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Working Paper

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Discussion papers // WZB, Schwerpunkt Märkte und Politik, Abteilung Marktprozesse und
Steuerung, No. 2008-21

Provided in cooperation with:

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Suggested citation: Geys, Benny; Moesen, Wim (2008) : Measuring local government technical
(in)efficiency: An application and comparison of FDH, DEA and econometric approaches,
Discussion papers // WZB, Schwerpunkt Märkte und Politik, Abteilung Marktprozesse und
Steuerung, No. 2008-21, <http://hdl.handle.net/10419/54663>

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**Measuring Local Government Technical (In)efficiency:
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Econometric Approaches**

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** Katholieke Universiteit Leuven

SP II 2008 – 21

August 2008

ISSN Nr. 0722 – 6748

**Research Area
Markets and Politics**

**Schwerpunkt
Märkte und Politik**

**Research Unit
Market Processes and Governance**

**Abteilung
Marktprozesse und Steuerung**

Zitierweise/Citation:

Benny Geys and Wim Moesen, **Measuring Local Government Technical (In)efficiency: An Application and Comparison of FDH, DEA and Econometric Approaches**, Discussion Paper SP II 2008 – 21, Wissenschaftszentrum Berlin, 2008.

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Internet: www.wzb.eu

ABSTRACT

Measuring Local Government Technical (In)efficiency: An Application and Comparison of FDH, DEA and Econometric Approaches

by Benny Geys and Wim Moesen *

Economic efficiency – understood in terms of jurisdictions providing a maximum amount of output for a given level of inputs – is one potential means to evaluate public policies. Various approaches, however, co-exist to measure the (technical) efficiency of organizations. Given that these rely on different underlying assumptions, it is important to assess whether, and to what extent, the approach taken affects the outcome of efficiency studies. The present paper employs a dataset of local governments in Flanders in 2000 to compare the three common approaches to measure (in)efficiency (i.c. FDH, DEA and econometric techniques). Our results indicate that the methodological choices of instrumentation have a substantial effect on analytic performance measurement. Hence, assessing the robustness of the results across various approaches to efficiency measurement is crucial to avoid incorrect inferences.

Keywords: Free disposal hull, data envelopment analysis, stochastic frontiers, government (in)efficiency, Flemish municipalities

ZUSAMMENFASSUNG

Zur Messung lokaler Regierungs(in)effizienz: Anwendung und Vergleich verschiedener Ansätze aus FDH, DEA und Ökonomie

Ökonomische Effizienz – verstanden im Sinne der Maximierung der Ausbringungsmenge für ein gegebenes Inputlevel – ist ein gängiges Mittel um staatliche Politiken zu evaluieren. Allerdings existieren mehrere Herangehensweisen, um die (technische) Effizienz von Organisationen zu messen. Unter der Voraussetzung, dass diese auf unterschiedlichen Annahmen basieren, ist es von Interesse, ob und inwiefern die gewählte Methode die Ergebnisse einer Untersuchung beeinflusst. Mit dem Datenmaterial aus flämischen Gemeindeverwaltungen im Jahr 2000 vergleichen wir die drei bedeutendsten Methoden der (In-)Effizienzmessung (FDH, DEH und ökonometrische Verfahren). Unsere Ergebnisse zeigen, dass die Wahl der Methode einen substantiellen Einfluss auf die Performancemessung hat. Aus diesem Grunde erscheint es mitunter unerlässlich, die Robustheit von Ergebnissen anhand verschiedener Effizienzmethoden zu überprüfen, um nicht Gefahr zu laufen, unzulässige Folgerungen zu ziehen.

* The authors are grateful to André Decoster, Jon H. Fiva, Holger Sieg and four anonymous referees for helpful comments.

Introduction

In many countries, a further decentralisation of tasks from higher level governments to the municipal level is contemplated. While smaller jurisdictions with more homogeneous populations may be better suited to match the provision of public goods with the preferences of their constituents (cfr. Mill, 1861; Musgrave 1959; Oates 1972, 1999; Tullock, 1969), an exceedingly small scale of operation may be economically unviable. That is, lower-level (and therefore smaller) jurisdictions may lack a sufficient fiscal basis, be unable to exploit economies of scale or lack sufficient managerial competencies and experience among their staff. The increased international attention for further decentralization – both in fiscal terms as in the allocation of tasks – thus raises the question whether local jurisdictions can (or do) adequately execute the tasks bestowed on them.

One way to evaluate public policies is by analysing whether or not (local) governments use their resources in an economically efficient manner. Economic efficiency – understood in terms of jurisdictions providing a maximum amount of output for a given level of inputs (i.e. minimizing ‘waste’ or ‘friction’) (e.g. Koopmans, 1951; Lovell, 1993) – is obviously only one among many public concerns (besides effectiveness, equity, responsiveness, adequateness, appropriateness, and so on; Dunn, 2004, 223-231). Our focus on it should not be taken to mean that it is more important than the remaining concerns or that policy decisions are not taken within a certain political and institutional environment (which affect policy outcomes). Nevertheless, administrative decisions about strategy and tactics and the evaluation of public policy often include measures of efficiency (besides the other above-mentioned criteria; Dunn, 2004, 358) and it is therefore crucial to understand the tools employed to measure it. Moreover, economic efficiency refers to a central (potential) benefit of decentralisation. In fact, when local governments are lacking in economic efficiency, the economic benefits from further a decentralisation of tasks are likely to be limited. There is little to gain by shifting tasks to inefficient levels of government.

