1985-2000).

The list of all results can be found in the appendix (Table A14). Figure 7 plots the input and output data. The observations that define the efficiency frontier are labelled, i.e. those that receive an uncorrected DEA-score of unity. These are Malawi in the year 1985, the Central African Republic (2000), China (1985), Korea (1990) and Switzerland (2000). The bias correction is moderate on average due to the relatively large number of observations. For a few observations however, the bootstrapping procedure finds that their inclusion introduces a strong bias. Malawi in 1985, for example, is an observation where the estimated bias is particularly strong, followed by the Central African Republic in 2000. The intuition for the relatively large bias that is attributed to those two observations is the following. In a DEA analysis without bootstrapping, they are on the efficiency frontier, hence a lot of other DEA-scores are influenced by their inclusion. Taking them out of the sample has a big impact if there are not many other observation that can potentially play a similar role for the definition of the efficiency frontier. This is the case for Malawi in 1985 and the Central African Republic in 2000, but not for Switzerland in (2000).³⁴

Figure 8 plots the bias-corrected efficiency scores as a function of the KOF globalization index. A simple linear regression seems to suggest that more globalized countries are more efficient, but the correspondence is not very strong. The next section explores this and other relationships in the data more carefully.

With respect to the “small is beautiful” result of Afonso et al. (2005), which has already been checked for its robustness in the FDH-sample, the result of the DEA analysis is similar. Figure 9 plots the bias-corrected efficiency scores as a function of the government share of real GDP per capita. Again, the government share of the countries with an efficiency score close to one is

³⁴ Note that given the presence of four observations per year for each country in the sample, the bootstrapping procedure accounts for outliers in the sense that the data of a country varies a lot across time.

diverse. However, the public sectors of a few countries with a very high government share operate far below the efficiency frontier.

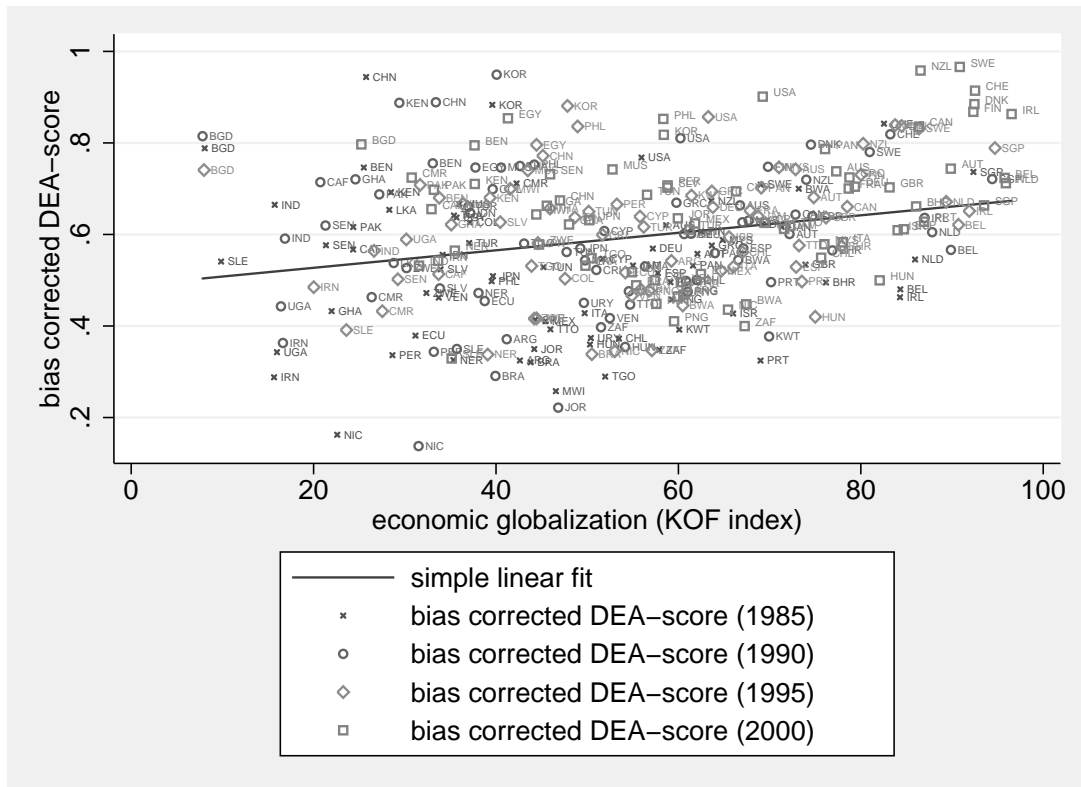


Figure 8: Public-sector efficiency and economic globalization (DEA-sample, 1985-2000).

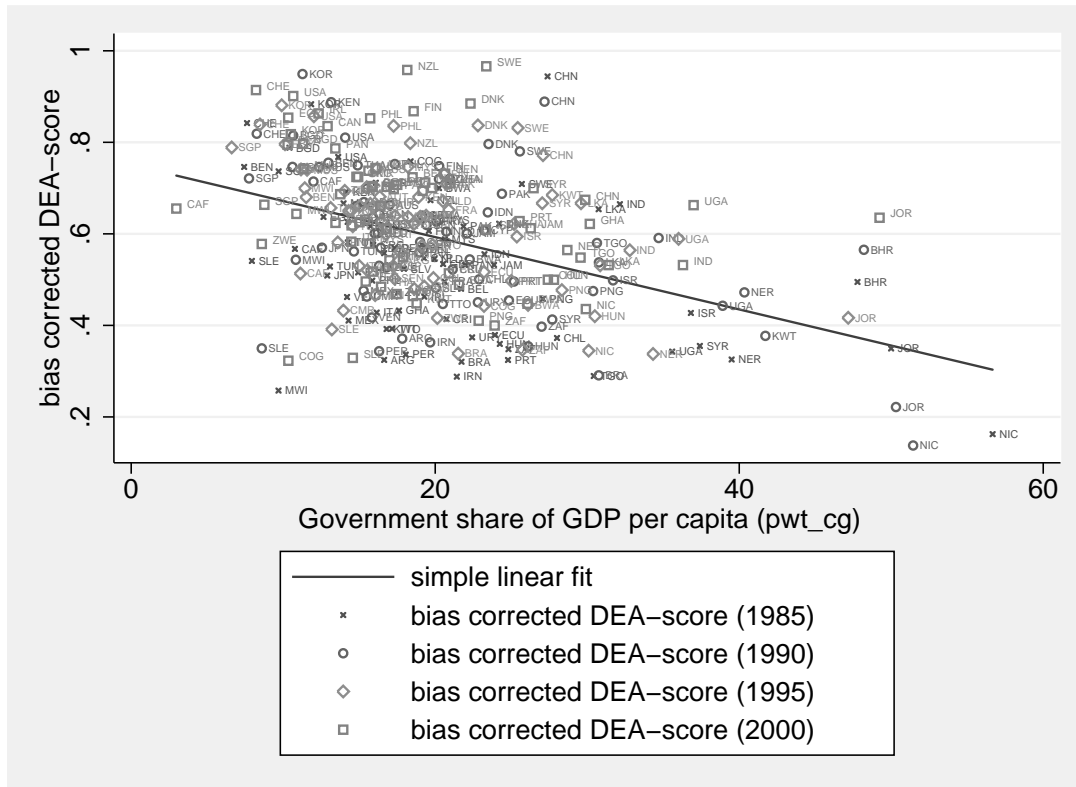


Figure 9: Public-sector efficiency and government share (DEA-sample, 1985-2000).

5 Public-sector efficiency and interjurisdictional competition – a second-stage estimation

In a DEA efficiency analysis, a second-stage estimation can be used to not only measure inefficiency of firms (or countries), as has been done in the last section, but to explain it, see section 2. The idea is that there might be circumstances that are not under control of decision-making units responsible for the organisation of the production process. In the context of this study, such circumstances are obvious. To build a railway line is much more difficult in a mountainous country (Switzerland, Nepal) than in a country with a relatively flat topography (Belgium, Netherlands).

In the theory of fiscal federalism, it has been argued that a possible determinant of public-sector efficiency is the intensity of interjurisdictional competition for a mobile tax base. From a theoretical point of view, the influence can go in both directions, depending on the set of assumptions used. For example, in [Becker \(2005\)](#), where the government is assumed to be a welfare maximiser and public-sector efficiency depends on past investment, tax competition harms efficiency. The opposite effect is also possible, see, for example, [Edwards / Keen \(1996\)](#); [Rauscher \(2000\)](#); [Wilson \(2005\)](#). In a growth model, [Rauscher \(2005\)](#) finds that it depends on the elasticity of intertemporal substitution whether “taming of the Leviathan” occurs. The theoretical work on the issue of interjurisdictional competition as a determinant of public sector efficiency so far does not come to an unambiguous result. The goal of the estimation presented below is not to provide a test which of the two conflicting views is supported by the data. Given the data available, it is not possible to simulate a ceteris paribus experiment that controls for the assumptions usually taken in theoretic work about public-sector modernisation. But

“letting the data speak” can give an idea about the importance and the sign of the intensity of interjurisdictional competition as an explanatory variable.³⁵

As a measure for the intensity of public-sector modernisation, I use the *KOF index of globalization* (Dreher, 2006; Dreher et al., 2008). Ideally, one would like to measure factor mobility, i.e. the ease of relocating taxable production factors to another jurisdiction. This measure should not be based on, for example, actual cross-border flows of capital. The actual flows of capital do not necessarily reflect that even with zero flows, there could be a credible threat of moving capital out of a jurisdiction.³⁶ In theoretical models of capital-tax competition with perfect capital mobility and identical jurisdictions, there are not necessarily cross-border flows of capital in the (long-run) equilibrium. But this does not mean that capital does not flee the country in which capital tax rates are raised.³⁷ The KOF data on globalisation contains sub-indices about economic, social and political globalisation. The economic globalisation index is compiled from data about actual flows but also about restrictions for trade and capital account transactions. I use the overall globalisation index (`kof_index`) as a proxy for the mobility of the tax base, which in turn is a measure for the intensity of interjurisdictional competition. The reasoning behind is that the political and social dimension of the index captures barriers to mobility like language and cultural differences or difficulties for foreign investors to adjust to another political system (Persson / Tabellini, 1992; Gordon / Bovenberg, 1996).

Other possible explanatory variables that have an impact on public sector efficiency are population density and two variables capturing attributes of the political system. Population density (`pwt_pop/landarea`, 1000 people per sq. km) is a proxy for the urbanisation of a country. Whether the urbanisation of a country offers cost-advantages or disadvantages is not clear per se. The degree of agglomeration has an influence on property prices and transport costs for example, but the overall effect on the efficiency of public goods and services production is ambiguous, see, for example Geys et al. (2007, p. 10). A political variable considered is the Herfindahl-index of all political parties (`pn_herftot`). The reasoning behind the inclusion of this index is that a higher concentration of political parties implies less political competition and hence lower public-sector efficiency. While the KOF index of globalisation might be a proxy for the elasticity of mobile tax bases internationally, it does not capture whether there is competition within the country between different subnational jurisdictions. I therefore include a federalism index (`pn_Gerring`) as another political variable. The theoretical literature about fiscal federalism and public-sector efficiency can be interpreted as statements about competition between countries or between lower levels of government. The expected sign of the coefficient is therefore ambiguous, for the reasons discussed above.

I include time dummies in all regressions (`year1990`, `year1995`, `year2000`). The regression analysis is done as a pooled cross section, hence including 296 (74 countries and 4 years)

³⁵ Oates (1985) tests whether the size of government is smaller in decentralised countries. The idea is that in decentralised countries, the intensity of interjurisdictional countries should be higher and therefore, the public sector should be smaller in decentralised countries if it is correctly described as a Leviathan that needs to be tamed. He doesn't find evidence for the Leviathan hypothesis and concludes that "Perhaps, after all, Leviathan is a mythical beast" Oates (1985, 756). See also Oates (1989) and Anderson / van den Berg (1998) for a recent test that does not find evidence for the Leviathan hypothesis.

³⁶ Hence, measures of capital mobility based on the correlation between domestic savings and investment (Feldstein / Horioka, 1980) are not appropriate in this context. They should be seen as measures of *actual* capital mobility, not of *potential* capital mobility. Coakley et al. (1998) review the literature about the claim of Feldstein / Horioka (1980) that capital mobility is relatively small. See Hoffmann (2004); Caporale et al. (2005); Christopoulos (2007); Evans et al. (2008) for recent re-estimations of the Feldstein-Horioka regression.

³⁷ See, for example, Wilson (1986, p. 300), for a model where it is only the *potential* of capital movements that matters for local governments when choosing their policy. Of course there are many models where even in equilibrium, capital goods are traded. Davies (2003) is an example. But the essential point here is that the actual flows of capital are not a good measure of the intensity of capital tax competition.

observations of the dependent variable, the bias-corrected DEA efficiency score. The time dummies capture possible time trends in the pattern of efficiency scores.³⁸ Furthermore, dummies for the continent a country belongs to are included as possible explanatory variables. They allow to answer the question if the pattern of public-sector efficiency is similar to the geographic dispersion of countries, perhaps because they share a common culture and history.

Another characteristic of the data is that it contains several observations per country. This construction has the advantage that the number of observations is multiplied by four compared with a procedure that looks at every year separately. The disadvantage is that a country in different years is treated as if it was a different country. This ignores that it is very likely that a country that performs well in 1985 performs similar well in later years. It can be expected that the variance of the residual is not constant. I am therefore using robust standard errors. A simple correlation matrix (not reported) does not indicate any problems with multicollinearity. As has been argued above, see page 10, I am using a truncated regression approach, where the upper limit of the dependent variable is set to one, the maximal possible efficiency score.

The selection of the estimated model follows a general-to-specific approach, where the main explanatory variable of interest is the index of economic globalisation. In the absence of an identification strategy, significance of globalisation – a proxy for the intensity of interjurisdictional competition - would allow the statement that a relationship between public-sector efficiency and interjurisdictional competition cannot be denied given the data I have. A statement about causality is not possible.

Equation (1) in Table 5 corresponds to the simple linear fit in Figure 8. Economic globalisation is a highly significant explanatory variable.³⁹ As for all other equations, the lower part of the table reports summary and diagnostic statistics. Under the heading “sigma (St.E. of Estimate)”, the estimated standard error of the regression is reported. The lower the estimated value is, the better the fit of the regression. The log pseudo-likelihood can be used as relative measure to compare different models. A higher value indicates that the fit of the model is better. And, finally, I report the Wald Chi-Square statistic. It can be used to test the hypothesis that the coefficients for all variables in the model (except the constant) are equal to zero. This hypothesis can be rejected for all regressions with a probability value of 1% or less.

Equation (2) is the most general model estimated. It includes all variables that are possible explanatory variables. Globalisation remains a significant variable. Most of the time and regional dummies are significant. The goodness of fit of the model is improved compared to model (1). The time dummies and a few of the continent dummies are significant. For the political variables, I do not have observations for all countries. Hence, they are left out in model (3) and will be considered separately. In equation (3), the globalisation measure, the government share and population density are significant. Most regional and all time dummies are significant as well. Equation (3) in Table 5 indicates⁴⁰ that the pattern of inefficiency in the sample can be explained by

- Time. Efficiency is higher in later years. For example, observations from the year 2000 on

³⁸ Note that four observations in time are not suitable to perform a time-series analysis. Hence a pooled regression has been chosen to increase the number of observations.

³⁹ I use the term “significant” when p-values are 10% or less.

⁴⁰ Equation (3) can be seen as the “best” model. The selection of models has been done with having in mind [Sala-I-Martin \(1997\)](#) who argues in favour of running multiple regressions and looking out for variables that are good predictors “on average”. The main variables of interest, the globalisation index and the percentage government share, are never dropped. Moving from model (1) to (2) and (3) shows that the inclusion of additional variables improves the goodness of fit. Dropping insignificant variables has not to be considered in model (3). Note that dropping a single continent dummy changes the reference group and is therefore not advisable.

average improved their efficiency score by roughly 0.09 percent.

- **Continent.** The continent dummies are in most regressions (reported and unreported) significant. The reference group consists of the pacific countries. This suggests that public-sector efficiency is partly driven by common characteristics of countries located on the same continent, such as climate conditions or a common history.
- **Population density.** Countries in the sample that are sparsely populated are less efficient. The population density variable is very stable in the several models I looked at.
- **Percentage Government Share.** Countries in which the government claims less real resources in percentage of GDP tend to have a more efficient public sector. The effect is very stable but of moderate size.

Table 6 reports the base regression (2) with all variables for easier reference, followed by three other equations that explore the political variables. Model (5) is an equation that includes the Herfindahl index of political fractionalisation and the unitary (inverse federalism) variable, together with the globalisation index and the government share. Population density has been left out as it is insignificant in model (2). From the two political variables, only the unitarism index is significant. This does not change if the continent dummies are left out, see equation (6). Globalisation, gains significance in this step, indicating that the pattern of globalisation across continents is not uniformly distributed. Equation (7), finally, is a model without the Herfindahl Index. I could not find a significant association of political fractionalisation with efficiency in all models I tried. The unitary (inverse federalism) variable, however, seems to be a useful predictor of public-sector efficiency.⁴¹

The additional results from Table 6 are:

- **Globalisation.** The globalisation index is significant in model (3) that excludes political variables. In the models that include political variables, globalisation is not a very stable predictor. Overall, there is weak evidence that globalisation has a positive but small impact on public-sector efficiency.
- **Unitarism (inverse federalism).** Among the political variables I tried, the unitarism measure proved to be the only one with explanatory power. The public sector of more centralised countries seems to be more efficient.

An issue that has not been covered so far is privatisation of public sector activities. Imagine a government that decides to cut spending on, for example, health care to a very low level. The variable measuring output (life expectancy) cannot be expected to drop proportionally, as people will spend private income on health care. A similar argument applies to all policy areas covered. One could therefore expect that countries where the provision of many public services and goods is not paid for with government expenditure systematically are more efficient than others where privatisation is less important. To capture this effect, I calculated a “privatisation index” that relies on private versus public expenditure on health care and education, using data from the World Development indicators and the UNESCO. I did not find evidence that this index explains the pattern of measured inefficiency in my sample. A possible reason could be that the impact of privatisation is covered by other variables like the continent and time dummies. Or, more likely, that the index I calculated is not appropriate.

⁴¹ I also tried the democracy and human rights indices from [Freedom House \(2008\)](#) and several other variables describing the political system covered by [Norris \(2008\)](#), but could not find a model where these have explanatory power.

	(1)	(2)	(3)
Variables:			
overall globalization index (KOF Index)	0.003*** (0.000)	0.001 (0.001)	0.002* (0.001)
Perce. Gov. Share (pwt_cg)		-0.008*** (0.001)	-0.007*** (0.001)
Population Density		0.059 (0.052)	0.091* (0.048)
Herfindahl Index political fractionalisation		0.010 (0.049)	
Unitarism index (Gerring-Thacker)		0.011** (0.005)	
Asia (dummy)		0.335 (0.239)	0.462** (0.212)
Australia (dummy)		0.414* (0.243)	0.537** (0.222)
Caribbean (dummy)		0.246 (0.235)	0.373* (0.213)
Europe (dummy)		0.291 (0.234)	0.416** (0.212)
Latin America (dummy)		0.205 (0.246)	0.327 (0.220)
North Africa (dummy)		0.319 (0.246)	0.471** (0.222)
North America (dummy)		0.404* (0.242)	0.518** (0.221)
Sub Saharan Africa (dummy)		0.277 (0.245)	0.412* (0.220)
year1990		0.054*** (0.021)	0.048** (0.021)
year1995		0.071*** (0.023)	0.056*** (0.021)
year2000		0.096*** (0.026)	0.079*** (0.025)
Constant	0.447*** (0.027)	0.271 (0.270)	0.175 (0.231)
sigma (St.E. of Estimate)	0.148*** (0.006)	0.111*** (0.005)	0.119*** (0.006)
Observations	296	262	296
Pseudo Log-Likelihood	151.790	206.685	215.003
Wald Chi-Square	37.808	317.653	308.396

Notes: Robust standard errors in parentheses. Significance: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Truncated regressions, upper limit set to 1. Estimation with robust Standard-Errors.

Point estimates of coefficients and standard errors rounded to three digits.

For the time-dummies, the reference year is 1985.