Numerous studies have previously taken up the issue of local government efficiency (see De Borger and Kerstens, 2000, for a review). Most of these studies, however, concentrate on efficiency in particular areas of public good provision: e.g. waste collection, police services, road maintenance, and so on (e.g. Kalseth and Rattsø, 1998; De Borger and Kerstens, 2000).¹ Though such analyses are of interest in their own right, they do not allow an assessment of the overall performance of governments. Nonetheless, general performance assessments are crucial to most adequately review the potential (economic) benefits of government decentralisation. Moreover, most previous work focuses on one methodological approach to efficiency measurement (i.e. FDH, DEA or a stochastic approach). Still, when the results of efficiency analyses are affected by the approach taken, a multiple-design approach might be crucial to avoid erroneous inferences (see, for example, De Borger and Kerstens, 1996; Bauer *et al.*, 1998; Cummins and Zi, 1998; Matthijs and Swinnen, 2001; von Hirschhausen *et al.*, 2006; Balcombe *et al.*, 2006).

The present analysis addresses both these caveats. We assess *overall* local government performance in the Flemish municipalities in the year 2000. Moreover, and arguably more importantly, we provide a comparison of three different approaches to efficiency measurement (i.e. FDH, DEA and stochastic approaches). As such, we assess whether the

¹ For exceptions, see, among others, Vanden Eeckaut *et al.* (1993), De Borger *et al.* (1994), De Borger and Kerstens, (1996), Athanassopoulos and Triantis (1998), Worthington (2000), Sampaio De Sousa and Stosic (2005), Hindriks and Gerard (2005), Geys (2006), Balaguer-Coll *et al.* (2007), Geys *et al.* (2007) and Borge *et al.* (2007).

conclusions drawn from efficiency analyses are robust to the technology employed. Our main findings indicate that a) there is some definite scope for improvements in the technical efficiency of Flemish local governments (a common finding under all three methodological approaches) and b) the level and variation in the level of inefficiency is affected by the approach taken. The latter finding should induce due caution in the interpretation of results from studies relying on one single approach only (and indicates that such studies should be used very carefully in administrative decisions about strategy and tactics).

1. Approaches to measure (government) efficiency

Economic efficiency, as mentioned, can be defined as jurisdictions providing a maximum amount of output for a given level of inputs (or requiring a minimum level of inputs for a given output). Most fundamentally, this implies that when a given jurisdiction X can transform A units of input into B units of output, other jurisdictions should be able to achieve the same outcome (if they operate equally efficiently). From this perspective, efficiency measurement appears straightforward at first sight. One first determines which combinations of inputs and outputs designate optimal or efficient behaviour. Then, in a second step, each jurisdiction is compared with the ‘best’-performing jurisdictions to determine the level of (in)efficiency. Applying these two steps in a real-world setting is, however, replete with difficulties. One set of problems concerns the choice of inputs and outputs to be considered in the analysis (Lovell, 1993). Obviously, this choice is not value-neutral and depends on what is deemed important by both the subject(s) of and those responsible for the efficiency study. This is of central concern since the results of efficiency analyses depend very much on these input/output choices, implying they should be adequately defended. A second set of problems is more methodological. How do we determine which input-output combinations are ‘optimal’ or ‘efficient’ (known as the ‘best practice’ frontier)? Is *any* deviation from the best practice frontier inefficiency or – and if so, how much – is to be interpreted as, say, measurement error?

While the value-laden input/output decisions are hard to resolve a priori (and will not be explicitly tackled in the present work), a number of different approaches have been proposed in the literature to address the methodological problems brought forward (for an excellent introduction, see Lovell, 1993).² One of the earliest approaches to efficiency measurement is known as Data Envelopment Analysis (DEA), a non-parametric method proposed by Farrell (1957). Under DEA, jurisdictions are designated as efficient when they outperform not only all other jurisdictions in the sample, but also all possible linear combinations of all other jurisdictions (even when the resulting input/output combinations do not occur in reality and are in some sense ‘virtual’ jurisdictions). Hence, each jurisdiction is compared to all possible ‘real’ and ‘virtual’ opponents, and deemed efficient only when it obtains a better overall performance (i.e. a higher aggregate index value) than all these opponents. A jurisdiction that is outperformed for at least one conceivable weighting scheme is “DEA-dominated” or inefficient (Melyn and Moesen, 1991; Cherchye and Vermeulen, 2006). The idea behind this approach is that dominated jurisdictions should, given the observed performance of all other jurisdictions in the sample, be able to perform better in at least one dimension (either reduce inputs or boost outputs). This is not the case for non-dominated observations, which are thus deemed efficient.³

² All proposed methods achieve relative rather than absolute efficiency measures in the sense that they build not on some absolute definition of efficiency, but rather determine the ‘best practice’ based on the decision-making units at hand (the only possibility in real-world applications; see also Hauner, 2005; Staat, 2006).