For the continent dummies, Pacific is the reference category.

Table 5: Regression results with environmental variables (dependent variable: bias-corrected DEA-scores). Models (1)-(4)

	(2)	(5)	(6)	(7)
Variables:				
overall globalization index (KOF Index)	0.001 (0.001)	0.001 (0.001)	0.002*** (0.000)	0.001 (0.001)
Perce. Gov. Share (pwt_cg)	-0.008*** (0.001)	-0.008*** (0.001)	-0.008*** (0.001)	-0.008*** (0.001)
Population Density	0.059 (0.052)			
Herfindahl Index political fractionalisation	0.010 (0.049)	0.009 (0.049)	0.019 (0.038)	
Unitarism index (Gerring-Thacker)	0.011** (0.005)	0.011** (0.005)	0.012* (0.006)	0.011** (0.005)
Asia (dummy)	0.335 (0.239)	0.053 (0.064)		0.049 (0.052)
Australia (dummy)	0.414* (0.243)	0.123** (0.056)		0.119** (0.048)
Caribbean (dummy)	0.246 (0.235)	-0.034 (0.056)		-0.037 (0.052)
Europe (dummy)	0.291 (0.234)	0.009 (0.052)		0.005 (0.041)
Latin America (dummy)	0.205 (0.246)	-0.086 (0.062)		-0.094* (0.049)
North Africa (dummy)	0.319 (0.246)	0.026 (0.056)		0.023 (0.052)
North America (dummy)	0.404* (0.242)	0.115* (0.059)		0.110** (0.054)
Sub Saharan Africa (dummy)	0.277 (0.245)	-0.015 (0.064)		-0.024 (0.057)
year1990	0.054*** (0.021)	0.056*** (0.021)	0.053** (0.023)	0.053*** (0.020)
year1995	0.071*** (0.023)	0.075*** (0.022)	0.069*** (0.022)	0.065*** (0.022)
year2000	0.096*** (0.026)	0.102*** (0.025)	0.092*** (0.023)	0.092*** (0.026)
Constant	0.271 (0.270)	0.573*** (0.107)	0.531*** (0.057)	0.596*** (0.082)
sigma (St.E. of Estimate)	0.111*** (0.005)	0.112*** (0.005)	0.124*** (0.005)	0.114*** (0.005)
Observations	262	262	262	275
Pseudo Log-Likelihood	206.685	205.852	179.212	211.081
Wald Chi-Square	317.653	323.052	142.580	345.102

Notes: Robust standard errors in parentheses. Significance: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Truncated regressions, upper limit set to 1. Estimation with robust Standard-Errors.

Point estimates of coefficients and standard errors rounded to three digits.

For the time-dummies, the reference year is 1985.

For the continent dummies, Pacific is the reference category.

Table 6: Regression results with environmental variables (dependent variable: bias-corrected DEA-scores). Models (2),(5)-(7)

The regression analysis so far has dealt with the levels of efficiency scores. To investigate the dynamics of public-sector modernisation, Table 7 reports models where the dependent variable is the change of public-sector efficiency between 1985 and 2000. For the independent variables, I took the values from 1985. Regression (8) contains only the globalisation index, the government share and a constant. Countries that in 1985 were more globalised made more progress in terms of public-sector efficiency during the 15 years covered in the sample. The constant, representing a trend, is not significant. A regression that contains all possible explanatory variables, model (9), has a better goodness of fit. Model (10) is derived by subsequently leaving insignificant variables out of the model. Whereas for the levels of public-sector efficiency the continental dummies have a relatively high explanatory power, this is reversed when the change of public-sector efficiency is considered. I could not find a model specification where the continental dummies have explanatory power. The Unitarism-Index and the government share proved to be stable in the models I tried. Its sign indicates that more centralised countries are more successful in improving public-sector efficiency. This is in line with [Kotsogiannis / Schwager \(2006\)](#), who argue on theoretical grounds against the popular idea that more federalised countries have advantages in creating policy innovations.⁴²

The time span covered in this study is too short to inspect dynamic properties of the measured efficiency-scores more closely, especially as public-sector modernisation presumably must be thought of as a slow process. But it is an interesting result that the explanatory variables affect the levels and the change of public-sector efficiency differently. Whereas for the level of public sector efficiency, the continent dummies are important predictors, both in terms of significance and size, this is not true for the change, i.e. the modernisation of the public sector. This suggests that the issue of public-sector modernisation is one where the distinction of stocks and flows really matters.⁴³ A more thorough analysis of the dynamic properties of public-sector efficiency, based on a longer period of time, could investigate whether there is long-run equilibrium of public sector efficiency. The results in this study suggest that there is no tendency that countries with a less efficient public sector are improving faster. Hence, a convergence of public-sector efficiency cannot be expected.

⁴² See [Inman / Rubinfeld \(1997\)](#) for an overview of the literature about federalised countries as a “laboratory” for policy innovations and [Kollman et al. \(2000\)](#); [Strumpf \(2002\)](#).

⁴³ Note that this distinction is explicitly made in [Becker \(2005\)](#).

	(8)	(9)	(10)
Variables:			
overall globalization index (1985, KOF)	0.003*** (0.001)	0.001 (0.002)	0.003*** (0.001)
Perce. Gov. Share (pwt_cg)	0.004*** (0.002)	0.004** (0.002)	0.004** (0.002)
Pop. Density		-0.033 (0.029)	-0.066*** (0.013)
Herfindahl Index political fractionalisation		-0.091 (0.091)	
Unitarism index (Gerring-Thacker)		0.029*** (0.010)	0.023** (0.010)
Asia (dummy)		-0.046 (0.084)	
Australia (dummy)		0.133 (0.091)	
Caribbean (dummy)		0.113 (0.083)	
Europe (dummy)		0.080 (0.098)	
Latin America (dummy)		0.094 (0.076)	
North Africa (dummy)		0.148** (0.076)	
North America (dummy)		0.137 (0.107)	
Constant	-0.084 (0.060)	-0.128 (0.104)	-0.188** (0.074)
sigma (St.E. of Estimate)	0.149*** (0.016)	0.131*** (0.019)	0.138*** (0.018)
Observations	74	62	68
Pseudo Log-Likelihood	35.986	38.097	38.405
Wald Chi-Square	17.538	335.005	99.213

Notes: Robust standard errors in parentheses. Significance: * p < 0.10, ** p < 0.05, *** p < 0.01.

Truncated regressions, upper limit set to 1. Estimation with robust Standard-Errors.

Point estimates of coefficients and standard errors rounded to three digits.

Table 7: Regression results with environmental variables (dependent variable: change in bias-corrected DEA-score 1985-2000). Models (8)-(10).

6 Conclusions

This study explores empirically the efficiency of the public sector of a large set of countries. Furthermore, it uses a regression analysis to explain the pattern of public sector (in-)efficiency. The focus here is on the “small-is-beautiful”-result found in [Afonso et al. \(2005\)](#) and on globalisation as a proxy for the intensity of interjurisdictional competition between countries. The regression analysis shows that the level of public-sector efficiency can partly be explained by continent dummies, suggesting that common history and cultural background are important factors. Smaller governments in the sample systematically have more efficient public sectors, what can be seen as support of the “small-is-beautiful”-result. Furthermore, it cannot be said that smaller countries tend to be closer to the efficiency border. The bulk of countries that are close to the efficiency border achieve this with a public sector of medium size, compared to all countries in the sample. More globalised countries also tend to be more efficient, albeit the effect is, again, not very sizable. Hence this can be seen as only mild evidence that the intensity of interjurisdictional competition plays a crucial role in the determination of public sector efficiency. Furthermore, it could be shown that the more centralised countries in the sample are more efficient. The effect is again not very big. But overall, the efficiency scores calculated in this study do not show a pattern that would be consistent with the idea that public sector efficiency is better when the degree of interjurisdictional competition (either between countries, or, within countries, between local jurisdictions) is higher. Over time, public sector efficiency has improved on average in the full sample of 74 countries. While continent dummies played an important and sizable role in explaining the level of public sector efficiency, this is not true for the change between 1985 and 2000.

Even if the “small-is-beautiful”-effect could have been shown to be sizable and significant, it would not be clear whether the result was useful in terms of policy advice. One might be tempted to suggest that an inefficient public sector should be scaled down to improve efficiency. In the terminology of an DEA-analysis, the diagnosis would be that a public sector that is large and inefficient is not scale-efficient. But this study is not dealing with private firms, where an optimal firm size might exist. The size of the public sector cannot be optimised following standard optimisation rules that can be applied to private firms.⁴⁴ How much the public sector spends to produce public goods and services is a political decision. Still, given that a society somehow has decided to spend a particular amount of tax revenue for education, health care and other policy fields, it is an important information whether the achieved outcome is as high as possible, compared to the efficiency frontier.⁴⁵

[Stone \(2002\)](#) formulates a harsh criticism of DEA and stochastic frontier analysis being applied to the efficiency of public services. Many of his recommendations apply to any empirical analysis, but his major point is that for the evaluation of public sector efficiency, one ideally would need to know how a society weights different goods and services. In this study, I chose to attach equal weights to policy fields – assuming that all policy fields are equally important in a social welfare function – and to all output measures – assuming that in the several policy fields, all societies weight the importance of a particular output similar. If efficiency scores for a particular country were to be criticised, the easiest defence would be to claim that the country, for example, defines its success in the area of health care not in terms of life expectancy at birth but tries to minimise the number of illnesses in a life span. It is not possible to account for this kind of criticism in a study like this that deals with a large variety of countries from all over the globe. Hence, the results for the countries should be interpreted with care. If a country is marked as a bad performer, or as inefficient, this is only a first indicator that the production of goods and services of the public sector is malfunctioning. See also [Smith / Street \(2005\)](#) for a discussion of the interplay of scientific studies of organisational efficiency and policy.

The best approach to gain an insight into the specifics of a particular country or a particular policy field seem to be studies that deal exclusively with the specific problems associated with, for example, the

⁴⁴ Hence, statistical tests that try to infer the scale properties of a production process from the data in the context of an DEA- or FDH-analysis – see [Banker \(1996\)](#); [Briec et al. \(2000\)](#); [Soleimani-damaneh et al. \(2006\)](#) – are not used above. Instead, I assumed variable returns to scale to enclose the data as tightly as possible. Especially for a study like this one, where the production process under inspection is as complex as policy-making, the concept of returns to scale is in my view not applicable.

⁴⁵ In the sample used for this study, the governments with a relatively high government share of GDP could be asked why they do not perform as well as Switzerland in 2000, see [Figure 7](#).

educational system in Germany. The Atkinson Review ([Atkinson, 2005](#)) surely provides more insight into the functioning of the public sector in Great Britain than any cross-country study of the type presented here can ever attain. But this does not mean that cross-country studies that compare the performance and efficiency of the public sector and are (necessarily) based on indicators chosen by the researcher are useless. They reveal common features and patterns in the operation of public sectors, for example in the case of this study, that globalisation seems to improve the efficiency of the input-usage of the public sector, but only mildly. An output-oriented efficiency measurement as it has been done in this study could be used to identify those countries that potentially can serve as a role model for others and that are similar in terms of the inputs that are used for the production of public goods and services. Overall, this study – and other that apply FDH- or DEA-methods to cross-country data – should be seen as an attempt to gain an oversight about the efficiency of public sectors that suggest where a more detailed analysis might be interesting.⁴⁶ It would be a crude misinterpretation to take the numbers presented here literally for the individual countries.⁴⁷ Even worse would be to base political decision solely on a study like this one.⁴⁸

After having mentioned at several places the caveats of DEA-efficiency measurement in a cross-country context, a robustness check might be interesting. How well do the bias-corrected DEA efficiency scores show a similar picture than other attempts to evaluate the efficiency of the public sector? The Worldwide Governance Indicators (WGI) project, see [Kaufmann et al. \(2008\)](#), aggregates in its recent edition 340 variables from 35 different sources into common indicators. Figure 10 shows the relationship between their index for government effectiveness and the bias-corrected DEA efficiency scores for the year 2000. There is a positive correlation between both indices that seems to be strong enough to claim that the efficiency scores calculated in this study are surprisingly robust and reliable when compared with [Kaufmann et al. \(2008\)](#).

⁴⁶ That the specifics and details matter when it comes to policy advice is also acknowledged in the final report of the Commission on Growth and Development, see [Commission on Growth and Development \(2008\)](#) and [Rodrik \(2008\)](#).

⁴⁷ See [Starck \(2007\)](#) for an example of a politicians that could not resist. He argues that the public sector should not exceed the size of 35% and could still attain core objectives. This number is based on a rough calculation of a possible government share of a hypothetical country, that is a “best performer” and at the same time a “low spender” in each of several policy fields including education, infrastructure investment and redistribution. See also [Heipertz \(2007\)](#).

⁴⁸ In the words of one of the commentators to [Stone \(2002\)](#): Reports that contain efficiency indices similar to those calculated in this study, should not “hide political values behind a technical smoke-screen” ([Stone, 2002](#), p. 423).

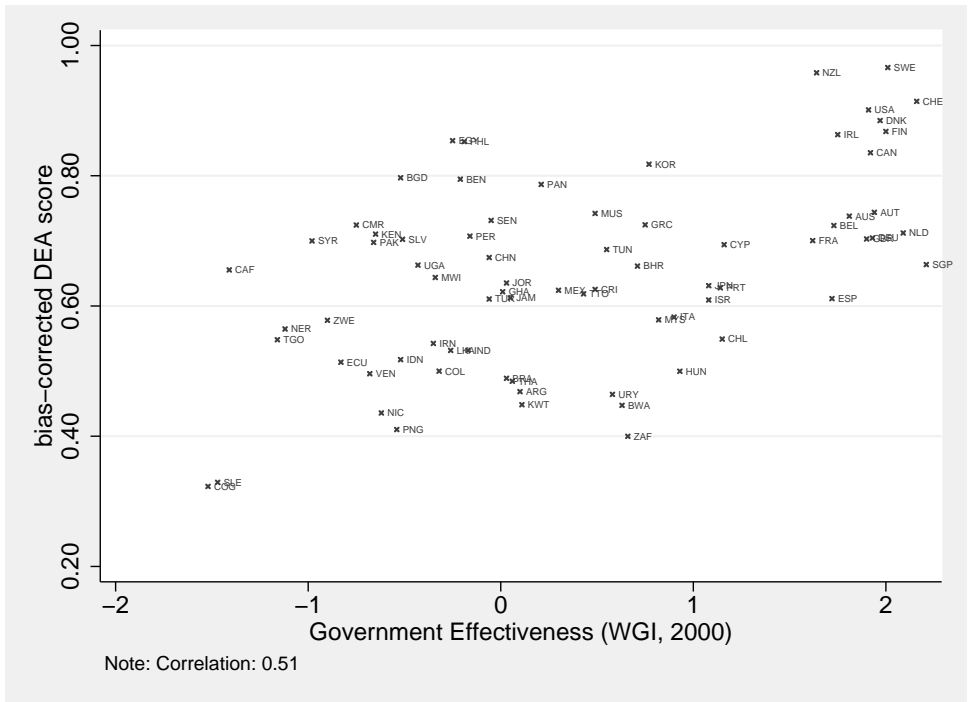


Figure 10: Bias-corrected DEA efficiency scores and the government effectiveness as rated in Kaufmann et al. (2008) for the year 2000.

I hope the study demonstrates that one way to proceed in further research about the relationship between public-sector efficiency is to apply DEA-methods. In particular, it seems to be reasonable and also possible to construct a panel-dataset that contains a broad range of countries and covers a longer time span than the one used in this study.⁴⁹ For example, the international data on educational attainment by Barro / Lee (2001) covers the years 1960-2000. A longer time-span would allow to assess the dynamics of public-sector efficiency empirically.⁵⁰

⁴⁹ Another reason to pin hopes on DEA- and, to a lesser extent, FDH-methods of efficiency analysis is that the methodology will be developed further in the near future, see the review of the recent literature in section 2 or the textbook by Cooper et al. (2007) that provides a comprehensive exposition of the state of the art in DEA.

⁵⁰ The approach could then be similar to the one in Büttner / Wildasin (2006). They analyse the dynamics of fiscal adjustments in a large sample of municipalities in the United States.

Appendix

The dataset (as far as licensing issues can be resolved), the “do-files” for use with Stata (and R) are available on request. The do-files start with reading in the original data, to avoid unrecoverable mistakes that happen when data is edited “by hand” in a spreadsheet program. Hence, the documentation of the data-cleaning is also available on request. See also my website, www.wiwi.uni-rostock.de/~wsf8545/. It contains a few scripts and other “tricks” to use Stata and L^AT_EX efficiently.

List of countries

Table A8: List of countries in the dataset. The last column indicates whether a country is included in the FDH study or not.

countrycode	countryname	DEA/FDH?
ARG	Argentina	DEA
AUS	Australia	DEA FDH
AUT	Austria	DEA FDH
BEL	Belgium	DEA
BEN	Benin	DEA FDH
BGD	Bangladesh	DEA
BHR	Bahrain	DEA FDH
BOL	Bolivia	FDH
BRA	Brazil	DEA FDH
BRB	Barbados	FDH
BWA	Botswana	DEA
CAF	Central African Republic	DEA
CAN	Canada	DEA FDH
CHE	Switzerland	DEA FDH
CHL	Chile	DEA FDH
CHN	China	DEA
CMR	Cameroon	DEA FDH
COG	Congo. Rep.	DEA FDH
COL	Colombia	DEA FDH
CRI	Costa Rica	DEA FDH
CYP	Cyprus	DEA FDH
DEU	Germany	DEA FDH
DNK	Denmark	DEA FDH
DOM	Dominican Republic	FDH
ECU	Ecuador	DEA
EGY	Egypt. Arab Rep.	DEA FDH
ESP	Spain	DEA
FIN	Finland	DEA FDH
FRA	France	DEA FDH
GBR	United Kingdom	DEA FDH
GHA	Ghana	DEA
GRC	Greece	DEA
HND	Honduras	FDH
HUN	Hungary	DEA FDH
IDN	Indonesia	DEA FDH
IND	India	DEA
IRL	Ireland	DEA FDH
IRN	Iran. Islamic Rep.	DEA FDH
ISR	Israel	DEA FDH

(continued on next page)

Table A8: List of countries in the dataset – continued

countrycode	countryname	DEA/FDH?
ITA	Italy	DEA
JAM	Jamaica	DEA FDH
JOR	Jordan	DEA
JPN	Japan	DEA
KEN	Kenya	DEA
KOR	Korea. Rep.	DEA FDH
KWT	Kuwait	DEA FDH
LKA	Sri Lanka	DEA FDH
MEX	Mexico	DEA
MUS	Mauritius	DEA
MWI	Malawi	DEA
MYS	Malaysia	DEA
NER	Niger	DEA
NIC	Nicaragua	DEA
NLD	Netherlands	DEA
NZL	New Zealand	DEA
PAK	Pakistan	DEA
PAN	Panama	DEA
PER	Peru	DEA
PHL	Philippines	DEA
PNG	Papua New Guinea	DEA
PRT	Portugal	DEA
SEN	Senegal	DEA
SGP	Singapore	DEA
SLE	Sierra Leone	DEA
SLV	El Salvador	DEA
SWE	Sweden	DEA
SYR	Syrian Arab Republic	DEA
TGO	Togo	DEA
THA	Thailand	DEA
TTO	Trinidad and Tobago	DEA
TUN	Tunisia	DEA
TUR	Turkey	DEA
UGA	Uganda	DEA
URY	Uruguay	DEA
USA	United States	DEA
VEN	Venezuela. RB	DEA
ZAF	South Africa	DEA
ZWE	Zimbabwe	DEA

(end of table)

Codebooks and description of variables**Table A9:** Codebook for the FDH-Analysis

Variable	obs	mean	sd	min	max	label
year	32	1990.0	0.0	1990.0	1990.0	Year
countrycode	32	.	.	.	.	Country Code

(continued on next page)

Table A9: Codebook for the FDH-Analysis – continued

Variable	obs	mean	sd	min	max	label
countryname	32	.	.	.	.	Country Name
country_id	32	58.8	30.1	13.0	115.0	ID number of country
airtrans_rcdw	32	114006.3	163737.9	500.0	670700.0	Air transport, registered carrier departures world-wide
airtrans_rcdw_rel	32	7.0	7.1	0.1	22.6	Air transport, registered carrier departures world-wide per 1000 people
balee_lsc15	32	14.3	11.0	1.7	44.7	percentage of secondary school complete in the total pop. (adults of age 15+)
balee_lu	32	20.8	22.6	0.0	78.5	percentage of no schooling in the total population (adults of age 25+)
efw_area2	32	5.7	2.0	2.2	8.3	Area 2: Legal Structure and Security of Property Rights (EFW Index)
efw_area3	32	7.0	2.4	0.0	9.7	Area 3: Access to Sound Money (EFW Index)
efw_area5	32	5.5	0.9	3.5	6.8	Area 5: Regulation of Credit, Labor, and Business (EFW Index)
exp_gov_pwt_pc_real	32	237651.9	194768.8	12875.0	766907.0	Real government expenditure per capita (PWT)
exp_gov_pwt_pc_real_ma	32	223149.5	176284.3	9828.4	720072.8	Moving Average of exp_gov_pwt_pc_real
exp_imf_4	32	0.1	0.1	0.0	0.5	Expenditure: Education affairs and services (in percent of GDP)
exp_imf_4_real	32	751.6	1761.4	39.7	8869.4	real expenditure (based on exp_imf_4)
exp_imf_4_real_ma	32	661.7	1572.3	34.9	8034.7	Moving Average of exp_imf_4_real
exp_imf_5	32	0.1	0.1	-0.0	0.7	Expenditure: Health affairs and services (in percent of GDP)
exp_imf_5_real	32	976.0	2531.1	-16.5	12324.4	real expenditure (based on exp_imf_5)
exp_imf_5_real_ma	32	842.4	2195.3	-10.2	10736.1	Moving Average of exp_imf_5_real
exp_imf_econ1	32	0.2	0.2	0.0	1.3	Expenditure: Expenditure on goods and services (in percent of GDP)
exp_imf_econ1_real	32	2249.2	4650.1	100.5	24099.5	real expenditure (based on exp_imf_econ1)

(continued on next page)

Table A9: Codebook for the FDH-Analysis – continued

Variable	obs	mean	sd	min	max	label
exp_imf_econ1_real_ma	32	2012.3	4189.2	90.2	21765.3	Moving Average of exp_imf_econ1_real
exp_imf_econI	32	0.6	1.0	0.1	5.2	Expenditure: Total expenditure and lending minus repayments (II+V) (in percent o
exp_imf_econIV	32	0.1	0.1	0.0	0.4	Expenditure: Capital expenditure (in percent of GDP)
exp_imf_econIV_real	32	689.2	1524.4	39.7	8329.7	real expenditure (based on exp_imf_econIV)
exp_imf_econIV_real_ma	32	634.9	1359.9	34.6	7414.1	Moving Average of exp_imf_econIV_real
exp_imf_econI_real	32	8181.6	19049.3	301.9	98281.2	real expenditure (based on exp_imf_econI)
exp_imf_econI_real_ma	32	7293.5	16760.8	280.3	86365.6	Moving Average of exp_imf_econI_real
gdp_curr_LCU	32	1.5e+13	4.9e+13	1.2e+07	2.1e+14	GDP (current LCU)
gdp_var	32	0.1	0.0	0.0	0.2	stability of real GDP per capita (coefficient of variation)
health_exp_private	32	.	.	.	.	Health expenditure, private (% of GDP)
health_exp_public	32	.	.	.	.	Health expenditure, public (% of GDP)
health_priv	32	0.9	0.7	0.2	2.9	Reliance on private vs. public expenditure in health care (2000)
inf_gdpdefl	32	92.3	448.7	-1.0	2509.5	Inflation, GDP deflator (annual %)
inf_gdpdefl_ma	32	11.9	13.0	1.5	59.2	Inflation (moving average)
inf_var	32	1.2	2.7	0.1	14.8	stability of price level (coefficient of variation)
kof_index	32	51.8	19.8	22.6	84.6	overall globalization index (KOF Index)
kof_index_a	32	54.8	18.4	16.6	87.0	economic globalization (KOF index)
kof_index_ai	32	55.4	16.6	7.9	88.8	actual flows (KOF index)
kof_index_aii	32	51.4	22.9	17.6	85.2	restrictions (KOF index)
kof_index_bii	32	51.4	25.0	7.3	90.7	information flows (KOF index)
landarea	32	1116968.1	2437883.2	430.0	9093510.0	Land area (sq. km)

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Table A9: Codebook for the FDH-Analysis – continued

Variable	obs	mean	sd	min	max	label
life_exp	32	70.2	7.1	53.2	77.4	Life expectancy at birth, total (years)
pn_Gerring	32	3.8	1.5	1.0	5.0	Unitarism index (Gerring-Thacker)
pn_herftot	32	0.5	0.3	0.2	1.0	Herfindahl Index political fractionalisation
pwt_cg	32	20.8	8.5	8.3	48.2	Government Share of CGDP (percent in Current Prices)
pwt_cgdp	32	9594.7	6747.9	839.0	22772.1	Real Gross Domestic Product per Capita (Int-Dollar in Current Prices)
pwt_cgdp_ma	32	8587.3	6023.7	853.1	20284.1	Moving Average of pwt_cgdp
pwt_grgdpch	32	1.3	6.9	-26.8	11.1	growth rate of Real GDP per capita (Constant Prices: Chain series) (percent in 2
pwt_grgdpch_ma	32	1.9	2.9	-5.2	9.4	Moving Average of pwt_grgdpch
pwt_kg	32	20.4	8.0	8.1	44.6	Government Share of RG-DPL (percent in 2000 Constant Prices)
pwt_pop	32	27688.7	43236.4	262.6	188005.4	Population (thousands)
pwt_rgdpc	32	11508.3	8065.9	1086.5	27515.3	Real GDP per capita (Constant Prices: Chain series) (IntD in 2000 Constant Price
region	32	.	.	.	.	Geographic Region
region_antarc	32	0.0	0.0	0.0	0.0	Antarctica dummy
region_asia	32	0.3	0.4	0.0	1.0	Asia dummy
region_austr	32	0.0	0.2	0.0	1.0	Australia dummy
region_carib	32	0.1	0.3	0.0	1.0	Caribbean dummy
region_europe	32	0.3	0.5	0.0	1.0	Europe dummy
region_latinam	32	0.2	0.4	0.0	1.0	Latin America dummy
region_northafr	32	0.0	0.2	0.0	1.0	North Africa dummy
region_northam	32	0.0	0.2	0.0	1.0	North America dummy
region_paci	32	0.0	0.0	0.0	0.0	Pacific dummy
region_subsafr	32	0.1	0.3	0.0	1.0	Sub Saharan Africa dummy
tel_mainl	32	220.6	207.6	2.8	587.4	Telephone mainlines (per 1,000 people)

(continued on next page)

Table A9: Codebook for the FDH-Analysis – continued

Variable	obs	mean	sd	min	max	label
wb_class_eap	32	0.1	0.2	0.0	1.0	East Asia + Pacific (World Bank Classification, April 2008)
wb_class_eca	32	0.0	0.0	0.0	0.0	Europe + Central Asia (World Bank Classification, April 2008)
wb_class_emu	32	0.2	0.4	0.0	1.0	Euro area (World Bank Classification, April 2008)
wb_class_hic	32	0.0	0.0	0.0	0.0	High income (World Bank Classification, April 2008)
wb_class_hpc	32	0.1	0.3	0.0	1.0	Heavily indebted poor countries (HIPC) (World Bank Classification, April 2008)
wb_class_lac	32	0.3	0.4	0.0	1.0	Latin America + Caribbean (World Bank Classification, April 2008)
wb_class_ldc	32	0.0	0.0	0.0	0.0	Least developed countries (UN classification)
wb_class_lic	32	0.0	0.2	0.0	1.0	Low income (World Bank Classification, April 2008)
wb_class_lmc	32	0.3	0.5	0.0	1.0	Lower middle income (World Bank Classification, April 2008)
wb_class_mna	32	0.1	0.2	0.0	1.0	Middle East + North Africa (World Bank Classification, April 2008)
wb_class_noc	32	0.2	0.4	0.0	1.0	High income: nonOECD (World Bank Classification, April 2008)
wb_class_oec	32	0.3	0.5	0.0	1.0	High income: OECD (World Bank Classification, April 2008)
wb_class_sas	32	0.0	0.2	0.0	1.0	South Asia (World Bank Classification, April 2008)
wb_class_ssa	32	0.1	0.3	0.0	1.0	Sub-Saharan Africa (World Bank Classification, April 2008)
wb_class_umc	32	0.2	0.4	0.0	1.0	Upper middle income (World Bank Classification, April 2008)
wgi_goveff	32	.	.	.	.	Government Effectiveness (WGI, 2000)

(end of table)

Table A10: Codebook for the DEA-Analysis. Years: 1985, 1990, 1995, 2000. Number of Countries: 74.

Variable	obs	mean	sd	min	max	label
year	296	1992.5	5.6	1985.0	2000.0	Year
countrycode	296	.	.	.	.	Country Code
countryname	296	.	.	.	.	Country Name
country_id	296	37.5	21.4	1.0	74.0	ID number of country
airtrans_rcdw	296	203974.1	850077.8	200.0	8820878.0	Air transport, registered carrier departures world-wide
airtrans_rcdw_rel	296	6.8	8.9	0.0	62.9	Air transport, registered carrier departures world-wide per 1000 people
balee_lsc15	296	11.1	9.2	0.2	44.9	percentage of secondary school complete in the total pop. (adults of age 15+)
balee_lu	296	26.4	24.3	0.0	90.6	percentage of no schooling in the total population (adults of age 25+)
efw_area2	296	5.8	1.9	2.0	9.6	Area 2: Legal Structure and Security of Property Rights (EFW Index)
efw_area3	296	7.0	2.4	0.0	9.8	Area 3: Access to Sound Money (EFW Index)
efw_area5	296	5.6	1.1	2.7	8.8	Area 5: Regulation of Credit, Labor, and Business (EFW Index)
exp_gov_pwt_pc_real	296	187186.2	159819.2	2806.9	766907.0	Real government expenditure per capita (PWT)
exp_gov_pwt_pc_real_ma	296	184224.5	159543.7	6450.8	849452.9	Moving Average of exp_gov_pwt_pc_real
gdp_curr_LCU	296	4.7e+14	7.3e+15	23.1	1.2e+17	GDP (current LCU)
gdp_var	296	0.1	0.0	0.0	0.3	stability of real GDP per capita (coefficient of variation)
health_exp_private	296	2.7	1.2	0.6	7.4	Health expenditure, private (% of GDP)
health_exp_public	296	3.5	2.0	0.5	8.2	Health expenditure, public (% of GDP)
health_priv	296	1.1	0.8	0.2	3.8	Reliance on private vs. public expenditure in health care (2000)
inf_gdpdefl	296	72.0	527.1	-7.0	6836.9	Inflation, GDP deflator (annual %)
inf_gdpdefl_ma	296	12.2	15.6	1.5	59.2	Inflation (moving average)

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Table A10: Codebook for the DEA-Analysis – continued

Variable	obs	mean	sd	min	max	label
inf_var	296	0.0	11.8	-140.7	20.3	stability of price level (coefficient of variation)
kof_index	296	51.2	19.3	12.3	93.6	overall globalization index (KOF Index)
kof_index_a	296	54.7	20.4	7.8	96.5	economic globalization (KOF index)
kof_index_ai	296	55.4	21.3	5.5	98.5	actual flows (KOF index)
kof_index_aii	296	53.6	23.5	9.1	97.1	restrictions (KOF index)
kof_index_bii	296	51.5	24.5	3.3	96.6	information flows (KOF index)
landarea	296	1009653.2	2172284.4	670.0	9326410.0	Land area (sq. km)
life_exp	296	67.8	9.6	39.0	81.1	Life expectancy at birth, total (years)
pn_Gerring	296	4.0	1.4	1.0	5.0	Unitarism index (Gerring-Thacker)
pn_herftot	296	0.5	0.3	0.0	1.0	Herfindahl Index political fractionalisation
pwt_cg	296	20.1	8.4	3.0	56.7	Government Share of CGDP (percent in Current Prices)
pwt_cgdp	296	8781.4	7801.5	531.7	34364.5	Real Gross Domestic Product per Capita (Int-Dollar in Current Prices)
pwt_cgdp_ma	296	8005.8	7083.2	503.4	31361.3	Moving Average of pwt_cgdp
pwt_grgdpch	296	2.0	4.8	-26.8	22.0	growth rate of Real GDP per capita (Constant Prices: Chain series) (percent in 2
pwt_grgdpch_ma	296	1.6	3.0	-7.6	13.8	Moving Average of pwt_grgdpch
pwt_kg	296	20.4	8.7	3.0	56.7	Government Share of RG-DPL (percent in 2000 Constant Prices)
pwt_pop	296	58110.2	170124.9	424.0	1262474.3	Population (thousands)
pwt_rgdpch	296	9962.1	8437.2	680.0	34364.5	Real GDP per capita (Constant Prices: Chain series) (IntD in 2000 Constant Price
region	296	.	.	.	.	Geographic Region
region_antarc	296	0.0	0.0	0.0	0.0	Antarctica dummy
region_asia	296	0.3	0.4	0.0	1.0	Asia dummy
region_austr	296	0.0	0.2	0.0	1.0	Australia dummy
region_carib	296	0.0	0.2	0.0	1.0	Caribbean dummy

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Table A10: Codebook for the DEA-Analysis – continued

Variable	obs	mean	sd	min	max	label
region_europe	296	0.2	0.4	0.0	1.0	Europe dummy
region_latinam	296	0.2	0.4	0.0	1.0	Latin America dummy
region_northafr	296	0.0	0.2	0.0	1.0	North Africa dummy
region_northam	296	0.0	0.2	0.0	1.0	North America dummy
region_paci	296	0.0	0.1	0.0	1.0	Pacific dummy
region_subsafr	296	0.2	0.4	0.0	1.0	Sub Saharan Africa dummy
tel_mainl	296	192.8	209.4	1.0	758.6	Telephone mainlines (per 1,000 people)
wb_class_eap	296	0.1	0.3	0.0	1.0	East Asia + Pacific (World Bank Classification, April 2008)
wb_class_eca	296	0.0	0.1	0.0	1.0	Europe + Central Asia (World Bank Classification, April 2008)
wb_class_emu	296	0.2	0.4	0.0	1.0	Euro area (World Bank Classification, April 2008)
wb_class_hic	296	0.0	0.0	0.0	0.0	High income (World Bank Classification, April 2008)
wb_class_hpc	296	0.2	0.4	0.0	1.0	Heavily indebted poor countries (HIPC) (World Bank Classification, April 2008)
wb_class_lac	296	0.2	0.4	0.0	1.0	Latin America + Caribbean (World Bank Classification, April 2008)
wb_class_ldc	296	0.0	0.0	0.0	0.0	Least developed countries (UN classification)
wb_class_lic	296	0.2	0.4	0.0	1.0	Low income (World Bank Classification, April 2008)
wb_class_lmc	296	0.2	0.4	0.0	1.0	Lower middle income (World Bank Classification, April 2008)
wb_class_mna	296	0.1	0.3	0.0	1.0	Middle East + North Africa (World Bank Classification, April 2008)
wb_class_noc	296	0.1	0.3	0.0	1.0	High income: nonOECD (World Bank Classification, April 2008)
wb_class_oec	296	0.3	0.4	0.0	1.0	High income: OECD (World Bank Classification, April 2008)
wb_class_sas	296	0.1	0.2	0.0	1.0	South Asia (World Bank Classification, April 2008)

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Table A10: Codebook for the DEA-Analysis – continued

Variable	obs	mean	sd	min	max	label
wb_class_ssa	296	0.2	0.4	0.0	1.0	Sub-Saharan Africa (World Bank Classification, April 2008)
wb_class_umc	296	0.2	0.4	0.0	1.0	Upper middle income (World Bank Classification, April 2008)
wgi_goveff	296	0.4	1.0	-1.5	2.2	Government Effectiveness (WGI, 2000)

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Table A11: Description of variables

variable / label / source	description
year: Year <i>Source:</i> -	-
countrycode: Country Code <i>Source:</i> -	Countrycodes follow WDI (2007)
countryname: Country Name <i>Source:</i> -	The full names of countries follow WDI (2007) .
country_id: ID number of country <i>Source:</i> -	-
airtrans_rcdw: Air transport, registered carrier departures worldwide <i>Source:</i> WDI (2007)	Registered carrier departures worldwide are domestic takeoffs and takeoffs abroad of air carriers registered in the country. Source: International Civil Aviation Organization, Civil Aviation Statistics of the World and ICAO staff estimates.
airtrans_rcdw_rel: Air transport, registered carrier departures worldwide per 1000 people <i>Source:</i> own calculations	calculated as <code>airtrans_rcdw/pwt_pop</code>
balee_lsc15: percentage of secondary school complete in the total pop. (adults of age 15+) <i>Source:</i> Barro / Lee (2001)	For a detailed description, see Barro / Lee (2001) and Barro / Lee (1993, 1996) .
balee_lu: percentage of no schooling in the total population (adults of age 25+) <i>Source:</i> Barro / Lee (2001)	For a detailed description, see Barro / Lee (2001) and Barro / Lee (1993, 1996) .
efw_area2: Area 2: Legal Structure and Security of Property Rights (EFW Index) <i>Source:</i> Gwartney / Lawson (2007)	EFW Index - Area 2: Legal Structure and Security of Property Rights. Computed from subindices <code>efw_area2a</code> - <code>efw_area2g</code> .
efw_area3: Area 3: Access to Sound Money (EFW Index) <i>Source:</i> Gwartney / Lawson (2007)	EFW Index - Area 3: Access to Sound Money. Computed from subindices <code>efw_area3a</code> - <code>efw_area3d</code> .
efw_area5: Area 5: Regulation of Credit, Labor, and Business (EFW Index) <i>Source:</i> Gwartney / Lawson (2007)	EFW Index - Area 5: Regulation of Credit, Labor, and Business. Computed from subindices <code>efw_area5a</code> - <code>efw_area5c</code> .