³ To give a simple numerical example, assume three jurisdictions (A, B and C). While these, for simplicity, use a given amount of inputs, they differ in the quantity of two outputs X and Y they produce (A, B, and C

The efficient jurisdictions then form the central elements of the best practice frontier (the exact shape of which depends on specific assumptions made; see below). To determine the relative (in)efficiency of non-efficient jurisdictions, their input/output combinations are projected onto this frontier. One thereby weighs the input/output combinations of the jurisdictions that directly dominate the inefficient jurisdiction in such a way as to minimize the estimated inefficiency of the inefficient observation (thus applying, in a sense, “benefit-of-the-doubt” weights; see Melyn and Moesen, 1991). More technically, DEA works through solving a linear programming problem of the following form:

$$\text{Min}_{\{\lambda_k, z_1, \dots, z_n\}} \lambda_k \tag{1}$$

$$\text{Subject to: } \lambda_k C_k - \sum_{j=1}^n z_j C_j \geq 0$$

$$\sum_{j=1}^n z_j y_{jr} \geq y_{kr} \quad \text{with } r = 1, \dots, s$$

$$\lambda_k, z_j \geq 0 \quad \text{for } j = 1, \dots, n$$

Where C_k and C_j represent total input by organisation k and j respectively, y_{kr} and y_{jr} denote the output level for organisations k and j with respect to output r , s equals the number of outputs taken into account and n is the number of organisations under study. Finally, z_j are weights given to the organisations with which organisation k is compared in the determination of its (in)efficiency. In equilibrium, the value of the objective function, λ_k , represents how efficient organisation k employs its inputs (C_k) in the production of its outputs ($r = 1, \dots, s$). Note that the formulation in equation (1) imposes constant returns to scale, leading the best practice frontier to be a straight line from the origin touching the input-output combination of the most efficient organisation(s) (hence, we label the result DEA-crs; see figure 1). However, constant returns to scale implies that jurisdictions can linearly scale input and outputs without affecting the level of efficiency. Such an assumption may be valid over limited ranges of production, but is unlikely to be justifiable in general. Assuming constant returns to scale may thus be overly restrictive. Hence, some scholars have allowed for variable returns to scale by adding one additional constraint (i.e. $\sum_{j=1}^n z_j = 0$) to equation (1).

This is labelled as DEA-vrs below (see figure 1).⁴

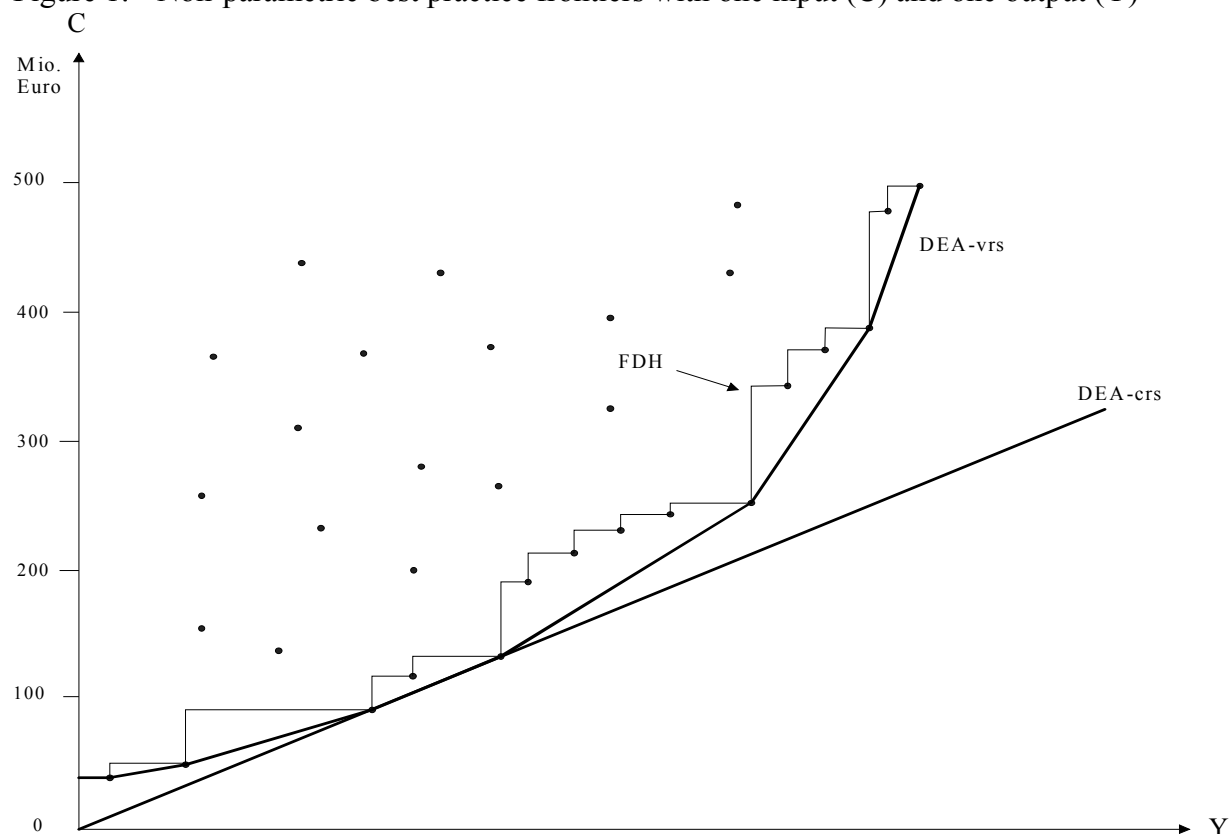
Another important characteristic of the linear programming problem in equation (1) is that the best practice frontier is assumed to be strictly convex. Still, there are “no valid theoretical arguments for assuming a priori that production possibilities are truly convex” (Cherchye *et*

produce 50, 25 and 7 units of X and 2, 10 and 35 units of Y respectively). Hence, while A is most efficient in producing output X (given the input constraint), C plays this role for output Y. Moreover, as one cannot construct a linear combination of the remaining two jurisdictions that outperforms (or dominates) A or C, both are termed ‘efficient’. Jurisdiction B is dominated by at least one other jurisdiction in both output dimensions and one can construct a linear combination of A and C that outperforms B (e.g. 50% A and 50% C would produce 26 X and 21 Y). Hence, B is inefficient.