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Table A11: Description of variables – continued

variable / label / source	description
exp_gov_pwt_pc_real: Real government expenditure per capita (PWT) <i>Source:</i> own calculations, based on PWT data	Real government expenditure per capita (PWT) (Current Prices). Calculated as $pwt_rgdpl \cdot pwt_kg$.
exp_gov_pwt_pc_real_ma: Moving Average of $exp_gov_pwt_pc_real$ <i>Source:</i> own calculations	Moving Average of $exp_gov_pwt_pc_real$ (Mean of current year and the four preceding years)
exp_imf_4: Expenditure: Education affairs and services (in percent of GDP) <i>Source:</i> IMF (2006)	Expenditure on education affairs and services (pre-primary and primary education affairs and services, secondary education affairs and services, tertiary education affairs and services, education services not definable by level, subsidiary services to education, education affairs and services not elsewhere classified). All Data has been converted from nominal expenditure in national currency to percentage of GDP using data on the nominal GDP from the World Development Indicators (gdp_curr_LCU). Zero values have been set to missing. The historical series uses the GFSM 1986 classification, see IMF (1986, p. 153-155).
exp_imf_4_real: real expenditure (based on exp_imf_4) <i>Source:</i> own calculations	Real expenditure per capita, based on exp_imf_4 ($exp_imf_4 \cdot pwt_cgdp$)
exp_imf_4_real_ma: Moving Average of $exp_imf_4_real$ <i>Source:</i> own calculations	Moving Average of $exp_imf_4_real$ (Mean of current year and the four preceding years)
exp_imf_5: Expenditure: Health affairs and services (in percent of GDP) <i>Source:</i> IMF (2006)	Expenditure on health affairs and services (hospital affairs and services, clinics, and medical, dental, and paramedical practitioners, public health affairs and services, medicaments, prostheses, medical equipment, and appliances or other prescribed health-related products, applied research and experimental development related to the health and medical delivery system, health affairs and services not elsewhere classified). All Data has been converted from nominal expenditure in national currency to percentage of GDP using data on the nominal GDP from the World Development Indicators (gdp_curr_LCU). Zero values have been set to missing. The historical series uses the GFSM 1986 classification, see IMF (1986, p. 156-158).
exp_imf_5_real: real expenditure (based on exp_imf_5) <i>Source:</i> own calculations	Real expenditure per capita, based on exp_imf_5 ($exp_imf_5 \cdot pwt_cgdp$)
exp_imf_5_real_ma: Moving Average of $exp_imf_5_real$ <i>Source:</i> own calculations	Moving Average of $exp_imf_5_real$ (Mean of current year and the four preceding years)

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Table A11: Description of variables – continued

variable / label / source	description
exp_imf_econ1: Expenditure: Expenditure on goods and services (in percent of GDP) <i>Source:</i> IMF (2006)	Expenditure on goods and services. This includes all government payments in exchange for goods and services, whether in the form of wages and salaries to employees, employer contributions to employee benefit schemes outside this level of government in compensation for employee services, or other purchases of goods and services. All Data has been converted from nominal expenditure in national currency to percentage of GDP using data on the nominal GDP from the World Development Indicators (gdp_curr_LCU). Zero values have been set to missing. The historical series uses the GFSM 1986 classification, see IMF (1986, p. 177).
exp_imf_econ1_real: real expenditure (based on exp_imf_econ1) <i>Source:</i> own calculations	Real expenditure per capita, based on exp_imf_econ1 (exp_imf_econ1 · pwt_cgdp)
exp_imf_econ1_real_ma: Moving Average of exp_imf_econ1_real <i>Source:</i> own calculations	Moving Average of exp_imf_econ1_real (Mean of current year and the four preceding years)
exp_imf_econI: Expenditure: Total expenditure and lending minus repayments (II+V) (in percent o <i>Source:</i> IMF (2006)	Total expenditure and lending minus repayments (total expenditure and capital expenditure). All Data has been converted from nominal expenditure in national currency to percentage of GDP using data on the nominal GDP from the World Development Indicators (gdp_curr_LCU). Zero values have been set to missing. The historical series uses the GFSM 1986 classification, see IMF (1986, p. 177).
exp_imf_econIV: Expenditure: Capital expenditure (in percent of GDP) <i>Source:</i> IMF (2006)	Capital expenditures. Capital expenditures are payments for the acquisition of fixed capital assets, strategic or emergency stocks, land, or intangible assets, or unrequited payments for the purpose of permitting the recipients to acquire such assets, compensating the recipients for damage or destruction of capital assets, or increasing the financial capital of the recipients. All Data has been converted from nominal expenditure in national currency to percentage of GDP using data on the nominal GDP from the World Development Indicators (gdp_curr_LCU). Zero values have been set to missing. The historical series uses the GFSM 1986 classification, see IMF (1986, p. 182).
exp_imf_econIV_real: real expenditure (based on exp_imf_econIV) <i>Source:</i> own calculations	Real expenditure per capita, based on exp_imf_econIV (exp_imf_econIV · pwt_cgdp)
exp_imf_econIV_real_ma: Moving Average of exp_imf_econIV_real <i>Source:</i> own calculations	Moving Average of exp_imf_econIV_real (Mean of current year and the four preceding years)
exp_imf_econI_real: real expenditure (based on exp_imf_econI) <i>Source:</i> own calculations	Real expenditure per capita, based on exp_imf_econI (exp_imf_econI · pwt_cgdp)

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Table A11: Description of variables – continued

variable / label / source	description
exp_imf_econI_real_ma: Moving Average of exp_imf_econI_real <i>Source:</i> own calculations	Moving Average of exp_imf_econI_real (Mean of current year and the four preceding years)
gdp_curr_LCU: GDP (current LCU) <i>Source:</i> WDI (2007)	GDP (current LCU). GDP at purchaser's prices is the sum of gross value added by all resident producers in the economy plus any product taxes and minus any subsidies not included in the value of the products. It is calculated without making deductions for depreciation of fabricated assets or for depletion and degradation of natural resources. Data are in current local currency.
gdp_var: stability of real GDP per capita (coefficient of variation) <i>Source:</i> own calculations, Heston et al. (2006)	Own calculations, based on pwt_rgdpc. A coefficient of variation is calculated for the current year and two years in the past and in the future.
health_exp_private: Health expenditure, private (% of GDP) <i>Source:</i> WDI (2007)	Private health expenditure includes direct household (out-of-pocket) spending, private insurance, charitable donations, and direct service payments by private corporations. <i>Source:</i> World Health Organization, World Health Report and updates and from the OECD for its member countries, supplemented by World Bank poverty assessments and country and sector studies, and household surveys conducted by governments or by statistical or international organizations.
health_exp_public: Health expenditure, public (% of GDP) <i>Source:</i> WDI (2007)	Public health expenditure consists of recurrent and capital spending from government (central and local) budgets, external borrowings and grants (including donations from international agencies and nongovernmental organizations), and social (or compulsory) health insurance funds. <i>Source:</i> World Health Organization, World Health Report and updates and from the OECD for its member countries, supplemented by World Bank poverty assessments and country and sector studies.
health_priv: Reliance on private vs. public expenditure in health care (2000) <i>Source:</i> own calculations, WDI (2007)	Reliance on private vs. public expenditure in health care in the year 2000. Calculated as health_exp_private / health_exp_public. High values indicates that private health care spending is important. If health_priv is equal to one, health care expenditure is equally private and public.
inf_gdpdefl: Inflation, GDP deflator (annual %) <i>Source:</i> WDI (2007)	Inflation as measured by the annual growth rate of the GDP implicit deflator shows the rate of price change in the economy as a whole. The GDP implicit deflator is the ratio of GDP in current local currency to GDP in constant local currency. <i>Source:</i> World Bank national accounts data, and OECD National Accounts data files.
inf_gdpdefl_ma: Inflation (moving average) <i>Source:</i> own calculations, Heston et al. (2006).	Own calculations, based on inf_gdpdefl. Moving Average, current year and two years in the past and in the future. To account for hyperinflation, values higher than the 90% percentile (59.23400115966797) have been replaced by the the 90% percentile. On the lower end, the data has been truncated at the 10% percentile.

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Table A11: Description of variables – continued

variable / label / source	description
inf_var: stability of price level (coefficient of variation) <i>Source:</i> own calculations, Heston et al. (2006)	Own calculations, based on <code>inf_gdpdefl</code> . A coefficient of variation is calculated for the current year and two years in the past and in the future.
kof_index: overall globalization index (KOF Index) <i>Source:</i> Dreher (2006) ; Dreher et al. (2008)	Index of globalization, compiled from subindices of economic, social and political globalization. See Dreher (2006) ; Dreher et al. (2008) for the weights used and other details.
kof_index_a: economic globalization (KOF index) <i>Source:</i> Dreher (2006) ; Dreher et al. (2008)	Index of economic globalization, compiled from data on actual flows (trade, foreign direct investment, portfolio investment, Income Payments to Foreign Nationals) and restrictions (Hidden Import Barriers, Mean Tariff Rate, Taxes on International Trade, Capital Account Restrictions). See Dreher (2006) ; Dreher et al. (2008) for the weights used and other details.
kof_index_ai: actual flows (KOF index) <i>Source:</i> Dreher (2006) ; Dreher et al. (2008)	Index of economic globalization (actual flows), compiled from data on trade, foreign direct investment, portfolio investment, Income Payments to Foreign Nationals. See Dreher (2006) ; Dreher et al. (2008) for the weights used and other details.
kof_index_aii: restrictions (KOF index) <i>Source:</i> Dreher (2006) ; Dreher et al. (2008)	Index of economic globalization (restrictions), compiled from data on Hidden Import Barriers, Mean Tariff Rate, Taxes on International Trade, Capital Account Restrictions. See Dreher (2006) ; Dreher et al. (2008) for the weights used and other details.
kof_index_bii: information flows (KOF index) <i>Source:</i> Dreher (2006) ; Dreher et al. (2008)	Index of social globalization (information flows), compiled from data on Internet Users, Cable Television, Trade in Newspapers, Radios. See Dreher (2006) ; Dreher et al. (2008) for the weights used and other details.
landarea: Land area (sq. km) <i>Source:</i> WDI (2007)	Land area is a country's total area, excluding area under inland water bodies, national claims to continental shelf, and exclusive economic zones. In most cases the definition of inland water bodies includes major rivers and lakes. <i>Source:</i> Food and Agriculture Organization, Production Yearbook and data files.
life_exp: Life expectancy at birth, total (years) <i>Source:</i>	Life expectancy at birth indicates the number of years a newborn infant would live if prevailing patterns of mortality at the time of its birth were to stay the same throughout its life. <i>Source:</i> World Bank staff estimates from various sources including census reports, the United Nations Population Division's World Population Prospects, national statistical offices, household surveys conducted by national agencies, and Macro International.
pn_Gerring: Unitarism index (Gerring-Thacker) <i>Source:</i> Norris (2008)	Data taken from dataset that accompanies Norris (2008) . The actual data is from Gerring / Thacker (2004) . The index measures the degree of centralization on a scale of 1 to 5. Examples of very federalised countries with a value of 1 are Switzerland and Germany.

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Table A11: Description of variables – continued

variable / label / source	description
pn_herftot: Herfindahl Index political fractionalisation <i>Source:</i> Norris (2008)	Data taken from dataset that accompanies Norris (2008). The actual data is from Beck et al. (2001). pn_herftot is the sum of the squared seat shares of all parties. Equals NA (missing) if there is no parliament or if there are no parties in the legislature and blank if any government or opposition party seats are blank. Higher values indicate that the political concentration is less.
pwt_cg: Government Share of CGDP (percent in Current Prices) <i>Source:</i> Heston et al. (2006)	See Data Appendix and Technical Documentation of Heston et al. (2006).
pwt_cgdp: Real Gross Domestic Product per Capita (IntDollar in Current Prices) <i>Source:</i> Heston et al. (2006)	See Data Appendix and Technical Documentation of Heston et al. (2006).
pwt_cgdp_ma: Moving Average of pwt_cgdp <i>Source:</i> own calculations	Moving Average of pwt_cgdp (Mean of current year and the four preceding years)
pwt_grgdpch: growth rate of Real GDP per capita (Constant Prices: Chain series) (percent in 2 <i>Source:</i> Heston et al. (2006)	See Data Appendix and Technical Documentation of Heston et al. (2006).
pwt_grgdpch_ma: Moving Average of pwt_grgdpch <i>Source:</i> own calculations	Moving Average of pwt_grgdpch, current year and the four preceding years.
pwt_kg: Government Share of RGDPL (percent in 2000 Constant Prices) <i>Source:</i> Heston et al. (2006)	See Data Appendix and Technical Documentation of Heston et al. (2006).
pwt_pop: Population (thousands) <i>Source:</i> Heston et al. (2006)	See Data Appendix and Technical Documentation of Heston et al. (2006).
pwt_rgdpch: Real GDP per capita (Constant Prices: Chain series) (IntD in 2000 Constant Price <i>Source:</i> Heston et al. (2006)	See Data Appendix and Technical Documentation of Heston et al. (2006).
region: Geographic Region <i>Source:</i> Information from this variable has been converted into 0,1-variables region_XYZ.	International Potato Center (2002)
region_antarc: Antarctica dummy <i>Source:</i> International Potato Center (2002)	See region
region_asia: Asia dummy <i>Source:</i> International Potato Center (2002)	See region
region_aus: Australia dummy <i>Source:</i> International Potato Center (2002)	See region
region_carib: Caribbean dummy <i>Source:</i> International Potato Center (2002)	See region

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Table A11: Description of variables – continued

variable / label / source	description
region_europe: Europe dummy <i>Source:</i> International Potato Center (2002)	See region
region_latinam: Latin America dummy <i>Source:</i> International Potato Center (2002)	See region
region_northafr: North Africa dummy <i>Source:</i> International Potato Center (2002)	See region
region_northam: North America dummy <i>Source:</i> International Potato Center (2002)	See region
region_paci: Pacific dummy <i>Source:</i> International Potato Center (2002)	See region
region_subsafr: Sub Saharan Africa dummy <i>Source:</i> International Potato Center (2002)	See region
tel_mainl: Telephone mainlines (per 1,000 people) <i>Source:</i> WDI (2007)	Telephone mainlines are fixed telephone lines connecting a subscriber to the telephone exchange equipment. <i>Source:</i> International Telecommunication Union, World Telecommunication Development Report and database, and World Bank estimates. Footnote: Please cite the International Telecommunication Union for third-party use of these data.
wb_class_eap: East Asia + Pacific (World Bank Classification, April 2008) <i>Source:</i> World Bank (2008)	East Asia + Pacific according to the World Bank Classification from April 2008.
wb_class_eca: Europe + Central Asia (World Bank Classification, April 2008) <i>Source:</i> World Bank (2008)	Europe + Central Asia according to the World Bank Classification from April 2008.
wb_class_emu: Euro area (World Bank Classification, April 2008) <i>Source:</i> World Bank (2008)	Euro area according to the World Bank Classification from April 2008.
wb_class_hic: High income (World Bank Classification, April 2008) <i>Source:</i> World Bank (2008)	High income according to the World Bank Classification from April 2008.
wb_class_hpc: Heavily indebted poor countries (HIPC) (World Bank Classification, April 2008) <i>Source:</i> World Bank (2008)	Heavily indebted poor countries (HIPC) according to the World Bank Classification from April 2008.
wb_class_lac: Latin America + Caribbean (World Bank Classification, April 2008) <i>Source:</i> World Bank (2008)	Latin America + Caribbean according to the World Bank Classification from April 2008.

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Table A11: Description of variables – continued

variable / label / source	description
wb_class_idc: Least developed countries (UN classification) <i>Source:</i> World Bank (2008)	Least developed countries (UN classification) -
wb_class_lic: Low income (World Bank Classification, April 2008) <i>Source:</i> World Bank (2008)	Low income according to the World Bank Classification from April 2008.
wb_class_lmc: Lower middle income (World Bank Classification, April 2008) <i>Source:</i> World Bank (2008)	Lower middle income according to the World Bank Classification from April 2008.
wb_class_mna: Middle East + North Africa (World Bank Classification, April 2008) <i>Source:</i> World Bank (2008)	Middle East + North Africa according to the World Bank Classification from April 2008.
wb_class_noc: High income: nonOECD (World Bank Classification, April 2008) <i>Source:</i> World Bank (2008)	High income: nonOECD according to the World Bank Classification from April 2008.
wb_class_oeo: High income: OECD (World Bank Classification, April 2008) <i>Source:</i> World Bank (2008)	High income: OECD according to the World Bank Classification from April 2008.
wb_class_sas: South Asia (World Bank Classification, April 2008) <i>Source:</i> World Bank (2008)	South Asia according to the World Bank Classification from April 2008.
wb_class_ssa: Sub-Saharan Africa (World Bank Classification, April 2008) <i>Source:</i> World Bank (2008)	Sub-Saharan Africa according to the World Bank Classification from April 2008.
wb_class_umc: Upper middle income (World Bank Classification, April 2008) <i>Source:</i> World Bank (2008)	Upper middle income according to the World Bank Classification from April 2008.
wgi_goveff: Government Effectiveness (WGI, 2000) <i>Source:</i> Kaufmann et al. (2008)	Government Effectiveness index in the year 2000 from the World-wide Governance Indicators (WGI) project.

Public-sector performance in the FDH-sample

Table A12: Public-sector performance for the FDH-sample. Reported are the PSP-indices for the six subareas (PSP1-6) and overall (PSP0). The table is sorted by the ranking based on PSP0.

rank	country	year	PSP1	PSP2	PSP3	PSP4	PSP5	PSP0	
1	DNK	Denmark	1990	1.29	2.03	1.07	2.54	1.40	1.67
2	CHE	Switzerland	1990	1.30	1.61	1.10	2.92	1.38	1.66
3	FIN	Finland	1990	1.28	1.93	1.07	2.55	1.03	1.57
4	AUS	Australia	1990	1.29	1.32	1.10	2.12	1.32	1.43
5	CAN	Canada	1990	1.35	1.14	1.10	2.14	1.20	1.39
6	GBR	United Kingdom	1990	1.25	1.00	1.08	1.84	1.71	1.38
7	IRL	Ireland	1990	1.15	1.20	1.06	2.25	1.17	1.37
8	FRA	France	1990	1.25	1.11	1.09	1.68	1.55	1.34
9	CYP	Cyprus	1990	1.03	1.19	1.09	1.76	1.53	1.32
10	KOR	Korea. Rep.	1990	0.95	2.12	1.01	0.90	1.58	1.31
11	AUT	Austria	1990	1.27	1.39	1.08	1.34	1.32	1.28
12	DEU	Germany	1990	1.25	1.61	1.07	1.22	1.22	1.27
13	BHR	Bahrain	1990	1.14	0.69	1.03	1.99	1.31	1.23
14	ISR	Israel	1990	0.66	1.14	1.09	1.26	1.09	1.05
15	BRB	Barbados	1990	1.04	0.93	1.06	0.83	1.02	0.98
16	CHL	Chile	1990	1.05	0.98	1.05	0.37	0.96	0.88
17	COL	Colombia	1990	0.74	0.71	0.97	0.41	1.49	0.87
18	CRI	Costa Rica	1990	1.11	0.72	1.08	0.50	0.84	0.85
19	JAM	Jamaica	1990	0.86	0.86	1.02	0.72	0.79	0.85
20	KWT	Kuwait	1990	0.71	1.00	1.07	0.69	0.60	0.81
21	HUN	Hungary	1990	0.97	1.01	0.99	0.35	0.64	0.79
22	IDN	Indonesia	1990	1.00	0.54	0.88	0.09	1.03	0.71
23	LKA	Sri Lanka	1990	0.75	0.98	1.01	0.05	0.73	0.70
24	EGY	Egypt. Arab Rep.	1990	0.88	0.56	0.89	0.09	1.00	0.68
25	BOL	Bolivia	1990	0.79	0.59	0.84	0.23	0.97	0.68
26	HND	Honduras	1990	0.89	0.67	0.94	0.30	0.54	0.67
27	BRA	Brazil	1990	0.65	0.62	0.95	0.34	0.51	0.61
28	COG	Congo. Rep.	1990	0.76	0.57	0.81	0.15	0.60	0.58
29	DOM	Dominican Republic	1990	0.73	0.60	0.97	0.20	0.36	0.57
30	IRN	Iran. Islamic Rep.	1990	0.75	0.60	0.92	0.14	0.19	0.52
31	BEN	Benin	1990	0.88	0.20	0.76	0.01	0.76	0.52
32	CMR	Cameroon	1990	0.98	0.38	0.78	0.05	0.13	0.47

Public-sector performance in the DEA-sample

Table A13: Public-sector performance for the DEA-sample. Reported are the PSP-indices for the six subareas (PSP1-6) and overall (PSP). The table is sorted by the ranking based on PSP0.

rank	country		year	PSP1	PSP2	PSP3	PSP4	PSP5	PSP0
1	CHE	Switzerland	2000	1.44	1.95	1.18	4.84	1.82	2.24
2	SWE	Sweden	2000	1.39	2.66	1.17	4.01	1.83	2.21
3	NZL	New Zealand	2000	1.45	1.20	1.16	5.83	1.39	2.21
4	USA	United States	2000	1.48	1.57	1.14	4.04	2.16	2.08
5	CHE	Switzerland	1995	1.40	1.95	1.16	3.65	2.09	2.05
6	IRL	Ireland	2000	1.38	1.42	1.13	4.05	2.26	2.05
7	DNK	Denmark	2000	1.44	2.38	1.13	3.36	1.83	2.03
8	FIN	Finland	2000	1.42	2.21	1.14	3.48	1.72	1.99
9	USA	United States	1995	1.46	1.66	1.12	3.64	2.00	1.98
10	CAN	Canada	2000	1.44	1.23	1.17	4.05	1.78	1.93
11	DNK	Denmark	1995	1.44	2.40	1.11	3.01	1.64	1.92
12	SWE	Sweden	1995	1.35	2.69	1.16	3.18	1.15	1.90
13	USA	United States	1990	1.34	1.66	1.11	3.38	1.85	1.87
14	NZL	New Zealand	1995	1.51	1.21	1.13	3.77	1.62	1.85
15	DNK	Denmark	1990	1.28	2.49	1.10	2.76	1.49	1.83
16	CHE	Switzerland	1990	1.29	1.96	1.14	3.15	1.49	1.81
17	SWE	Sweden	1990	1.18	1.73	1.14	3.55	1.34	1.79
18	USA	United States	1985	1.32	2.17	1.10	2.94	1.40	1.78
19	CHE	Switzerland	1985	1.28	2.17	1.13	2.61	1.43	1.72
20	FIN	Finland	1990	1.27	2.36	1.10	2.76	1.12	1.72
21	AUS	Australia	1995	1.40	1.51	1.15	2.89	1.62	1.71
22	AUT	Austria	2000	1.38	1.62	1.15	2.55	1.85	1.71
23	AUS	Australia	2000	1.42	1.45	1.17	2.87	1.57	1.70
24	FIN	Finland	1995	1.41	2.29	1.13	2.82	0.74	1.68
25	NZL	New Zealand	1990	1.22	1.21	1.11	3.86	0.94	1.67
26	BEL	Belgium	2000	1.35	1.11	1.14	2.88	1.82	1.66
27	NLD	Netherlands	2000	1.46	1.25	1.15	2.67	1.63	1.63
28	SWE	Sweden	1985	1.13	1.90	1.13	2.95	1.01	1.63
29	DEU	Germany	2000	1.34	1.70	1.15	2.24	1.66	1.62
30	GBR	United Kingdom	2000	1.46	1.16	1.15	2.62	1.70	1.62
31	FRA	France	2000	1.33	1.32	1.16	2.50	1.72	1.61
32	CYP	Cyprus	2000	1.05	1.52	1.15	2.86	1.41	1.60
33	IRL	Ireland	1995	1.44	1.42	1.12	2.65	1.34	1.59
34	KWT	Kuwait	1995	1.09	1.25	1.12	1.36	3.02	1.57
35	AUT	Austria	1995	1.31	1.63	1.13	2.23	1.53	1.57
36	NZL	New Zealand	1985	1.08	1.31	1.09	3.20	1.14	1.56
37	SGP	Singapore	2000	1.37	1.04	1.15	2.51	1.70	1.55

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Table A13: Public-sector performance for the DEA-sample – continued

rank	country	year	PSP1	PSP2	PSP3	PSP4	PSP5	PSP0	
38	BHR	Bahrain	2000	1.17	1.02	1.10	3.12	1.34	1.55
39	KOR	Korea. Rep.	2000	1.06	2.49	1.12	1.78	1.29	1.55
40	NLD	Netherlands	1995	1.40	1.26	1.14	2.32	1.58	1.54
41	AUS	Australia	1990	1.28	1.57	1.14	2.29	1.41	1.54
42	KOR	Korea. Rep.	1995	0.99	2.55	1.08	1.38	1.66	1.53
43	CAN	Canada	1995	1.43	1.28	1.15	2.26	1.51	1.53
44	DEU	Germany	1995	1.34	1.75	1.13	1.81	1.58	1.52
45	SGP	Singapore	1995	1.41	1.03	1.13	2.14	1.83	1.51
46	FRA	France	1995	1.26	1.31	1.15	2.06	1.71	1.50
47	CAN	Canada	1990	1.33	1.34	1.14	2.34	1.29	1.49
48	KOR	Korea. Rep.	1990	0.94	2.62	1.05	1.01	1.79	1.48
49	CYP	Cyprus	1995	1.03	1.46	1.14	2.47	1.29	1.48
50	GRC	Greece	2000	1.09	1.84	1.15	2.07	1.23	1.48
51	GBR	United Kingdom	1990	1.23	1.16	1.12	2.01	1.86	1.48
52	GBR	United Kingdom	1995	1.46	1.15	1.13	2.23	1.36	1.47
53	IRL	Ireland	1990	1.14	1.42	1.10	2.38	1.28	1.46
54	JPN	Japan	2000	1.32	1.30	1.20	1.64	1.84	1.46
55	AUS	Australia	1985	1.29	1.57	1.12	2.13	1.17	1.46
56	PRT	Portugal	2000	1.27	0.97	1.13	1.90	1.95	1.44
57	FRA	France	1990	1.24	1.30	1.13	1.85	1.67	1.44
58	CYP	Cyprus	1990	1.02	1.40	1.13	1.92	1.71	1.43
59	CAN	Canada	1985	1.28	1.37	1.13	2.24	1.15	1.43
60	TTO	Trinidad and Tobago	2000	1.20	1.11	1.02	2.33	1.50	1.43
61	ESP	Spain	2000	1.29	1.16	1.16	1.98	1.56	1.43
62	BEL	Belgium	1995	1.26	1.13	1.13	2.22	1.39	1.43
63	DNK	Denmark	1985	1.09	1.49	1.10	2.37	1.08	1.43
64	FIN	Finland	1985	1.17	1.47	1.09	2.21	1.08	1.40
65	MYS	Malaysia	1995	1.21	1.13	1.05	1.09	2.52	1.40
66	ISR	Israel	2000	1.20	1.31	1.16	1.93	1.38	1.40
67	DEU	Germany	1990	1.24	1.94	1.11	1.36	1.32	1.39
68	MUS	Mauritius	2000	1.22	1.95	1.06	1.37	1.37	1.39
69	NLD	Netherlands	1990	1.26	1.28	1.13	1.77	1.50	1.39
70	AUT	Austria	1990	1.26	1.65	1.11	1.48	1.43	1.39
71	JPN	Japan	1990	1.28	1.30	1.16	1.43	1.67	1.37
72	JOR	Jordan	2000	1.24	0.93	1.04	0.58	3.02	1.36
73	ISR	Israel	1995	1.05	1.33	1.14	1.76	1.53	1.36
74	JPN	Japan	1995	1.31	1.31	1.17	1.60	1.42	1.36
75	ITA	Italy	2000	1.22	1.13	1.17	1.70	1.56	1.36
76	GRC	Greece	1995	1.02	1.83	1.14	1.87	0.88	1.35
77	GRC	Greece	1990	1.00	1.79	1.13	1.58	1.16	1.33

(continued on next page)

Table A13: Public-sector performance for the DEA-sample – continued

rank	country		year	PSP1	PSP2	PSP3	PSP4	PSP5	PSP0
78	ESP	Spain	1990	1.03	1.15	1.13	1.30	2.04	1.33
79	DEU	Germany	1985	1.20	2.10	1.09	1.05	1.19	1.33
80	BHR	Bahrain	1995	1.17	0.93	1.09	2.34	1.05	1.32
81	BEL	Belgium	1990	1.26	1.16	1.12	1.51	1.46	1.30
82	TTO	Trinidad and Tobago	1995	1.09	1.08	1.03	2.29	1.00	1.30
83	BHR	Bahrain	1990	1.13	0.81	1.06	2.09	1.38	1.29
84	AUT	Austria	1985	1.18	1.67	1.09	1.30	1.23	1.29
85	SGP	Singapore	1990	1.23	0.93	1.10	1.64	1.57	1.29
86	MUS	Mauritius	1995	1.24	1.89	1.04	0.92	1.29	1.28
87	NLD	Netherlands	1985	1.25	1.24	1.13	1.54	1.12	1.26
88	ESP	Spain	1995	1.24	1.16	1.15	1.57	1.16	1.26
89	PAN	Panama	2000	1.14	1.51	1.10	1.03	1.49	1.25
90	ITA	Italy	1990	1.20	1.13	1.13	1.32	1.42	1.24
91	GBR	United Kingdom	1985	1.20	1.11	1.10	1.59	1.16	1.23
92	ITA	Italy	1995	1.12	1.13	1.15	1.49	1.27	1.23
93	JPN	Japan	1985	1.21	1.27	1.15	1.23	1.24	1.22
94	SGP	Singapore	1985	1.18	0.94	1.08	1.60	1.27	1.21
95	MUS	Mauritius	1990	1.02	1.82	1.02	0.71	1.44	1.20
96	CHL	Chile	2000	1.23	1.15	1.13	0.98	1.38	1.17
97	KOR	Korea. Rep.	1985	0.88	1.63	1.01	0.50	1.84	1.17
98	CYP	Cyprus	1985	0.88	1.33	1.12	1.34	1.18	1.17
99	HUN	Hungary	2000	1.16	1.26	1.05	1.20	1.19	1.17
100	PRT	Portugal	1990	0.99	0.89	1.09	0.95	1.90	1.16
101	PRT	Portugal	1995	1.24	0.94	1.11	1.46	0.99	1.15
102	ISR	Israel	1990	0.65	1.35	1.13	1.38	1.20	1.14
103	FRA	France	1985	1.07	1.09	1.11	1.43	1.01	1.14
104	GRC	Greece	1985	0.91	1.20	1.11	1.38	1.09	1.14
105	MYS	Malaysia	2000	1.09	1.19	1.07	1.09	1.24	1.14
106	BHR	Bahrain	1985	1.15	0.81	1.04	2.25	0.42	1.13
107	PAN	Panama	1995	1.17	1.52	1.08	0.75	1.06	1.12
108	CHL	Chile	1995	1.23	1.14	1.11	0.73	1.36	1.11
109	BEL	Belgium	1985	1.23	1.14	1.11	1.12	0.93	1.11
110	ARG	Argentina	1995	1.02	1.10	1.07	0.66	1.64	1.10
111	IRL	Ireland	1985	1.07	1.29	1.08	1.19	0.84	1.09
112	MYS	Malaysia	1990	1.19	1.04	1.04	0.78	1.28	1.06
113	CRI	Costa Rica	2000	1.17	0.81	1.15	1.07	1.09	1.06
114	CHN	China	2000	0.96	1.20	1.04	0.33	1.74	1.06
115	MUS	Mauritius	1985	1.10	1.26	1.00	0.56	1.24	1.03
116	ESP	Spain	1985	1.00	1.23	1.12	0.98	0.82	1.03
117	KWT	Kuwait	2000	1.09	1.27	1.13	1.20	0.44	1.03
118	ITA	Italy	1985	0.98	1.12	1.11	1.02	0.88	1.02

(continued on next page)

Table A13: Public-sector performance for the DEA-sample – continued

rank	country		year	PSP1	PSP2	PSP3	PSP4	PSP5	PSP0
119	CRI	Costa Rica	1995	1.11	0.82	1.13	0.94	1.08	1.02
120	TUN	Tunisia	2000	1.04	0.85	1.07	0.41	1.71	1.02
121	JAM	Jamaica	2000	1.09	1.04	1.05	0.95	0.95	1.02
122	MYS	Malaysia	1985	1.15	0.93	1.02	0.60	1.33	1.01
123	LKA	Sri Lanka	1995	0.95	1.20	1.07	0.07	1.74	1.00
124	MEX	Mexico	2000	0.90	1.31	1.09	0.54	1.13	0.99
125	TTO	Trinidad and Tobago	1990	1.00	1.05	1.03	1.67	0.23	0.99
126	ARG	Argentina	2000	1.17	1.10	1.09	0.88	0.72	0.99
127	URY	Uruguay	2000	1.10	1.03	1.10	0.97	0.76	0.99
128	HUN	Hungary	1995	1.09	1.23	1.03	0.69	0.88	0.98
129	ISR	Israel	1985	0.65	1.40	1.11	1.13	0.61	0.98
130	PHL	Philippines	2000	1.08	1.65	1.03	0.15	0.97	0.97
131	URY	Uruguay	1995	0.89	1.03	1.08	0.71	1.15	0.97
132	COL	Colombia	2000	0.83	0.90	1.05	0.82	1.19	0.96
133	THA	Thailand	1990	1.08	0.65	0.99	0.15	1.88	0.95
134	CHL	Chile	1990	1.04	1.14	1.09	0.39	1.07	0.95
135	PAN	Panama	1990	1.06	1.52	1.07	0.40	0.68	0.95
136	THA	Thailand	1995	1.12	0.71	1.00	0.26	1.62	0.94
137	CHN	China	1995	0.85	1.15	1.02	0.11	1.55	0.94
138	SLV	El Salvador	2000	1.09	0.52	1.03	0.70	1.31	0.93
139	JAM	Jamaica	1995	0.95	1.01	1.06	0.79	0.86	0.93
140	COL	Colombia	1990	0.74	0.81	1.01	0.44	1.63	0.93
141	TTO	Trinidad and Tobago	1985	0.96	0.96	1.02	1.69	-0.02	0.92
142	PAN	Panama	1985	1.07	1.09	1.05	0.43	0.95	0.92
143	PHL	Philippines	1995	1.08	1.59	1.00	0.12	0.78	0.91
144	BRA	Brazil	2000	0.95	0.74	1.04	0.72	1.08	0.91
145	JAM	Jamaica	1990	0.85	0.98	1.05	0.75	0.89	0.90
146	PER	Peru	2000	1.04	1.09	1.02	0.25	1.12	0.90
147	KWT	Kuwait	1985	1.07	1.21	1.08	0.94	0.21	0.90
148	CRI	Costa Rica	1990	1.10	0.81	1.12	0.54	0.91	0.89
149	URY	Uruguay	1990	0.90	1.01	1.07	0.46	1.01	0.89
150	TUN	Tunisia	1995	1.00	0.75	1.05	0.27	1.37	0.89
151	CHN	China	1990	0.84	1.09	1.02	0.03	1.46	0.89
152	TUR	Turkey	2000	0.82	0.73	1.04	0.84	0.99	0.88
153	EGY	Egypt. Arab Rep.	2000	1.10	0.84	1.01	0.26	1.19	0.88
154	LKA	Sri Lanka	2000	0.92	1.24	1.09	0.12	1.03	0.88
155	HUN	Hungary	1985	0.92	1.14	1.02	0.30	1.01	0.88
156	ZAF	South Africa	1990	0.78	0.63	0.91	0.41	1.64	0.88
157	BWA	Botswana	2000	1.24	0.86	0.72	0.51	1.01	0.87
158	KWT	Kuwait	1990	0.70	1.21	1.11	0.75	0.57	0.87

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Table A13: Public-sector performance for the DEA-sample – continued

rank	country		year	PSP1	PSP2	PSP3	PSP4	PSP5	PSP0
159	IRN	Iran. Islamic Rep.	2000	0.94	0.97	1.02	0.48	0.85	0.85
160	ZAF	South Africa	2000	1.16	0.73	0.72	0.48	1.17	0.85
161	HUN	Hungary	1990	0.95	1.18	1.02	0.38	0.70	0.85
162	JOR	Jordan	1995	1.05	0.87	1.02	0.49	0.78	0.84
163	BWA	Botswana	1990	0.98	0.63	0.93	0.37	1.28	0.84
164	CHN	China	1985	0.86	0.89	1.01	0.01	1.42	0.84
165	MEX	Mexico	1995	0.93	1.26	1.07	0.43	0.48	0.83
166	JOR	Jordan	1985	0.95	0.62	0.96	0.57	1.06	0.83
167	ECU	Ecuador	1995	0.89	0.87	1.05	0.30	1.02	0.83
168	TUR	Turkey	1990	0.72	0.66	0.97	0.37	1.35	0.82
169	IDN	Indonesia	1995	0.94	0.73	0.94	0.14	1.28	0.81
170	SLV	El Salvador	1995	1.07	0.51	1.01	0.39	1.03	0.80
171	TUR	Turkey	1995	0.79	0.73	1.00	0.64	0.85	0.80
172	COG	Congo. Rep.	1985	0.80	0.62	0.84	0.25	1.50	0.80
173	PHL	Philippines	1990	0.70	1.17	0.97	0.11	1.05	0.80
174	JAM	Jamaica	1985	0.72	0.92	1.05	0.94	0.36	0.80
175	VEN	Venezuela. RB	2000	0.79	1.05	1.08	0.70	0.37	0.80
176	LKA	Sri Lanka	1985	0.87	1.14	1.03	0.04	0.91	0.80
177	COL	Colombia	1995	0.74	0.86	1.03	0.65	0.69	0.79
178	VEN	Venezuela. RB	1995	0.55	1.12	1.06	0.56	0.67	0.79
179	COL	Colombia	1985	0.81	0.81	1.00	0.45	0.85	0.78
180	ECU	Ecuador	2000	0.67	0.89	1.08	0.36	0.90	0.78
181	PER	Peru	1995	0.90	1.07	1.00	0.23	0.68	0.78
182	PRT	Portugal	1985	0.90	0.75	1.08	0.59	0.57	0.78
183	THA	Thailand	1985	1.02	0.66	0.97	0.10	1.14	0.78
184	VEN	Venezuela. RB	1985	1.02	0.93	1.03	0.60	0.31	0.78
185	BWA	Botswana	1985	1.02	0.42	0.92	0.25	1.23	0.77
186	THA	Thailand	2000	1.03	0.75	1.01	0.36	0.71	0.77
187	IRN	Iran. Islamic Rep.	1995	0.72	0.84	0.99	0.28	1.01	0.77
188	BWA	Botswana	1995	1.11	0.75	0.83	0.29	0.86	0.77
189	ECU	Ecuador	1990	0.75	0.85	1.02	0.32	0.90	0.77
190	LKA	Sri Lanka	1990	0.74	1.16	1.05	0.05	0.81	0.76
191	IND	India	2000	1.02	0.67	0.93	0.10	1.10	0.76
192	ZAF	South Africa	1995	1.06	0.74	0.86	0.40	0.76	0.76
193	PAK	Pakistan	1995	0.95	0.87	0.90	0.09	1.01	0.76
194	PNG	Papua New Guinea	1995	0.94	0.34	0.83	0.48	1.22	0.76
195	IDN	Indonesia	1990	1.00	0.64	0.91	0.10	1.16	0.76
196	MEX	Mexico	1990	0.87	1.21	1.05	0.32	0.33	0.75
197	EGY	Egypt. Arab Rep.	1995	0.96	0.76	0.97	0.16	0.92	0.75

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Table A13: Public-sector performance for the DEA-sample – continued

rank	country		year	PSP1	PSP2	PSP3	PSP4	PSP5	PSP0
198	PAK	Pakistan	1990	0.84	0.92	0.87	0.06	1.06	0.75
199	ZAF	South Africa	1985	0.86	0.68	0.88	0.33	0.96	0.74
200	SYR	Syrian Arab Republic	2000	0.76	0.79	1.07	0.32	0.77	0.74
201	EGY	Egypt. Arab Rep.	1990	0.87	0.67	0.92	0.10	1.11	0.73
202	PNG	Papua New Guinea	1985	1.03	0.21	0.79	1.19	0.44	0.73
203	PNG	Papua New Guinea	1990	1.06	0.29	0.81	1.21	0.28	0.73
204	SYR	Syrian Arab Republic	1995	0.76	0.74	1.04	0.21	0.87	0.73
205	TUN	Tunisia	1990	0.86	0.65	1.04	0.21	0.86	0.72
206	CRI	Costa Rica	1985	0.94	0.82	1.10	0.44	0.32	0.72
207	CMR	Cameroon	1985	0.95	0.38	0.80	0.07	1.43	0.72
208	CHL	Chile	1985	0.96	1.12	1.06	0.27	0.19	0.72
209	PAK	Pakistan	2000	0.88	0.83	0.93	0.09	0.87	0.72
210	URY	Uruguay	1985	0.86	1.04	1.06	0.45	0.12	0.70
211	ECU	Ecuador	1985	0.84	0.84	0.98	0.29	0.55	0.70
212	VEN	Venezuela. RB	1990	0.81	0.76	1.05	0.51	0.37	0.70
213	ARG	Argentina	1990	0.72	1.09	1.06	0.49	0.12	0.70
214	BRA	Brazil	1995	0.64	0.70	1.01	0.42	0.71	0.69
215	IND	India	1990	0.88	0.53	0.87	0.03	1.16	0.69
216	IND	India	1995	0.96	0.60	0.91	0.05	0.94	0.69
217	IND	India	1985	0.93	0.47	0.83	0.02	1.17	0.69
218	NIC	Nicaragua	2000	1.01	0.60	1.03	0.09	0.69	0.68
219	CMR	Cameroon	2000	0.86	0.52	0.75	0.04	1.17	0.67
220	TUN	Tunisia	1985	0.80	0.55	0.96	0.20	0.77	0.66
221	KEN	Kenya	1990	0.96	0.40	0.88	0.06	0.99	0.66
222	MEX	Mexico	1985	0.71	0.76	1.02	0.32	0.48	0.66
223	SEN	Senegal	2000	0.87	0.34	0.90	0.07	1.06	0.65
224	BRA	Brazil	1990	0.64	0.69	0.98	0.36	0.56	0.65
225	PNG	Papua New Guinea	2000	0.93	0.38	0.84	0.44	0.63	0.65
226	TUR	Turkey	1985	0.75	0.59	0.94	0.16	0.78	0.64
227	SLV	El Salvador	1985	0.70	0.49	0.90	0.20	0.92	0.64
228	EGY	Egypt. Arab Rep.	1985	1.02	0.59	0.86	0.09	0.65	0.64
229	UGA	Uganda	2000	1.04	0.42	0.69	0.01	1.02	0.63
230	BGD	Bangladesh	2000	0.86	0.48	0.90	0.01	0.90	0.63
231	ARG	Argentina	1985	0.65	0.99	1.04	0.47	-0.01	0.63
232	IDN	Indonesia	1985	0.94	0.68	0.86	0.09	0.53	0.62
233	IDN	Indonesia	2000	0.76	0.81	0.97	0.14	0.41	0.62