⁴ This additional constraint generates an efficiency measure without scale efficiency effects such that the comparison of DEA-crs and DEA-vrs gives an indication of the presence of scale effects (e.g. Worthington, 2000; Wu *et al.*, 2003; von Hirschhausen *et al.*, 2006).

al., 2000, 263-264; see also McFadden, 1978) and some empirical studies suggest violations of the convexity hypothesis (e.g. Hasenkamp, 1976). Hence, this assumption was relaxed in later work by Deprins *et al.* (1984) and Tulkens (1993). By imposing two additional restrictions on equation (1) (i.e. $\sum_{j=1}^n z_j = 0$ and $z_j \in \{0, 1\}$), their Free Disposal Hull (FDH) method yields a frontier with a staircase shape in the input-output space (see figure 1). The basic idea in terms of determining efficient and inefficient observations is, however, the same as under DEA (see above).

Figure 1: Non-parametric best practice frontiers with one input (C) and one output (Y)



Importantly, both non-parametric approaches (DEA and FDH) share the common feature that *all* deviations from the frontier are designated as inefficiency. This has two important implications. Firstly, since the different restrictions posed on the problem in equation (1) influence the shape of the efficiency frontier (and thereby how closely it envelops the data), they also directly affect the efficiency estimates retained from the analysis. While this mitigates the value of the retained (in)efficiency estimates, it has less impact on the relative performance of the assessed jurisdictions (which, as mentioned in footnote 2, is the most important information from these types of analyses). Secondly, and more problematic, it entails that deviations from the best practice frontier which are due to measurement errors or other stochastic influences are also identified as inefficiency (which is inappropriate).

Stochastic parametric approaches to efficiency measurement – developed by Aigner *et al.* (1977) and Meeusen and van den Broeck (1977) – avoid the latter problem by allowing the researcher to distinguish between measurement error and inefficiency. With the risk of oversimplifying this methodological approach, one might describe the basic idea as the estimation of a production (or cost) function upon which “inefficiency is identified with [the] disturbances in [this] regression model” (Greene, 1993, 68). The disturbance term – i.e. the

realized deviations from the estimated frontier isoquant – is, however, (non-trivially) separated into random white noise and inefficiency. More technically, an appropriate formulation of a standard, general production function would be (in translogarithmic form following Christensen *et al.*, 1973 and dropping municipality subscripts for convenience):

$$\ln C = \alpha + \sum_{r=1}^s \beta_r \ln y_r + \frac{1}{2} \sum_{r=1}^s \sum_{q=1}^s \lambda_{rq} \ln y_r \ln y_q + \underbrace{v+u}_{=\varepsilon} \quad (2)$$

where, as before, C designates the input indicator, y indicates the various output indicators, s points to the number of outputs in the model and β_r and λ_{rq} are parameters to be estimated. Crucially, the error term ε is composed of two parts (assumed to be independent) and thereby allows distinguishing between measurement error and inefficiency. More specifically, it consists of a symmetric component (u; assumed to be white noise) and a one-sided non-negative component representing inefficiency (v; generally assumed half-normally distributed though similar findings result from assuming a truncated normal distribution, cfr. De Borger and Kerstens, 1996; Méon and Weill, 2005). While estimation of equation (2) generates estimates of the composed error term ε , the conditional distribution of v_i given ($u_i + v_i$) contains all available information about v_i for any organisation i (Jondrow *et al.*, 1982; Bauer, 1983). Either the mean or the mode of this conditional distribution can then be used as a point estimate of v_i : i.e. $E(v_i | u_i + v_i)$ or $M(v_i | u_i + v_i)$ respectively. Below, we use the mean of this conditional distribution (denoted SF-Mean) to designate cost inefficiencies. Hence, SF-Mean indicates to what extent inputs can be reduced without reducing current output levels (though, for ease of comparison with the non-parametric approaches, we invert this index to obtain efficiency rather than inefficiency ratings).

2. Local governments in Belgium: Institutional context

As in most West-European countries, Belgian municipalities have traditionally had important responsibilities with respect to education, housing, health care, social welfare, recreation, infrastructure and the environment (including refuse collection) (John, 2001, 36). While the local governments have significant authority in executing these particular tasks, their description and aims are laid down in federal and regional legislation (e.g. the “Municipal Law” or *Gemeentewet*). Hence, though article 162 of the Belgian Constitution explicitly states that municipalities can take any initiative to the benefit of their inhabitants and in the communal interest, they are by no means free to do as what they please. In fact, the same article of the Constitution also asserts that municipalities are subject to intervention from higher-level governments to prevent violations of the law or harm to (broader) public interest. This places Belgium firmly in a “Southern-European”, Napoleonic tradition where the central (and, in the case of Belgium, regional) government wields significant power (John, 2001, 34-39; Moesen, 2005).

More recently, increased discussions have taken place in Belgium on a further decentralisation of tasks from higher-level governments to the municipal level (Moesen, 2005). This discussion first appeared in 1988-89 when a significant amount of resources and responsibilities – in total amounting to about one third of state spending – was redistributed from the federal to the regional level (Gérard, 2001). The idea that about 25 per cent of these resources and responsibilities could immediately be further de-centralised towards the local level was at that point, however, disregarded (Moesen, 2005). Nevertheless, this ‘localisation’ discussion revived at the onset of the new Millennium, when the Flemish regional government launched a ‘core assignments debate’ (*kerntakendebat*) aimed at a

thorough discussion concerning the redistribution of tasks and resources across the regional, provincial and municipal governments. Thus far, however, the process remains very much top-down (i.e. the regional government decides about which tasks divestiture towards the municipalities can be discussed) rather than bottom-up (i.e. the municipalities demanding more autonomy) (Moesen, 2005).