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Table A13: Public-sector performance for the DEA-sample – continued

rank	country		year	PSP1	PSP2	PSP3	PSP4	PSP5	PSP0
234	ZWE	Zimbabwe	1990	0.78	0.58	0.90	0.10	0.73	0.62
235	SLV	El Salvador	1990	0.66	0.50	0.97	0.22	0.74	0.62
236	GHA	Ghana	1990	0.81	0.42	0.84	0.07	0.94	0.62
237	KEN	Kenya	2000	1.02	0.50	0.77	0.09	0.65	0.61
238	COG	Congo. Rep.	1990	0.75	0.67	0.84	0.15	0.58	0.60
239	PAK	Pakistan	1985	0.86	0.34	0.85	0.05	0.90	0.60
240	GHA	Ghana	2000	0.88	0.48	0.86	0.05	0.71	0.60
241	BGD	Bangladesh	1990	0.78	0.44	0.81	0.01	0.94	0.60
242	CAF	Central African Republic	2000	0.82	0.35	0.65	0.04	1.06	0.58
243	SEN	Senegal	1990	0.83	0.32	0.85	0.05	0.85	0.58
244	BRA	Brazil	1985	0.58	0.57	0.95	0.32	0.45	0.57
245	MWI	Malawi	1985	0.87	0.40	0.69	0.07	0.84	0.57
246	GHA	Ghana	1995	0.86	0.46	0.86	0.02	0.66	0.57
247	BGD	Bangladesh	1995	0.89	0.46	0.86	0.01	0.62	0.57
248	BGD	Bangladesh	1985	0.74	0.40	0.76	0.01	0.90	0.57
249	BEN	Benin	2000	0.86	0.29	0.80	0.04	0.83	0.56
250	ZWE	Zimbabwe	2000	0.74	0.63	0.63	0.13	0.65	0.56
251	IRN	Iran. Islamic Rep.	1990	0.75	0.71	0.96	0.16	0.18	0.55
252	NIC	Nicaragua	1995	0.87	0.54	1.00	0.07	0.27	0.55
253	PHL	Philippines	1985	0.71	1.03	0.93	0.10	-0.04	0.55
254	TGO	Togo	1990	0.86	0.32	0.85	0.02	0.66	0.54
255	JOR	Jordan	1990	0.88	0.78	1.00	0.52	-0.48	0.54
256	BEN	Benin	1985	0.82	0.15	0.76	0.05	0.91	0.54
257	KEN	Kenya	1995	0.87	0.46	0.83	0.06	0.44	0.53
258	UGA	Uganda	1995	0.77	0.41	0.68	0.01	0.79	0.53
259	SEN	Senegal	1985	0.82	0.32	0.80	0.08	0.63	0.53
260	BEN	Benin	1990	0.87	0.22	0.78	0.02	0.74	0.53
261	IRN	Iran. Islamic Rep.	1985	0.72	0.60	0.91	0.11	0.29	0.53
262	MWI	Malawi	1995	0.66	0.37	0.71	0.04	0.81	0.52
263	KEN	Kenya	1985	1.00	0.33	0.87	0.06	0.32	0.52
264	ZWE	Zimbabwe	1985	0.80	0.49	0.91	0.11	0.26	0.51
265	SYR	Syrian Arab Republic	1985	0.63	0.55	0.97	0.14	0.23	0.50
266	CAF	Central African Republic	1990	0.85	0.30	0.73	0.10	0.51	0.50
267	PER	Peru	1985	0.33	0.99	0.93	0.16	0.06	0.49
268	ZWE	Zimbabwe	1995	0.86	0.59	0.77	0.10	0.14	0.49
269	NER	Niger	2000	0.92	0.13	0.79	0.02	0.59	0.49
270	BEN	Benin	1995	0.78	0.26	0.80	0.03	0.53	0.48
271	TGO	Togo	1995	0.78	0.37	0.86	0.03	0.32	0.47

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Table A13: Public-sector performance for the DEA-sample – continued

rank	country		year	PSP1	PSP2	PSP3	PSP4	PSP5	PSP0
272	TGO	Togo	2000	0.78	0.40	0.85	0.04	0.24	0.46
273	CMR	Cameroon	1990	0.98	0.43	0.81	0.05	0.04	0.46
274	NER	Niger	1990	0.90	0.09	0.69	0.01	0.62	0.46
275	SYR	Syrian Arab Republic	1990	0.60	0.68	1.01	0.17	-0.18	0.46
276	MWI	Malawi	2000	0.76	0.38	0.68	0.04	0.42	0.45
277	PER	Peru	1990	0.45	0.91	0.97	0.14	-0.23	0.45
278	SEN	Senegal	1995	0.72	0.33	0.88	0.06	0.26	0.45
279	COG	Congo. Rep.	1995	0.71	0.64	0.80	0.20	-0.15	0.44
280	MWI	Malawi	1990	0.81	0.37	0.72	0.04	0.12	0.41
281	CAF	Central African Republic	1985	0.67	0.19	0.73	0.13	0.29	0.40
282	CMR	Cameroon	1995	0.83	0.48	0.78	0.03	-0.14	0.40
283	NIC	Nicaragua	1985	0.34	0.44	0.90	0.08	0.19	0.39
284	UGA	Uganda	1990	0.42	0.43	0.74	0.01	0.35	0.39
285	SLE	Sierra Leone	1985	0.58	0.15	0.58	0.07	0.52	0.38
286	GHA	Ghana	1985	0.52	0.39	0.81	0.04	0.07	0.37
287	CAF	Central African Republic	1995	0.75	0.32	0.70	0.04	-0.02	0.36
288	NER	Niger	1985	0.83	0.08	0.65	0.02	0.06	0.33
289	NER	Niger	1995	0.73	0.12	0.74	0.01	-0.05	0.31
290	UGA	Uganda	1985	0.44	0.27	0.75	0.01	0.05	0.31
291	NIC	Nicaragua	1990	0.40	0.47	0.95	0.11	-0.41	0.30
292	TGO	Togo	1985	0.85	0.26	0.83	0.04	-0.49	0.30
293	COG	Congo. Rep.	2000	0.63	0.66	0.78	0.18	-0.78	0.29
294	SLE	Sierra Leone	1995	0.63	0.20	0.58	0.01	-0.06	0.27
295	SLE	Sierra Leone	2000	0.80	0.24	0.60	0.01	-0.41	0.25
296	SLE	Sierra Leone	1990	0.58	0.17	0.58	0.02	-0.12	0.24

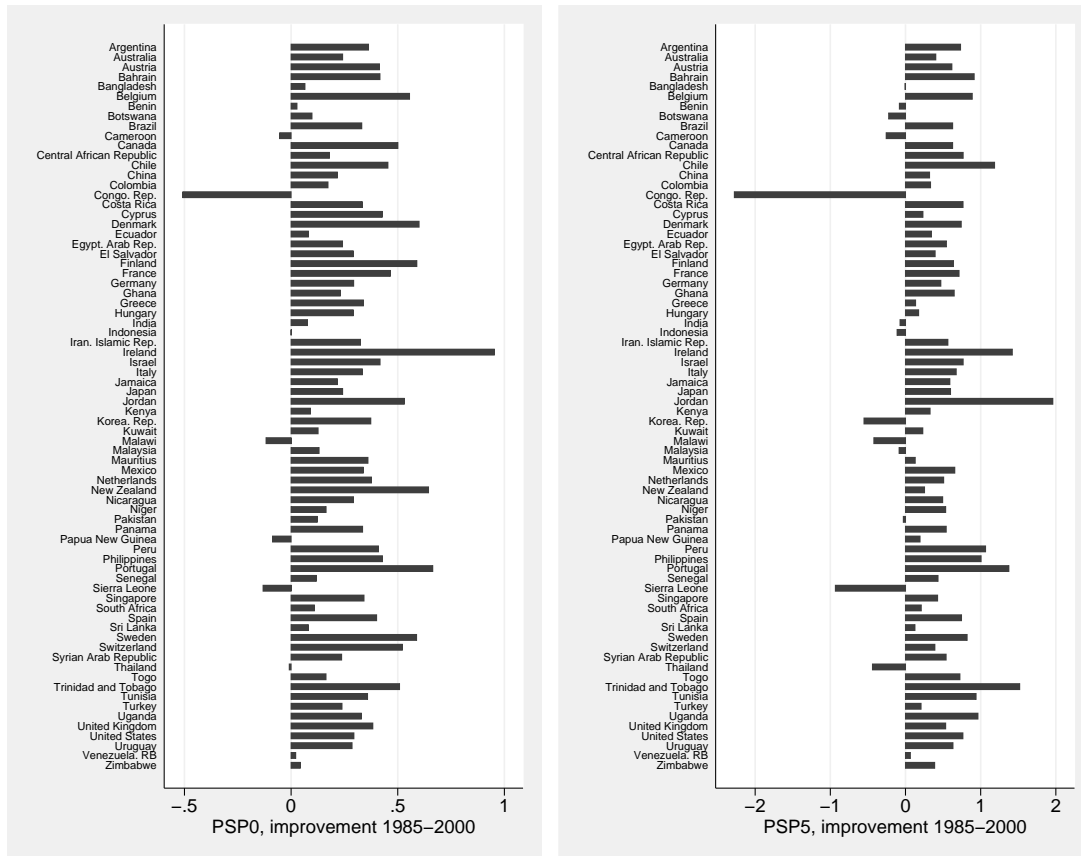


Figure A11: Change of public-sector performance 1985-2000. Left: Overall PSP. Right: PSP5, economic stability and performance.

Public-sector efficiency in the DEA-sample

Table A14: Public-sector efficiency for the DEA-sample. (Bias, 95% confidence interval, uncorrected DEA-score, corrected DEA-score)

country	year	bias	lower bound CI	upper bound CI	DEA-score	DEA-score (corrected)
SWE	Sweden	2000	0.02	0.93	0.99	0.97
NZL	New Zealand	2000	0.03	0.92	0.98	0.96
KOR	Korea. Rep.	1990	0.05	0.91	0.99	0.95
CHN	China	1985	0.06	0.90	0.99	0.94

(continued on next page)

Table A14: Public-sector efficiency for the DEA-sample – continued

country		year	bias	lower bound CI	upper bound CI	DEA-score	DEA-score (corrected)
CHE	Switzerland	2000	0.09	0.88	0.98	1.00	0.91
USA	United States	2000	0.03	0.86	0.93	0.93	0.90
CHN	China	1990	0.03	0.85	0.92	0.92	0.89
KEN	Kenya	1990	0.07	0.82	0.94	0.95	0.89
DNK	Denmark	2000	0.02	0.85	0.90	0.90	0.88
KOR	Korea. Rep.	1985	0.03	0.85	0.91	0.91	0.88
KOR	Korea. Rep.	1995	0.03	0.84	0.91	0.91	0.88
FIN	Finland	2000	0.02	0.83	0.89	0.89	0.87
IRL	Ireland	2000	0.05	0.82	0.91	0.91	0.86
USA	United States	1995	0.02	0.82	0.88	0.88	0.86
EGY	Egypt. Arab Rep.	2000	0.03	0.82	0.88	0.88	0.85
PHL	Philippines	2000	0.03	0.82	0.87	0.88	0.85
CHE	Switzerland	1985	0.03	0.80	0.87	0.88	0.84
CHE	Switzerland	1995	0.08	0.80	0.90	0.92	0.84
DNK	Denmark	1995	0.02	0.80	0.85	0.85	0.84
PHL	Philippines	1995	0.03	0.80	0.86	0.86	0.84
CAN	Canada	2000	0.03	0.80	0.86	0.86	0.84
SWE	Sweden	1995	0.02	0.80	0.85	0.85	0.83
CHE	Switzerland	1990	0.05	0.78	0.86	0.86	0.82
KOR	Korea. Rep.	2000	0.03	0.78	0.84	0.85	0.82
BGD	Bangladesh	1990	0.06	0.76	0.87	0.88	0.81
USA	United States	1990	0.02	0.78	0.83	0.83	0.81
NZL	New Zealand	1995	0.03	0.76	0.82	0.82	0.80
BGD	Bangladesh	2000	0.05	0.75	0.84	0.85	0.80
DNK	Denmark	1990	0.02	0.76	0.81	0.81	0.80
EGY	Egypt. Arab Rep.	1995	0.03	0.76	0.83	0.83	0.80
BEN	Benin	2000	0.07	0.73	0.86	0.86	0.79
SGP	Singapore	1995	0.03	0.75	0.81	0.82	0.79
BGD	Bangladesh	1985	0.07	0.73	0.85	0.85	0.79
PAN	Panama	2000	0.03	0.75	0.82	0.82	0.79
SWE	Sweden	1990	0.02	0.75	0.80	0.80	0.78
CHN	China	1995	0.02	0.74	0.79	0.80	0.77
USA	United States	1985	0.03	0.73	0.79	0.80	0.77
COG	Congo. Rep.	1985	0.02	0.73	0.78	0.78	0.76
BEN	Benin	1990	0.10	0.70	0.85	0.86	0.76
PHL	Philippines	1990	0.02	0.72	0.77	0.78	0.75

(continued on next page)

Table A14: Public-sector efficiency for the DEA-sample – continued

country		year	bias	lower bound CI	upper bound CI	DEA-score	DEA-score (corrected)
THA	Thailand	1990	0.02	0.72	0.77	0.77	0.75
FIN	Finland	1990	0.02	0.72	0.77	0.77	0.75
MYS	Malaysia	1995	0.02	0.71	0.77	0.77	0.75
EGY	Egypt. Arab Rep.	1990	0.03	0.72	0.77	0.77	0.75
BEN	Benin	1985	0.15	0.70	0.89	0.90	0.75
MUS	Mauritius	1990	0.03	0.71	0.77	0.78	0.75
AUT	Austria	2000	0.02	0.71	0.76	0.76	0.74
AUS	Australia	1995	0.02	0.71	0.76	0.76	0.74
MUS	Mauritius	2000	0.02	0.71	0.76	0.77	0.74
BGD	Bangladesh	1995	0.05	0.69	0.78	0.79	0.74
MUS	Mauritius	1995	0.03	0.71	0.76	0.76	0.74
AUS	Australia	2000	0.02	0.71	0.76	0.76	0.74
SGP	Singapore	1985	0.03	0.71	0.76	0.76	0.74
SEN	Senegal	2000	0.04	0.69	0.77	0.77	0.73
FIN	Finland	1995	0.02	0.70	0.75	0.75	0.73
GRC	Greece	2000	0.03	0.69	0.75	0.75	0.72
CMR	Cameroon	2000	0.03	0.69	0.75	0.76	0.72
BEL	Belgium	2000	0.02	0.69	0.74	0.74	0.72
SGP	Singapore	1990	0.02	0.69	0.74	0.75	0.72
GHA	Ghana	1990	0.04	0.68	0.76	0.76	0.72
NZL	New Zealand	1990	0.02	0.69	0.74	0.74	0.72
CAF	Central African Republic	1990	0.07	0.66	0.78	0.78	0.71
NLD	Netherlands	2000	0.02	0.68	0.73	0.73	0.71
CMR	Cameroon	1985	0.02	0.68	0.73	0.74	0.71
KEN	Kenya	2000	0.04	0.67	0.75	0.75	0.71
SWE	Sweden	1985	0.02	0.68	0.72	0.72	0.71
PAK	Pakistan	1995	0.02	0.68	0.73	0.73	0.71
PER	Peru	2000	0.02	0.68	0.73	0.73	0.71
DEU	Germany	2000	0.02	0.67	0.72	0.72	0.70
GBR	United Kingdom	2000	0.02	0.67	0.72	0.72	0.70
SLV	El Salvador	2000	0.02	0.67	0.72	0.73	0.70
PAN	Panama	1995	0.03	0.67	0.73	0.73	0.70
FRA	France	2000	0.02	0.67	0.72	0.72	0.70
BWA	Botswana	1985	0.02	0.67	0.72	0.72	0.70
SYR	Syrian Arab Republic	2000	0.02	0.67	0.72	0.72	0.70

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Table A14: Public-sector efficiency for the DEA-sample – continued

country		year	bias	lower bound CI	upper bound CI	DEA-score	DEA-score (corrected)
MWI	Malawi	1995	0.18	0.66	0.87	0.88	0.70
COL	Colombia	1990	0.02	0.67	0.72	0.72	0.70
PAK	Pakistan	2000	0.02	0.67	0.72	0.72	0.70
CYP	Cyprus	2000	0.02	0.66	0.71	0.71	0.69
GRC	Greece	1995	0.02	0.66	0.72	0.72	0.69
KEN	Kenya	1985	0.05	0.64	0.74	0.74	0.69
PAK	Pakistan	1990	0.02	0.66	0.71	0.71	0.69
TUN	Tunisia	2000	0.03	0.66	0.71	0.72	0.69
KWT	Kuwait	1995	0.01	0.66	0.70	0.70	0.68
AUT	Austria	1995	0.02	0.65	0.70	0.70	0.68
KEN	Kenya	1995	0.04	0.64	0.72	0.72	0.68
BEN	Benin	1995	0.06	0.63	0.74	0.74	0.68
CHN	China	2000	0.04	0.65	0.70	0.71	0.67
NZL	New Zealand	1985	0.02	0.64	0.70	0.70	0.67
NLD	Netherlands	1995	0.01	0.64	0.69	0.69	0.67
GRC	Greece	1990	0.02	0.64	0.69	0.69	0.67
SYR	Syrian Arab Republic	1995	0.02	0.64	0.68	0.69	0.67
LKA	Sri Lanka	1995	0.03	0.64	0.70	0.70	0.67
MUS	Mauritius	1985	0.03	0.64	0.70	0.70	0.67
PER	Peru	1995	0.02	0.64	0.68	0.69	0.67
IND	India	1985	0.02	0.64	0.68	0.69	0.66
AUS	Australia	1990	0.02	0.63	0.68	0.68	0.66
SGP	Singapore	2000	0.05	0.63	0.71	0.71	0.66
UGA	Uganda	2000	0.03	0.63	0.69	0.69	0.66
BHR	Bahrain	2000	0.03	0.63	0.69	0.69	0.66
TUR	Turkey	1990	0.02	0.63	0.68	0.68	0.66
CAN	Canada	1995	0.02	0.63	0.68	0.68	0.66
DEU	Germany	1995	0.02	0.63	0.68	0.68	0.66
THA	Thailand	1995	0.03	0.63	0.68	0.68	0.66
CAF	Central African Republic	2000	0.34	0.69	0.98	1.00	0.66
LKA	Sri Lanka	1985	0.02	0.63	0.67	0.67	0.65
FRA	France	1995	0.01	0.62	0.67	0.67	0.65
IRL	Ireland	1995	0.06	0.62	0.70	0.71	0.65
TUN	Tunisia	1995	0.02	0.62	0.67	0.67	0.65
IDN	Indonesia	1990	0.02	0.62	0.66	0.67	0.65

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Table A14: Public-sector efficiency for the DEA-sample – continued

country		year	bias	lower bound CI	upper bound CI	DEA-score	DEA-score (corrected)
MWI	Malawi	2000	0.11	0.60	0.74	0.75	0.64
CAN	Canada	1990	0.02	0.61	0.66	0.66	0.64
THA	Thailand	1985	0.02	0.62	0.66	0.66	0.64
GBR	United Kingdom	1990	0.02	0.61	0.66	0.66	0.64
JAM	Jamaica	1995	0.03	0.61	0.66	0.67	0.64
CYP	Cyprus	1995	0.02	0.61	0.66	0.66	0.64
IDN	Indonesia	1995	0.02	0.61	0.66	0.66	0.64
EGY	Egypt. Arab Rep.	1985	0.02	0.61	0.66	0.66	0.64
GBR	United Kingdom	1995	0.02	0.61	0.65	0.65	0.64
IRL	Ireland	1990	0.04	0.60	0.68	0.68	0.64
JOR	Jordan	2000	0.03	0.60	0.66	0.67	0.64
JPN	Japan	2000	0.02	0.60	0.65	0.65	0.63
MYS	Malaysia	1990	0.02	0.61	0.65	0.65	0.63
PRT	Portugal	2000	0.01	0.60	0.64	0.64	0.63
SLV	El Salvador	1995	0.02	0.60	0.64	0.65	0.63
FRA	France	1990	0.01	0.60	0.64	0.64	0.63
COL	Colombia	1985	0.02	0.60	0.64	0.65	0.63
CRI	Costa Rica	2000	0.02	0.60	0.64	0.65	0.63
MEX	Mexico	2000	0.03	0.60	0.65	0.65	0.62
DNK	Denmark	1985	0.01	0.60	0.64	0.64	0.62
GHA	Ghana	2000	0.03	0.59	0.64	0.65	0.62
GHA	Ghana	1995	0.03	0.59	0.65	0.65	0.62
BEL	Belgium	1995	0.01	0.59	0.64	0.64	0.62
AUS	Australia	1985	0.03	0.59	0.65	0.65	0.62
SEN	Senegal	1990	0.03	0.59	0.64	0.65	0.62
TTO	Trinidad and Tobago	2000	0.04	0.59	0.66	0.66	0.62
CAN	Canada	1985	0.02	0.59	0.64	0.64	0.62
TUR	Turkey	1995	0.02	0.59	0.63	0.64	0.62
PAK	Pakistan	1985	0.02	0.59	0.64	0.64	0.62
JAM	Jamaica	2000	0.02	0.59	0.63	0.64	0.61
ESP	Spain	2000	0.03	0.58	0.63	0.64	0.61
TUR	Turkey	2000	0.03	0.59	0.63	0.64	0.61
ISR	Israel	2000	0.01	0.58	0.62	0.62	0.61
CYP	Cyprus	1990	0.03	0.58	0.64	0.64	0.61
FIN	Finland	1985	0.02	0.58	0.62	0.63	0.61
NLD	Netherlands	1990	0.01	0.58	0.62	0.62	0.60

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Table A14: Public-sector efficiency for the DEA-sample – continued

country		year	bias	lower bound CI	upper bound CI	DEA-score	DEA-score (corrected)
DEU	Germany	1990	0.02	0.58	0.62	0.62	0.60
AUT	Austria	1990	0.02	0.57	0.62	0.62	0.60
JAM	Jamaica	1990	0.03	0.58	0.63	0.63	0.60
CRI	Costa Rica	1995	0.02	0.58	0.62	0.62	0.60
ISR	Israel	1995	0.01	0.57	0.61	0.61	0.59
IND	India	1990	0.02	0.57	0.61	0.61	0.59
UGA	Uganda	1995	0.03	0.56	0.62	0.62	0.59
MYS	Malaysia	1985	0.02	0.56	0.61	0.61	0.59
ITA	Italy	2000	0.02	0.56	0.60	0.60	0.58
COG	Congo. Rep.	1990	0.02	0.56	0.60	0.60	0.58
TUR	Turkey	1985	0.02	0.56	0.60	0.60	0.58
JPN	Japan	1995	0.03	0.55	0.61	0.61	0.58
TGO	Togo	1990	0.03	0.55	0.60	0.61	0.58
MYS	Malaysia	2000	0.02	0.55	0.60	0.60	0.58
ZWE	Zimbabwe	2000	0.02	0.55	0.60	0.60	0.58
SEN	Senegal	1985	0.03	0.55	0.60	0.60	0.58
GRC	Greece	1985	0.02	0.55	0.59	0.60	0.58
TTO	Trinidad and Tobago	1995	0.04	0.55	0.61	0.61	0.58
BHR	Bahrain	1995	0.01	0.55	0.59	0.59	0.57
JPN	Japan	1990	0.04	0.54	0.60	0.61	0.57
ESP	Spain	1990	0.04	0.54	0.61	0.61	0.57
DEU	Germany	1985	0.02	0.54	0.59	0.59	0.57
CAF	Central African Republic	1985	0.05	0.52	0.61	0.62	0.57
BEL	Belgium	1990	0.01	0.54	0.58	0.58	0.57
BHR	Bahrain	1990	0.01	0.54	0.58	0.58	0.57
NER	Niger	2000	0.03	0.53	0.59	0.60	0.56
IND	India	1995	0.02	0.54	0.58	0.58	0.56
TUN	Tunisia	1990	0.02	0.54	0.58	0.58	0.56
CHL	Chile	1995	0.02	0.53	0.58	0.58	0.56
PAN	Panama	1990	0.02	0.54	0.58	0.58	0.56
AUT	Austria	1985	0.02	0.53	0.58	0.58	0.56
IDN	Indonesia	1985	0.02	0.53	0.57	0.57	0.56
CHL	Chile	2000	0.03	0.52	0.57	0.58	0.55
TGO	Togo	2000	0.03	0.52	0.58	0.58	0.55
CYP	Cyprus	1985	0.03	0.52	0.57	0.57	0.55

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Table A14: Public-sector efficiency for the DEA-sample – continued

country		year	bias	lower bound CI	upper bound CI	DEA-score	DEA-score (corrected)
NLD	Netherlands	1985	0.01	0.52	0.56	0.56	0.55
BWA	Botswana	1990	0.03	0.52	0.57	0.57	0.54
MWI	Malawi	1990	0.15	0.52	0.68	0.69	0.54
IRN	Iran. Islamic Rep.	2000	0.03	0.52	0.57	0.57	0.54
ARG	Argentina	1995	0.02	0.52	0.56	0.56	0.54
SLE	Sierra Leone	1985	0.05	0.50	0.59	0.60	0.54
LKA	Sri Lanka	1990	0.02	0.52	0.56	0.56	0.54
GBR	United Kingdom	1985	0.02	0.51	0.55	0.55	0.53
JAM	Jamaica	1985	0.03	0.51	0.55	0.56	0.53
PAN	Panama	1985	0.02	0.51	0.55	0.55	0.53
IND	India	2000	0.02	0.51	0.55	0.55	0.53
LKA	Sri Lanka	2000	0.02	0.51	0.55	0.55	0.53
TGO	Togo	1995	0.03	0.50	0.56	0.56	0.53
ITA	Italy	1990	0.02	0.51	0.55	0.55	0.53
ITA	Italy	1995	0.02	0.51	0.55	0.55	0.53
ESP	Spain	1995	0.03	0.50	0.56	0.56	0.53
TUN	Tunisia	1985	0.02	0.51	0.54	0.55	0.53
ZWE	Zimbabwe	1990	0.02	0.51	0.54	0.54	0.53
SLV	El Salvador	1985	0.02	0.50	0.54	0.54	0.52
CRI	Costa Rica	1990	0.02	0.50	0.54	0.54	0.52
MEX	Mexico	1995	0.02	0.50	0.54	0.54	0.52
IDN	Indonesia	2000	0.02	0.50	0.53	0.53	0.52
ECU	Ecuador	1995	0.02	0.49	0.54	0.54	0.52
ESP	Spain	1985	0.02	0.49	0.53	0.54	0.52
ECU	Ecuador	2000	0.03	0.49	0.54	0.54	0.51
CAF	Central African Republic	1995	0.06	0.47	0.57	0.58	0.51
JPN	Japan	1985	0.04	0.48	0.55	0.55	0.51
COL	Colombia	1995	0.02	0.48	0.52	0.53	0.50
SEN	Senegal	1995	0.03	0.48	0.53	0.53	0.50
CHL	Chile	1990	0.02	0.48	0.52	0.52	0.50
COL	Colombia	2000	0.02	0.48	0.51	0.52	0.50
HUN	Hungary	2000	0.02	0.48	0.52	0.52	0.50
ISR	Israel	1990	0.01	0.48	0.51	0.51	0.50
PHL	Philippines	1985	0.01	0.48	0.51	0.51	0.50
PRT	Portugal	1995	0.01	0.48	0.51	0.51	0.50

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Table A14: Public-sector efficiency for the DEA-sample – continued

country		year	bias	lower bound CI	upper bound CI	DEA-score	DEA-score (corrected)
VEN	Venezuela. RB	2000	0.02	0.47	0.51	0.52	0.50
PRT	Portugal	1990	0.02	0.47	0.52	0.52	0.50
FRA	France	1985	0.01	0.47	0.51	0.51	0.50
BHR	Bahrain	1985	0.01	0.47	0.50	0.51	0.49
BRA	Brazil	2000	0.02	0.47	0.50	0.51	0.49
IRN	Iran. Islamic Rep.	1995	0.02	0.46	0.50	0.51	0.48
THA	Thailand	2000	0.02	0.46	0.50	0.51	0.48
SLV	El Salvador	1990	0.02	0.46	0.50	0.50	0.48
BEL	Belgium	1985	0.01	0.46	0.49	0.49	0.48
URY	Uruguay	1995	0.02	0.46	0.50	0.50	0.48
PNG	Papua New Guinea	1995	0.02	0.46	0.50	0.50	0.48
MEX	Mexico	1990	0.02	0.46	0.49	0.50	0.48
PNG	Papua New Guinea	1990	0.02	0.46	0.50	0.50	0.47
NER	Niger	1990	0.02	0.45	0.49	0.49	0.47
ZWE	Zimbabwe	1985	0.01	0.45	0.48	0.49	0.47
ARG	Argentina	2000	0.02	0.44	0.49	0.49	0.47
VEN	Venezuela. RB	1995	0.02	0.45	0.48	0.48	0.47
URY	Uruguay	2000	0.02	0.44	0.49	0.49	0.46
CMR	Cameroon	1990	0.02	0.44	0.48	0.48	0.46
IRL	Ireland	1985	0.04	0.44	0.50	0.50	0.46
VEN	Venezuela. RB	1985	0.02	0.44	0.48	0.48	0.46
PNG	Papua New Guinea	1985	0.02	0.44	0.48	0.48	0.46
ECU	Ecuador	1990	0.02	0.44	0.47	0.47	0.45
URY	Uruguay	1990	0.02	0.43	0.47	0.47	0.45
KWT	Kuwait	2000	0.01	0.43	0.46	0.46	0.45
BWA	Botswana	2000	0.02	0.43	0.46	0.46	0.45
TTO	Trinidad and Tobago	1990	0.03	0.42	0.47	0.47	0.45
BWA	Botswana	1995	0.02	0.43	0.46	0.46	0.44
UGA	Uganda	1990	0.03	0.42	0.47	0.47	0.44
COG	Congo. Rep.	1995	0.02	0.42	0.46	0.46	0.44
NIC	Nicaragua	2000	0.02	0.42	0.45	0.46	0.44
GHA	Ghana	1985	0.03	0.41	0.45	0.46	0.43
CMR	Cameroon	1995	0.02	0.41	0.45	0.45	0.43
ITA	Italy	1985	0.03	0.41	0.45	0.46	0.43
ISR	Israel	1985	0.01	0.41	0.44	0.44	0.43
HUN	Hungary	1995	0.02	0.40	0.44	0.44	0.42

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Table A14: Public-sector efficiency for the DEA-sample – continued

country		year	bias	lower bound CI	upper bound CI	DEA-score	DEA-score (corrected)
VEN	Venezuela. RB	1990	0.02	0.40	0.43	0.43	0.42
JOR	Jordan	1995	0.02	0.40	0.43	0.43	0.42
ZWE	Zimbabwe	1995	0.01	0.40	0.43	0.43	0.42
CRI	Costa Rica	1985	0.01	0.40	0.43	0.43	0.41
SYR	Syrian Arab Republic	1990	0.01	0.40	0.42	0.43	0.41
MEX	Mexico	1985	0.02	0.39	0.43	0.43	0.41
PNG	Papua New Guinea	2000	0.02	0.39	0.43	0.43	0.41
ZAF	South Africa	2000	0.02	0.38	0.42	0.42	0.40
ZAF	South Africa	1990	0.02	0.38	0.42	0.42	0.40
TTO	Trinidad and Tobago	1985	0.03	0.37	0.42	0.42	0.39
KWT	Kuwait	1985	0.01	0.38	0.40	0.40	0.39
SLE	Sierra Leone	1995	0.04	0.36	0.43	0.43	0.39
ECU	Ecuador	1985	0.01	0.36	0.39	0.39	0.38
KWT	Kuwait	1990	0.01	0.36	0.39	0.39	0.38
URY	Uruguay	1985	0.01	0.36	0.38	0.39	0.37
CHL	Chile	1985	0.01	0.36	0.38	0.39	0.37
ARG	Argentina	1990	0.01	0.36	0.38	0.38	0.37
IRN	Iran. Islamic Rep.	1990	0.02	0.35	0.38	0.38	0.36
HUN	Hungary	1985	0.03	0.34	0.39	0.39	0.36
SYR	Syrian Arab Republic	1985	0.01	0.34	0.37	0.37	0.36
HUN	Hungary	1990	0.02	0.34	0.37	0.38	0.35
SLE	Sierra Leone	1990	0.05	0.32	0.39	0.40	0.35
JOR	Jordan	1985	0.02	0.33	0.37	0.37	0.35
ZAF	South Africa	1985	0.02	0.33	0.36	0.36	0.35
ZAF	South Africa	1995	0.02	0.33	0.36	0.37	0.35
NIC	Nicaragua	1995	0.02	0.33	0.36	0.36	0.34
PER	Peru	1990	0.01	0.33	0.35	0.36	0.34
UGA	Uganda	1985	0.02	0.33	0.36	0.36	0.34
BRA	Brazil	1995	0.01	0.32	0.35	0.35	0.34
NER	Niger	1995	0.02	0.32	0.35	0.35	0.34
PER	Peru	1985	0.01	0.32	0.35	0.35	0.34
SLE	Sierra Leone	2000	0.09	0.31	0.41	0.42	0.33
NER	Niger	1985	0.01	0.31	0.34	0.34	0.33
ARG	Argentina	1985	0.01	0.31	0.33	0.34	0.32
PRT	Portugal	1985	0.03	0.31	0.35	0.35	0.32
COG	Congo. Rep.	2000	0.02	0.31	0.34	0.34	0.32

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Table A14: Public-sector efficiency for the DEA-sample – continued

country		year	bias	lower bound CI	upper bound CI	DEA-score	DEA-score (corrected)
BRA	Brazil	1985	0.01	0.31	0.33	0.33	0.32
BRA	Brazil	1990	0.02	0.28	0.31	0.31	0.29
TGO	Togo	1985	0.01	0.28	0.30	0.30	0.29
IRN	Iran. Islamic Rep.	1985	0.01	0.28	0.30	0.30	0.29
MWI	Malawi	1985	0.74	0.60	0.96	1.00	0.26
JOR	Jordan	1990	0.02	0.21	0.24	0.24	0.22
NIC	Nicaragua	1985	0.01	0.15	0.17	0.17	0.16
NIC	Nicaragua	1990	0.01	0.13	0.14	0.15	0.14

References

- AFONSO, António / AUBYN, Miguel St. (2006a). Cross-country efficiency of secondary education provision: A semi-parametric analysis with non-discretionary inputs. *Economic Modelling*, 23(3): 476–491. doi:10.1016/j.econmod.2006.02.003.
- (2006b). Relative Efficiency of Health Provision: a DEA Approach with Non-discretionary Inputs. *Working Papers 2006/33*, Department of Economics, Institute for Economics and Business Administration (ISEG), Technical University of Lisbon. Available from: <http://ideas.repec.org/p/ise/isegwp/wp332006.html>.
- (2007). Assessing Health Efficiency Across Countries with a Two-Step and Bootstrap Analysis. Paper presented at the conference “Fiscal Policy Challenges in Europe”, 22-23 March 2007, Ministry of Finance, Berlin.
- AFONSO, António / SCHUHKNECHT, Ludger / TANZI, Vito (2005). Public Sector Efficiency: An International Comparison. *Public Choice*, 123(3-4): 321–347. doi:10.1007/s11127-005-7165-2.
- (2006). Public sector efficiency: evidence for new EU member states and emerging markets. *European Central Bank Working Paper Series*, 581. Available from: <http://econpapers.repec.org/paper/ecbecbwps/20060581.htm>.
- ANDERSON, John E. / VAN DEN BERG, Hendrik (1998). Fiscal Decentralization and Government Size: An International Test for Leviathan Accounting for Unmeasured Economic Activity. *International Tax and Public Finance*, 5(2): 171–186. doi:10.1023/A:1008690304663.
- ANGELOPOULOS, Konstantinos / PHILIPPOPOULOS, Apostolis / TSIONAS, Efthymios (2007). Does public sector efficiency matter? Revisiting the relation between fiscal size and economic growth in a world sample. Mimeo. Available from: http://econpapers.repec.org/paper/glaglaewp/2007_5f30.htm.

- ATKINSON, Tony (2005). *Atkinson Review: Final report. Measurement of Government Output and Productivity for the National Accounts*. Palgrave Macmillan, Hampshire, New York. Available from: <http://www.statistics.gov.uk/about/data/methodology/specific/PublicSector/atkinson/default.asp>.
- BANKER, Rajiv D. (1993). Maximum likelihood, consistency and data envelopment analysis: a statistical foundation. *Management Science*, 39(10): 1265–1273.
- (1996). Hypothesis tests using data envelopment analysis. *Journal of Productivity Analysis*, 7(2): 139–159. doi:10.1007/BF00157038.
- BANKER, Rajiv D. / JOHNSTON, H. (1995). Evaluating the Impacts of Operating Strategies on Efficiency in the U.S. Airline Industry. In: CHARNES, A. / COOPER, W. W. / LEWIN, A. / SEIFORD, L. (editors), *Data Envelopment Analysis: Theory, Methodology and Applications*, chapter 6. Kluwer Academic Publishers.
- BANKER, Rajiv D. / NATARAJAN, Ram (2008). Evaluating Contextual Variables Affecting Productivity Using Data Envelopment Analysis. *Operations Research*, 56(1): 48–58. doi:10.1287/opre.1070.0460.
- BARR, Richard S. (2004). DEA Software Tools and Technology: A State-of-the-Art Survey. In: COOPER, W.W. / SEIFORD, L. M. / ZHU, J. (editors), *Handbook on Data Envelopment Analysis*, pages 539–566. Kluwer Academic Publishers.
- BARRO, Robert J. / LEE, Jong-Wha (1993). International Comparisons of Educational Attainment. *Journal of Monetary Economics*, 32(3): 363–394. Data and description available from <http://go.worldbank.org/HKOH13Y5D0>. doi:10.1016/0304-3932(93)90023-9.
- (1996). International Measures of Schooling Years and Schooling Quality. *American Economic Review*, 86(2): 218–23. Data available from <http://www.cid.harvard.edu/ciddata/ciddata.html> (retrieved June 2008).
- (2001). International Data on Educational Attainment: Updates and Implications. *Oxford Economic Papers*, 53(3): 541–563. Data available from <http://www.cid.harvard.edu/ciddata/ciddata.html> (retrieved June 2008).
- BAUM, Christopher F (2008). Using Stata Effectively. Slides, University of Sheffield, research seminar May. Available from: http://www.shef.ac.uk/content/1/c6/08/47/65/kit_slides.pdf.
- BECK, Thorsten / CLARKE, George / GROFF, Alberto / KEEFER, Philip / / WALSH, Patrick (2001). New tools in comparative political economy: The Database of Political Institutions. *World Bank Economic Review*, 15(1): 165–176. Data and description available from <http://go.worldbank.org/2EAGGLRZ40>.
- BECKER, Daniel (2005). Dynamic Tax Competition and Public-Sector Modernisation. *Thünen-Series of Applied Economic Theory*, 56. Revised version April 2008. Available from: <http://EconPapers.repec.org/RePEc:ros:wpaper:56>.
- BJØRNSKOV, Christian / DREHER, Axel / FISCHER, Justina (2007). The bigger the better? Evidence of the effect of government size on life satisfaction around the world. *Public Choice*, 130(3): 267–292. doi:10.1007/s11127-006-9081-5.
- BRIEC, Walter / KERSTENS, Kristiaan / LELEU, Hervé / EECKAUT, Philippe Vanden (2000). Returns to Scale on Nonparametric Deterministic Technologies: Simplifying Goodness-of-Fit