This institutional setting is important since it has been frequently argued that decisions made by those at the top involve choices among values or goals, whereas decisions lower in the organization or delivery system are largely devoid of such value content (see Simon, 1957; March and Simon, 1958). Hence, in systems that have traditionally been driven by the central government (such as Belgium), the work of local governments has much larger “factual” (or means-focused) content than “value” (or ends-focused) content. Local government work in Belgium thus can be best described as ‘do-or-die’ and has traditionally been somewhat devoid of value choices. This is very different from, for example, the US, where municipalities have much more political weight and independence (and the value-component of local policy decisions is much larger). This generates a situation that is particularly conducive to efficiency measurements (as the value content or neutrality of the inputs and outputs then becomes less of an issue).⁵

3. Empirical analysis

In this section, we apply the procedures discussed in the previous section (FDH, DEA-crs, DEA-vrs and SF-Mean) to data from 304 of the 308 Flemish municipal governments in the year 2000 (data availability precluding the inclusion of the remaining four municipalities). As input variable (C), we use total current expenditures in each municipality.⁶ The level of local public goods provision is gauged through five output variables (see Vanden Eeckaut *et al.*, 1993; De Borger *et al.*, 1994; De Borger and Kerstens, 1996): (a) the number of subsistence grants beneficiaries, (b) the number of students in local primary schools, (c) the surface of public recreational facilities (in hectare), (d) the total length of municipal roads (in km) and (e) the share of municipal waste collected through door-to-door collections. These measures relate to important responsibilities of Flemish local governments with respect to social, educational, recreational, infrastructure and environmental services. More specifically, the number of subsistence grants beneficiaries and primary school students proxy the extent of social welfare and educational service provision. The surface of public recreational facilities indicates the provision of recreational, leisure services. The length of municipal roads proxies the provision of local infrastructure goods and the share of waste collected indicates public environmental and ecological services. Clearly, none of these variables is a direct output measure and they should best be seen as crude proxies for the level of public goods provision (De Borger *et al.*, 1994; De Borger and Kerstens, 1996). Therefore, as in previous work on local government efficiency, “the outputs used are rather loosely related to the services delivered by municipal governments” (De Borger and Kerstens, 1996, 153-154). This, regrettably, reflects the general problem with defining and measuring public sector outputs (cfr. Levitt and Joyce, 1987; De Borger and Kerstens, 1996).⁷ The results are summarized in table 1.

⁵ We are grateful to two anonymous referees for pointing this out to us.

⁶ One might argue that taking total expenditures is inappropriate if not all dimensions of public goods provision are taken up into the efficiency calculation. Therefore, we re-estimated the efficiency ratings using only spending on those issues for which we observe government outputs (discussed below). The correlation between both sets of efficiency ratings is very high ($r=0.72$) and they lead to the same qualitative conclusions. We are grateful to Holger Sieg for pointing this out to us (results available upon request).

⁷ Unfortunately, information on variation in output quality and input prices was not available. Panel data could admittedly help in resolving some of the problems related to these measurement issues. However,

Table 1: Technical efficiency in Flemish municipalities (N=304)

	DEA-crs (1)	DEA-vrs (2)	Scale =(1)/(2)	FDH	SF-Mean
Average (all)	49.57	64.32	79.82	95.04	85.76
Average (inefficient)	47.74	58.19	78.14	77.81	85.76
Standard deviation	14.06	20.06	15.61	11.58	5.24
Minimum	17.98	24.51	34.80	28.81	57.18
Maximum	100	100	100	100	95.52
Number inefficient	297	265	295	82	304
Number efficient	7	39	9	222	0
of which efficient by default ^a	0	6	-	154	-

Note: ^a Municipalities are efficient by default when they are not dominated by another municipality, but also do not dominate any other municipality.

As can be seen in table 1, there appears to be scope for improvements in the performance of municipal governments (in terms of their economically efficient use of inputs in the production of public goods). This is in line with by and large all previous studies on local government performance, both those regarding overall performance (as here) as those concentrating on one particular service (see De Borger and Kerstens, 2000). Still, given the data-problem mentioned above, interpreting the levels of (in)efficiency mentioned in Table 1 should be done with proper care and we will therefore not dwell on these findings here.⁸

Regarding our central research question, it can be easily seen that the efficiency ratings from the three non-parametric approaches (FDH, DEA-crs and DEA-vrs) clearly depend on the assumptions made with respect to the shape of the best practice frontier (or, in other words, on the restrictions placed on the linear programming problem in equation (1)). For example, measuring efficiency without scale efficiency effects (i.e. imposing variable rather than constant returns to scale in the DEA approach) leads to significantly higher estimated efficiency ratings. In fact, the difference between the average value under DEA-vrs and DEA-crs is statistically significant ($t = 4.39$; $p < 0.01$).⁹ Also, when we drop the convexity assumption (i.e. move from DEA to FDH), the estimated efficiency scores become even higher (as expected since the best practice frontier then wraps itself closer around the data). Difference-in-means t-tests indicate that these differences between FDH and DEA-crs and DEA-vrs are statistically significant beyond the 1% level ($t = 15.63$ and $t = 9.51$ respectively).

time series data were not available for several of our output variables such that this could not be addressed in the present analysis.

⁸ Also, the level of (in)efficiency observed using these methods is affected by the choice of inputs and outputs. Whereas this choice in the present analysis has been determined by data availability and previous scientific analyses, this choice should in real-world applications be carefully defended. The reason is that the resulting efficiency estimates and judgments might otherwise benefit those who values and interests have been most influential in the choice of input and output variables.

⁹ Note that this also indicates that a significant part of the observed inefficiency (i.e. roughly 20 percent) derives from production at an inefficient scale (though it does not indicate whether the scale of production is too small or too large on average). A similar effect is observed for data on New South Wales by Worthington and Dollery (2002), for Spanish municipalities by Balaguer-Coll *et al.* (2002) and for US cities by Moore *et al.* (2005). Still, disregarding scale effects, excessive use of resources still occurred (as can be seen in column (2) of Table 1).

However, 154 of the 222 municipalities designated as efficient under FDH are efficient ‘by default’ (i.e. these municipalities are not dominated by another municipality, but also fail to dominate any other). Hence, their efficiency status lacks substantive meaning (e.g. De Borger *et al.*, 1992) and one might state that they figure as ‘soldiers in no-mans land’. Moving from the non-parametric approaches to the parametric one, such ‘soldiers in no-mans land’ disappear. Just as among the non-parametric approaches, however, the estimated inefficiency is likewise found to differ significantly between the non-parametric approaches and the parametric one. Indeed, the average inefficiency level under SF-Mean is substantially smaller than under the DEA approach ($t = 14.34$ and $t = 7.42$ when comparing SF-Mean to DEA-crs and DEA-vrs respectively), but larger than under FDH ($t = 3.94$).¹⁰ Similar results have been found by, among others, De Borger and Kerstens (1996) and Balcombe *et al.* (2006).

Before we conclude that the various approaches lead to different results, it is important to remember that arguably the most important information to be taken from these types of studies is the *relative* performance of municipalities. In fact, it is well-known that the *absolute* efficiency levels derived from the analysis are specific to the sample used and assumptions made (cfr. *supra*). Hence, it may be more important to compare the various approaches in terms of the ordering of municipalities from more to less efficient. To the extent that such a relative performance assessment leads to the same results across approaches, we are able to clearly distinguish which municipalities consistently do better than the others. In order to assess this relative ordering of efficiencies across municipalities, we calculate the interrelation between the results from all four measures presented. The resulting correlation matrix is presented in table 2.

Table 2: Correlation matrix efficiency scores

	DEA-crs	DEA-vrs	FDH	SF-Mean
DEA-crs	1			
DEA-vrs	0.703	1		
FDH	0.322	0.419	1	
SF-Mean	0.695	0.574	0.447	1

It is clear from table 2 that the outcomes using the various approaches are generally relatively strongly positively correlated.¹¹ This indicates that – although there are differences in the exact level of efficiency depending on the approach used (see table 1) – the efficiency ratings from various approaches tend to support similar conclusions as to the municipalities’ relative performance (cfr. De Borger and Kerstens, 1996; Cummins and Zi, 1998; von Hirschhausen *et al.*, 2006; Balcombe *et al.*, 2006). This is reassuring given that all measures discussed in this analysis are essentially relative rather than absolute performance measures (calculating inefficiency relative to the data-specific best practice frontier rather than to some a priori exogenous determination of efficiency). Nonetheless, the largest value in table 2 is 0.70. Hence, significant variation remains even in the relative performance of municipalities across the various efficiency approaches. This should lead future researchers to carefully check whether the results employing their preferred efficiency measure(s) are robust against using alternative approaches.

¹⁰ The inefficiency of the inefficient municipalities is, however, larger under FDH than SF-Mean.

¹¹ Obviously, the correlations between FDH and the other approaches are lower due to the large number of observations that are ‘efficient by default’ under the FDH-method.

4. Conclusion and discussion

Shifting the provision of public goods to regional or local levels of government may be – at least theoretically – intrinsically desirable for certain types of public services (cfr. Mill, 1861; Musgrave 1959; Oates 1972, 1999; Tullock, 1969). It, however, engenders the question whether local governments are capable of adequately and accurately executing the tasks bestowed on them. One of the means to evaluate this question is by looking at the economic efficiency of local governments. Indeed, one can question the benefits of a further decentralisation of tasks to local governments when local governments are incapable of adequately executing their current tasks (unless, obviously, higher-level governments are found to be even less efficient than local ones). Nevertheless, for an evaluation of local governments' economic efficiency to be of practical value, we need to understand the tools through which such an assessment is made in practice. This is not a trivial question as the assessment of economic (or technical) efficiency is not straightforward, and various approaches to measure it have been brought forward in the literature. These, however, build on different underlying assumptions to calculate efficiency. To the extent that these approaches lead to similar results, we can rest assured that the results are robust to differences in these underlying assumptions. If not, we need to be careful in interpreting the results from studies using one particular approach.

In the present paper, we addressed this (methodological) question by employing a number of parametric and non-parametric approaches to estimate the level of local government technical (in)efficiency in Flanders in 2000. The results allow for two main conclusions. Firstly, all approaches indicate at least some scope for improvement in the efficiency of the Flemish municipalities. One may therefore question their ability and/or willingness to efficiently perform the tasks allocated to them and, in the same breath, the oft-cited rationale to further decentralise public goods provision towards local levels of government.¹² Secondly, and more crucially to our central research question, comparing the outcomes of the various approaches to efficiency measurement indicates that the point estimates for (in)efficiency can vary widely depending on the specific approach used. Nonetheless, the results are generally relatively strongly correlated such that they tend to support similar conclusions as to the municipalities' *relative* performance. Since all approaches included in the present study essentially are relative rather than absolute performance measures, this is reassuring.