- Methods Using Operations on Technologies. *Journal of Productivity Analysis*, 14(3): 267–274. doi:10.1016/j.ejor.2005.01.051.
- BRÜMMERHOFF, Dieter (2007). *Volkswirtschaftliche Gesamtrechnungen*. Oldenbourg, München, Wien.
- BÜTTNER, Thiess / WILDASIN, David E. (2006). The dynamics of municipal fiscal adjustment. *Journal of Public Economics*, 90: 1115–1132. doi:10.1016/j.jpubeco.2005.09.002.
- CAPORALE, Guglielmo Maria / PANOPOULOU, Ekaterini / PITTIS, Nikitas (2005). The Feldstein-Horioka puzzle revisited: A Monte Carlo study. *Journal of International Money and Finance*, 24(7): 1143–1149. Available from: <http://www.sciencedirect.com/science/article/B6V9S-4H8FPGW-2/2/d44a123bd8b3ed6b8a3114abe21a1d1c>.
- CAZALS, Catherine / FLORENS, Jean-Pierre / SIMAR, Léopold (2002). Nonparametric frontier estimation: a robust approach. *Journal of Econometrics*, 106(1): 1–25. doi:10.1016/S0304-4076(01)00080-X.
- CHARNES, A. / COOPER, W. W. / RHODES, E. (1978). Measuring the efficiency of decision making units. *European Journal of Operational Research*, 2(6): 429–444. doi:10.1016/0377-2217(78)90138-8.
- CHERCHYE, Laurens / POST, Thierry (2003). Methodological Advances in DEA: A survey and an application for the Dutch electricity sector. *Statistica Neerlandica*, 57(4): 410–438. doi:10.1111/1467-9574.00238.
- CHRISTOPOULOS, Dimitris (2007). A reassessment of the Feldstein-Horioka hypothesis of perfect capital mobility: evidence from historical data. *Empirica*, 34(3): 273–280. doi:10.1007/s10663-007-9044-1.
- CÍZEK, Pavel / HÄRDLE, Wolfgang / WERON, Rafa (editors) (2005). *Statistical Tools for Finance and Insurance*. Springer, Berlin. Available from: <http://mars.wiwi.hu-berlin.de/ebooks/html/stf/>.
- COAKLEY, Jerry / KULASIB, Farida / SMITH, Ron (1998). The Feldstein-Horioka Puzzle and Capital Mobility: A Review. *International Journal of Finance and Economics*, 3(2): 169–188.
- COELLI, Tim (1996). A Guide to FRONTIER Version 4.1: A Computer Program for Stochastic Frontier Production and Cost Function Estimation. *Centre for Efficiency and Productivity Analysis (CEPA), Working Papers*, 7/96. FRONTIER is available at <http://www.uq.edu.au/economics/cepa/frontier.htm>.
- COELLI, Tim / PRASADA RAO, D. S / BATTESE, George E (2005). *An Introduction to Efficiency and Productivity Analysis*. Springer, New York, 2nd ed edition.
- COMMISSION ON GROWTH AND DEVELOPMENT (2008). *The Growth Report. Strategies for Sustained Growth and Inclusive Development*. The International Bank for Reconstruction and Development / The World Bank, Washington. Available from: <http://www.growthcommission.org/>.
- COOPER, William W. / SEIFORD, Lawrence M. / TONE, Kaoru (2007). *Data envelopment analysis: a comprehensive text with models, applications, references and DEA-solver software*. Springer, New York.

- DAVIES, Ronald B. (2003). The OECD Model Tax Treaty: Tax Competition And Two-Way Capital Flows. *International Economic Review*, 44(2): 725–753.
- DEBREU, Gerard (1951). The Coefficient of Resource Utilization. *Econometrica*, 19(3): 273–292.
- DEPRINS, D. / SIMAR, Léopold / TULKENS, Henry (1984). Measuring labor efficiency in post offices. In: MARCHAND, Maurice / PESTIEAU, Pierre / TULKENS, Henry (editors), *The performance of public enterprises: concepts and measurement*. North-Holland, Amsterdam.
- DOWRICK, Steve (2005). The Penn World Table: A Review. *The Australian Economic Review*, 38(2): 223–228. doi:10.1111/j.1467-8462.2005.00369.x.
- DREHER, Axel (2006). Does Globalization Affect Growth? Evidence from a new Index of Globalization. *Applied Economics*, 38(10): 1091–1110. Data retrieved from <http://globalization.kof.ethz.ch/>, March 2008.
- DREHER, Axel / GASTON, Noel / MARTENS, Pim (2008). *Measuring Globalization - Gauging its Consequence*. Springer, New York.
- EDWARDS, Jeremy / KEEN, Michael (1996). Tax Competition and Leviathan. *European Economic Review*, 40(1): 113–134. doi:10.1016/0014-2921(95)00057-7.
- EVANS, Paul / KIM, Bong-Han / OH, Keun-Yeob (2008). Capital mobility in saving and investment: A time-varying coefficients approach. *Journal of International Money and Finance*, 27(5): 806–815. doi:10.1016/j.jimonfin.2008.04.005.
- FÄRE, Rolf / GROSSKOPF, Shawna / LOVELL, C. A. Knox (1985). *The measurement of efficiency of production*. Kluwer Academic Publishers, Boston Hingham, MA.
- (1994). *Production Frontiers*. Cambridge University Press.
- FARRELL, M. J. (1957). The Measurement of Productive Efficiency. *Journal of the Royal Statistical Society. Series A (General)*, 120(3): 253–290.
- FELDSTEIN, Martin / HORIOKA, Charles (1980). Domestic Saving and International Capital Flows. *Economic Journal*, 90(358): 314–329.
- FERRIER, Gary D. / LOVELL, C. A. Knox (1990). Measuring cost efficiency in banking: Econometric and linear programming evidence. *Journal of Econometrics*, 46(1-2): 229–245. doi:10.1016/0304-4076(90)90057-Z.
- FREEDOM HOUSE (2008). Freedom in the World. Historical Rankings, annual 1973 to 2006. Available from: <http://www.freedomhouse.org> [retrieved May 2008].
- GATTOUFI, Said / ORAL, Muhittin / REISMAN, Arnold (2004). Data envelopment analysis literature: a bibliography update (1951-2001). *Socio-Economic Planning Sciences*, 38(2-3): 159–229. doi:10.1016/S0038-0121(03)00023-5.
- GERRING, John / THACKER, Strom C. (2004). Political Institutions and Corruption: The Role of Unitarism and Parliamentarism. *British Journal of Political Science*, 34(2): 295–330.
- GEYS, Benny / HEINEMANN, Friedrich / KALB, Alexander (2007). Local Governments in the Wake of Demographic Change: Efficiency and Economies of Scale in German Municipalities. *ZEW Discussion Paper*, 07-036. Available from: <ftp://ftp.zew.de/pub/zew-docs/dp/dp07036.pdf>.

- GIJBELS, Irene / MAMMEN, Enno / PARK, Byeong U. / SIMAR, Leopold (1999). On Estimation of Monotone and Concave Frontier Functions. *Journal of the American Statistical Association*, 94(445): 220–228.
- GORDON, Roger H. / BOVENBERG, A. Lans (1996). Why Is Capital So Immobile Internationally? Possible Explanations and Implications for Capital Income Taxation. *American Economic Review*, 86(5): 1057–1075.
- GROSSKOPF, S. (1996). Statistical inference and nonparametric efficiency: A selective survey. *Journal of Productivity Analysis*, V7(2): 161–176. doi:10.1007/BF00157039.
- GUPTA, Sanjeev / VERHOEVEN, Marijn (2001). The efficiency of government expenditure: experiences from Africa. *Journal of Policy Modeling*, 23(4): 433–467.
- GWARTNEY, James D. / LAWSON, Robert (2007). *Economic freedom of the world. 2007 Annual Report*. Economic Freedom Network. Data retrieved from the website, March 2008. Available from: <http://www.freetheworld.com>.
- HEIPERTZ, Martin (2007). Effizienz. Ist unser Staat zu teuer? *Trend – Zeitschrift für Soziale Marktwirtschaft*, [2007](111). Available from: <http://www.trend-zeitschrift.de/archiv/archiv111.html>.
- HESTON, Alan / SUMMERS, Robert / ATEN, Bettina (2006). Penn World Table Version 6.2. Center for International Comparisons of Production, Income and Prices at the University of Pennsylvania. Available from: www.pwt.econ.upenn.edu/ [retrieved 8. June 2008].
- HOFFMANN, Mathias (2004). International capital mobility in the long run and the short run: can we still learn from saving-investment data? *Journal of International Money and Finance*, 23(1): 113–131.
- IMF (1986). *A manual on government finance statistics*. International Monetary Fund, Washington, DC.
- (2006). *Government Finance Statistics, Historical (IMF-GFS)*. International Monetary Fund. March 2006 edition.
- IMF, FISCAL AFFAIRS DEPARTMENT (1995). *Unproductive Public Expenditures. A Pragmatic Approach To Policy Analysis, Pamphlet Series*, volume 48. International Monetary Fund. Available from: <http://www.imf.org/external/pubs/ft/pam/pam48/pam48con.htm>.
- INMAN, Robert P. / RUBINFELD, Daniel L. (1997). Rethinking Federalism? *Journal of Economic Perspectives*, 11(4): 43–64.
- INTERNATIONAL POTATO CENTER (2002). Country shape file for the World.
- JEONG, Seok-Oh / SIMAR, Léopold (2006). Linearly interpolated FDH efficiency score for nonconvex frontiers. *Journal of Multivariate Analysis*, 97(10): 2141–2161.
- JOHNSON, Andrew / MCGINNIS, Leon (2006). The Hyperbolic Oriented Efficiency Measure as a Remedy to Infeasibility of Super Efficiency Models. *Working Paper, School of Industrial and Systems Engineering, Georgia Institute of Technology*.
- KAUFMANN, Daniel / KRAAY, Aart / MASTRUZZI, Massimo (2008). Governance Matters VII: Governance Indicators for 1996-2007. World Bank Policy Research. Dataset available at <http://www.govindicators.org/>.

- KNEIP, A. / SIMAR, L. / WILSON, P. W. (forthcoming). Asymptotics and Consistent Bootstraps for DEA Estimators in Non-parametric Frontier Models. *Econometric Theory*. Forthcoming.
- KNEIP, Alois / PARK, Byeong U. / SIMAR, Léopold (1998). A Note On The Convergence Of Nonparametric DEA Estimators For Production Efficiency Scores. *Econometric Theory*, 14(6): 783–793.
- KNEIP, Alois / SIMAR, Léopold / WILSON, Paul W. (2003). Asymptotics for DEA Estimators in Non-parametric Frontier Models. *Université catholique de Louvain, Institut de statistique, Discussion Papers*, 317.
- KNOWLES, Stephen (2001). Are the Penn World Tables data on government consumption and investment being misused? *Economics Letters*, 71(2): 293–298.
- KOLLMAN, Ken / MILLER, John H. / PAGE, Scott E. (2000). Decentralization and the search for policy solutions. *The journal of law, economics, & organization*, 16(1): 102–128.
- KOOPMANS, Tjalling C. (1951). Analysis of Production as an Efficient Combination of Activities. In: KOOPMANS, Tjalling C. (editor), *Activity Analysis of Production and Allocation. Proceedings of a Conference*, chapter 3, pages 33–97. John Wiley and Sons, New York. Available at <http://cowles.econ.yale.edu/P/cm/m13/index.htm>.
- KOTSOGIANNIS, Christos / SCHWAGER, Robert (2006). On the incentives to experiment in federations; . *Journal of Urban Economics*, 60(3): 484–497. doi:10.1016/j.jue.2006.04.008.
- KUMBHAKAR, Subal C. / LOVELL, C. A. Knox (2000). *Stochastic Frontier Analysis*. Cambridge University Press.
- MADDALA, Gangadharrao Soundaryarao (1992). *Introduction to econometrics*. Prentice Hall, Englewood Cliffs, NJ.
- MARTINS-FILHO, Carlos / YAO, Feng (2007). Nonparametric frontier estimation via local linear regression. *Journal of Econometrics*, 141(1): 283–319. doi:10.1016/j.jeconom.2007.01.005.
- MAYER, Helmut (2001). Preis- und Volumenmessung in den Volkswirtschaftlichen Gesamtrechnungen. *Wirtschaft und Statistik*, [2001](12): 1032–1043.
- MELITZ, Marc J. (2003). The Impact of Trade on Intra-Industry Reallocations and Aggregate Industry Productivity. *Econometrica*, 71(6): 1695–1725. doi:10.1111/1468-0262.00467.
- NORRIS, Pippa (2008). *Driving democracy. Do Power Sharing Institutions Work?* Cambridge University Press. Dataset available at <http://www.pippanorris.com/>.
- OATES, Wallace E. (1985). Searching for Leviathan: An Empirical Study. *American Economic Review*, 75(4): 748–757.
- (1989). Searching for Leviathan: A Reply and Some Further Reflections. *American Economic Review*, 79(3): 578–583.
- PARK, B.U. / SIMAR, Léopold / WEINER, Ch. (2000). The FDH Estimator for Productivity Efficiency Scores. *Econometric Theory*, 16(6): 855–877. Available from: http://journals.cambridge.org/abstract_S0266466600166034.
- PERSSON, Torsten / TABELLINI, Guido (1992). The Politics of 1992: Fiscal Policy and European Integration. *Review of Economic Studies*, 59(4): 689–701.

- PUIG-JUNOY, Jaume (1998). Technical efficiency in the clinical management of critically ill patients. *Health Economics*, 7(3): 263–277.
- R DEVELOPMENT CORE TEAM (2008). *R: A Language and Environment for Statistical Computing*. R Foundation for Statistical Computing, Vienna, Austria.
- RAUSCHER, Michael (2000). Interjurisdictional Competition and Public-Sector Prodigality: The Triumph of the Market over the State? *FinanzArchiv*, 57(1): 89–105.
- (2005). Economic Growth and Tax-Competing Leviathans. *International Tax and Public Finance*, 12(4): 457–474. doi:10.1007/s10797-005-1834-4.
- RODRIK, Dani (2008). Spence Christens a New Washington Consensus. *The Economists' Voice*, 5(3): Article 4.
- SALA-I-MARTIN, Xavier X. (1997). I Just Ran Two Million Regressions. *The American Economic Review*, 87(2): 178–183.
- SEIFORD, Lawrence M. (1996). Data envelopment analysis: The evolution of the state of the art (1978-1995). *Journal of Productivity Analysis*, 7(2): 99–137. doi:10.1007/BF00157037.
- SIMAR, Léopold (2007). How to improve the performances of DEA/FDH estimators in the presence of noise? *Journal of Productivity Analysis*, 28(3): 183–201. doi:10.1007/s11123-007-0057-3.
- SIMAR, Léopold / WILSON, Paul W. (1998). Sensitivity Analysis of Efficiency Scores: How to Bootstrap in Nonparametric Frontier Models. *Management Science*, 44(1): 49–61.
- (2000a). A general methodology for bootstrapping in non-parametric frontier models. *Journal of Applied Statistics*, 27(6): 779–802. doi:10.1080/02664760050081951.
- (2000b). Statistical Inference in Nonparametric Frontier Models: The State of the Art. *Journal of Productivity Analysis*, 13(1): 49–78. doi:10.1023/A:1007864806704.
- (2007). Estimation and inference in two-stage, semi-parametric models of production processes. *Journal of Econometrics*, 136(1): 31–64. doi:10.1016/j.jeconom.2005.07.009.
- SIMAR, Léopold / ZELENYUK, Valentin (2007). Statistical inference for aggregates of Farrell-type efficiencies. *Journal of Applied Econometrics*, 22(7): 1367–1394. doi:10.1002/jae.991.
- SMITH, Peter C. / STREET, Andrew (2005). Measuring the efficiency of public services: the limits of analysis. *Journal of the Royal Statistical Society: Series A (Statistics in Society)*, 127(2): 401–417. doi:10.1111/j.1467-985X.2005.00355.x.
- SOLEIMANI-DAMANEH, M. / JAHANSHALOO, G. R. / RESHADI, M. (2006). On the estimation of returns-to-scale in FDH models. *European Journal of Operational Research*, 174(2): 1055–1059. doi:10.1016/j.ejor.2005.01.051.
- STARCK, Jürgen (2007). Fit for the future? Towards a lean and efficient public sector. Speech by Jürgen Stark, Member of the Executive Board of the ECB given at the conference “Fiscal Policy Challenges in Europe” organised by the German Ministry of Finance and Centre for European Economic Research. Available from: http://www.ecb.int/press/key/date/2007/html/sp070323_1.en.html.
- STATISTISCHES BUNDESAMT (2003). Neue Deflationierungsmethoden. Sitzung des Fachausschusses Volkswirtschaftliche Gesamtrechnungen am 26. November 2003. TOP 2.1.2:

- Neue Deflationierungsmethoden. Available from: <http://www.destatis.de/jetspeed/portal/cms/Sites/destatis/Internet/DE/Content/Wissenschaftsforum/MethodenVerfahren/VGR/Revision/FachausschussRevision2005>.
- STONE, M. (2002). How not to measure the efficiency of public services (and how one might). *Journal of the Royal Statistical Society: Series A (Statistics in Society)*, 165(3): 405–434. doi:10.1111/1467-985X.02461.
- STRUMPF, KOLEMAN S. (2002). Does Government Decentralization Increase Policy Innovation? *Journal of Public Economic Theory*, 4(2): 207–241.
- SUMMERS, Robert / HESTON, Alan (1991). The Penn World Table (Mark 5): An Expanded Set of International Comparisons, 1950-1988. *The Quarterly Journal of Economics*, 106(2): 327–368.
- TULKENS, Henry (1993). On FDH efficiency analysis: Some methodological issues and applications to retail banking, courts, and urban transit. *Journal of Productivity Analysis*, 4(1): 183–210. doi:10.1007/BF01073473.
- UK CENTRE FOR THE MEASUREMENT OF GOVERNMENT ACTIVITY, OFFICE FOR NATIONAL STATISTICS (2005). Improvements in the methodology for measuring government output. *Economic Trends*, 622. Available from: <http://www.statistics.gov.uk/about/data/methodology/specific/PublicSector/atkinson/default.asp>.
- UNITED NATIONS (2001). System of National Accounts 1993. Online Version. Includes approved Updates till 2002. Prepared under the auspices of the Inter-Secretariat Working Group on National Accounts (Commission of the European Communities - Eurostat / International Monetary Fund / Organisation for Economic Co-operation and Development / United Nations / World Bank. Available from: <http://unstats.un.org/unsd/sna1993/introduction.asp> [retrieved May 2008].
- UNITED NATIONS ECONOMIC AND SOCIAL COUNCIL (2004). Basic Data on Government Expenditure and Taxation. In: *Committee of Experts on Public Administration. Third Session. (E/C.16/2004/7)*. Available from: <http://unpan1.un.org/intradoc/groups/public/documents/UN/UNPAN015272.pdf>.
- UNU-WIDER (2008). UNU-WIDER World Income Inequality Database, Version 2.0c, May 2008. World Institute for Development Economics Research of the United Nations University. Data available from <http://www.wider.unu.edu/research/>.
- VARIAN, Hal R. (1990). Goodness-of-fit in optimizing models. *Journal of Econometrics*, 46(1-2): 125–140.
- WDI (2007). *World Development Indicators 2007 (CD-ROM)*. World Bank, Washington, D.C.
- WILSON, John D. (1986). A Theory of Interregional Tax Competition. *Journal of Urban Economics*, 19(3): 296–315.
- (2005). Welfare-Improving Competition for Mobile Capital. *Journal of Urban Economics*, 57(1): 1–18. doi:10.1016/j.jue.2004.08.003.
- WILSON, Paul W. (1993). Detecting outliers in deterministic nonparametric frontier models with multiple outputs. *Journal of Business and Economic Statistics*, 11(3): 319–323.

- (2007). FEAR: A Package for Frontier Efficiency Analysis with R. *Socio-Economic Planning Sciences*. Forthcoming.
- (2008a). FEAR 1.11 Command Reference. Mimeo, Dept. of Economics, Clemson University, Clemson, South Carolina.
- (2008b). FEAR 1.11 User's Guide. Mimeo, Dept. of Economics, Clemson University, Clemson, South Carolina.
- WORLD BANK (2008). Country Classification (April 2008). Available from: <http://go.worldbank.org/K2CKM78CC0> [retrieved 12.06 2008].