Finally, however, a word of caution is in order. The results of efficiency measurements such as those presented in this work crucially depend on the availability of adequate, timely and accurate data. Data availability (or, rather, lack thereof) made it impossible to include measures for all – or even most – local government outputs, to account for possible quality and input price variations and to extend the analysis over multiple years. Hence, our results should not be taken as an ultimate end. Rather, the data limitations confronting the present analysis should be regarded as a point of debate in the discussion on (local) government performance measurement (cfr. Moore *et al.*, 2005). Without adequate information about the level and quality of public good provisions, an assessment of whether or not the 'value for money' of public good provision is satisfactory is problematic. Such assessments at different levels of government, however, are crucial as a means to assess part of the potential benefits of (further) fiscal decentralisation.

¹² On a more positive note, one might argue that at least part of the fiscal problems faced by local governments in Flanders these days can be confronted by making more efficient use of available resources. Given the inherent unpopularity of tax increases (Niskanen, 1979; Vermeir and Heyndels, 2006), this might be seen by local politicians as a viable – and electorally more rewarding (or, at least, less intricate) – alternative.

References

- Aigner, D.J., C.A.K. Lovell, and P. Schmidt (1977) Formulation and estimation of stochastic frontier production function models, *Journal of Econometrics*, **6**, 21-37.
- Alt, J.E., and D.D. Lassen (2006) Fiscal transparency, political parties and debt in OECD countries, *European Economic Review*, **50(6)**, 1403-1439.
- Athanassopoulos, A., and K. Triantis (1998) Assessing aggregated cost efficiency and the related policy implications for Greek local municipalities, *Infor*, **36**, 66-83.
- Balcombe, K., I. Fraser, and J.H. Kim (2006) Estimating technical efficiency of Australian dairy farms using alternative frontier methodologies, *Applied Economics*, **38(19)**, 2221-2236.
- Balaguer-Coll, M.T., D. Prior-Jimenez, and J.M. Vela-Bargues (2002) Efficiency and quality in local government management: The case of Spanish local authorities, Universitat Autònoma de Barcelona, *mimeo*.
- Balaguer-Coll, M.T., E. Tortosa-Ausina, and D. Prior (2007) On the determinants of local government performance: A two-stage nonparametric approach, *European Economic Review*, **51(2)**, 425-451.
- Bauer, P.W. (1983) A technique for estimating a cost system that allows for inefficiency, *Federal Reserve Bank of Cleveland Working Paper*, No. 8704.
- Bauer, P.W., A.N. Berger, G.D. Ferrier, and D.B. Humpfrey (1998) Consistency conditions for regulatory analysis of financial institutions: A comparison of frontier efficiency methods, *Journal of Economics and Business*, **50**, 85-114.
- Borge, L.-E., T. Falch, and P. Tovmo (2007) Public Sector Efficiency: The Impact of Political and Budgetary Institutions, Fiscal Capacity and Democratic Participation. *NTNU Department of Economics Working Paper*, No. 2007/01.
- Cherchye, L., T. Kuosmanen, and T. Post (2000) What is the economic meaning of FDH? A reply to Thrall, *Journal of Productivity Analysis*, **13**, 263-267.
- Cherchye, L., and F. Vermeulen (2006) Robust rankings of multidimensional performances: An application to Tour de France racing cyclists, *Journal of Sports Economics*, **7**, 359-373.
- Christensen, L.R., D.W. Jorgenson, and L.J. Lawrence (1973) Transcendental logarithmic production frontiers, *Review of Economics and Statistics*, **55(1)**, 28-45.
- Cummins, J.D., and H. Zi (1998) Comparison of frontier efficiency methods: An application to the US life insurance industry, *Journal of Productivity Analysis*, **10**, 131-152.
- De Borger, B., K. Kerstens, W. Moesen, and J. Vanneste (1992) A non-parametric non-convex approach to technical efficiency: An illustration of radial efficiency measures and some sensitivity results, *SESO Working paper*, 92/276, University of Antwerp.
- De Borger, B., K. Kerstens, W. Moesen, and J. Vanneste (1994) Explaining differences in productive efficiency: An application to Belgian municipalities, *Public Choice*, **80**, 339-358.
- De Borger, B., and K. Kerstens (1996) Cost efficiency of Belgian local governments: A comparative analysis of FDH, DEA and econometric approaches, *Regional Science and Urban Economics*, **26**, 145-170.
- De Borger, B., and K. Kerstens (2000) What is known about municipal efficiency? The Belgian case and beyond, in *Public Provision and Performance: Contributions from*

- Efficiency and Productivity Measurement* (Ed.) J. Blank, Elsevier, Amsterdam, pp. 299-330.
- De Prins, D., L. Simar, and H. Tulkens (1984) Measuring labour efficiency in post offices, in *The Performance of Public Enterprises: Concepts and Measurement* (Eds.) M. Marchand, P. Pestieau, and H. Tulkens, North Holland, Amsterdam, pp. 243-267.
- Dunn, W.N. (2004) *Public policy analysis: An introduction*, Pearson Prentice Hall, New Jersey.
- Farrell, M. (1957) The measurement of productive efficiency, *Journal of the Royal Statistical Society, Series A: General*, **120**, 253-281.
- Gérard, M. (2001) *Fiscal federalism in Belgium* Paper presented at a conference on “Fiscal Imbalance”, Quebec City (Canada), September 13-14, 2001.
- Geys, B. (2006) Looking across borders: A test of spatial policy interdependence using local government efficiency ratings, *Journal of Urban Economics*, **60(3)**, 443-462.
- Geys, B., F. Heinemann, and A. Kalb (2007) Local governments in the wake of demographic change: Efficiency and economies of scale in German municipalities, *ZEW Discussion Paper*, 07-036.
- Greene, W.H. (1993) The econometric approach to efficiency analysis, in *The Measurement of Productive Efficiency: Techniques and Applications* (Eds.) H. Fried, C.A.K. Lovell, and S. Schmidt, Oxford University Press, Oxford, pp. 68-119.
- Hasenkamp, G. (1976) A study of multiple-output production functions, *Journal of Econometrics*, **4**, 253-262.
- Hauer, D. (2005) Explaining efficiency differences among German and Austrian banks, *Applied Economics*, **37(9)**, 969-980.
- Hindriks, J., and F. Gerard (2005) Le palmares des villes et communes en Wallonie: Une approche en termes d’efficacité, *Regards Économiques*, **35**, 1-16.
- John, P. (2001) *Local Governance in Western Europe*, Sage, London.
- Jondrow, J., C.A.K. Lovell, I. Materov, and P. Schmidt (1982) On the estimation of technical inefficiency in the stochastic frontier production function model, *Journal of Econometrics*, **19**, 233-238.
- Kalseth, J., and J. Rattsø (1998) Political control of administrative spending: The case of local governments in Norway, *Economics and Politics*, **10**, 63-83.
- Koopmans, T.C. (1951) *Activity analysis of production and allocation*, John Wiley, New York.
- Levitt, M., and M. Joyce (1987) *The growth and efficiency of public spending*, Cambridge University Press, Cambridge.
- Lovell, C.A.K. (1993) Production frontiers and productive efficiency, in *The Measurement of Productive Efficiency: Techniques and Applications* (Eds.) H. Fried, C.A.K. Lovell, and S. Schmidt, Oxford University Press, Oxford, pp. 3-67.
- March, J.G., and H. Simon (1958) *Organizations*, John Wiley, New York.
- Matthijs, E., and J. Swinnen (2001) Production organization and efficiency during transition: An empirical analysis of East German agriculture, *Review of Economics and Statistics*, **83**, 100-107.

- Meeusen, W., and J. van den Broeck (1977) Efficiency estimation from Cobb-Douglas production functions with composed error, *International Economic Review*, **18(2)**, 435-444.
- Melyn, W., and W. Moesen (1991) Towards a synthetic indicator of macroeconomic performance: Unequal weighting when limited information is available, *Center for Economic Studies Public Economics Research Paper*, No. 17.
- Méon, P.-G., and L. Weill (2005) Does better governance foster efficiency? An aggregate frontier analysis, *Economics of Governance*, **6(1)**, 75-90.
- Mill, J.S. (1861) *Considerations on representative government in utilitarianism, liberty and representative government*, J.M. Dent, London.
- Moesen, W. (2005) *Gemeentelijk goed en rekenschappelijk bestuur*, Center for Economic Studies, KULeuven, mimeo.
- Moore, A., J. Nolan, and G.F. Segal (2005) Putting out the trash: measuring municipal efficiency in US cities, *Urban Affairs Review*, **41(2)**, 237-259.
- Musgrave, R.M. (1959) *The Theory of Public Finance*, McGraw-Hill, New York.
- Niskanen, W.A. (1979) Bureaucrats and politicians, *Journal of Law and Economics*, **18**, 617-643.
- Oates, W.E. (1972) *Fiscal Federalism*, Harcourt Brace Jovanovich, New York.
- Oates, W.E. (1999) An Essay on Fiscal Federalism, *Journal of Economic Literature*, **37**, 1120-1149.
- Samapio De Sousa, M.C., and B. Stosic (2005) Technical efficiency of the Brazilian municipalities: Correcting non-parametric frontier measurements for outliers, *Journal of Productivity Analysis*, **24**, 157-181.
- Simon, H. (1957) *Models of man*, John Wiley, New York.
- Staat, M. (2006) Efficiency of hospitals in Germany: a DEA-bootstrap approach, *Applied Economics*, **38(19)**, 2255-2263.
- Tulkens, H. (1993) On FDH efficiency analysis: Some methodological issues and applications to retail banking, courts and urban transit, *Journal of Productivity Analysis*, **4(1-2)**, 183-210.
- Tullock, G. (1969) Federalism: problems of scale, *Public Choice*, **6**, 19-29.
- Vanden Eeckhaut, P., H. Tulkens, and M. Jamar (1993) Cost efficiency in Belgian municipalities, in *The Measurement of Productive Efficiency: Techniques and Applications* (Eds.) H. Fried, C.A.K. Lovell, and S. Schmidt, Oxford University Press, Oxford, pp. 300-334.
- Vermeir, J., and B. Heyndels (2006) Tax policy and yardstick voting in Flemish municipal elections, *Applied Economics*, **38(19)**, 2285-2298.
- Von Hirschhausen, C., A. Cullmann, and A. Kappeler (2006) Efficiency analysis of German electricity distribution utilities: Non-parametric and parametric tests, *Applied Economics*, **38(21)**, 2553-2566.
- Worthington, A.C. (2000) Cost efficiency in Australian local government: A comparative analysis of mathematical programming and econometric approaches, *Financial Accountability and Management*, **16(3)**, 201-223.

- Worthington, A.C., and B.E. Dollery (2002) Incorporating contextual information in public sector efficiency analyses: A comparative study of NSW local governments, *Applied Economics*, **34**, 453-464.
- Wu, S., S. Devadoss, and Y. Lu (2003) Estimation and decomposition of technical efficiency for sugarbeet farms, *Applied Economics*, **35(4)**, 471-484.