COST EFFICIENCY OF FINNISH MUNICIPALITIES IN BASIC SERVICE PROVISION 1994-2002 *

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Abstract: We study the cost efficiency of basic welfare service provision in 353 Finnish municipalities in 1994-2002. We proceed applying methodologically a two step approach. First, Data Envelopment Analysis (DEA), a non-parametric linear programming method, is employed in calculating a best practise production frontier and related efficiency scores for municipalities. In DEA the outputs consist of six to ten volume indicators of the most important services in health, social and educational sector. As the combined input, total real costs of providing these services were used. According to our results there were considerable cost efficiency differences between the municipalities, and they remained fairly stable over time. A small group of peripheral municipalities scored clearly below the others. Ten most efficient municipalities were rather small and located mostly in Southern Finland. Ten biggest cities showed rather varying performance ranking between 65 and 317. As the second stage, differences in the DEA efficiency scores were explained with regression models. It was found that peripheral location, high income level (high wages), large population, high unemployment, diverse service structure, big share of services bought from other municipalities tend to reduce efficiency of municipal service provision. Big share of municipal workers in age group 35-49 years, dense urban structure and high education level of inhabitants tend to increase efficiency. These results apply for the whole period and mostly for its sub-periods, too. A high share of costs covered by state grants reduced efficiency in first years after the end of matching grant era in 1993. Later, and especially after moving to a purer lump-sum grant system, our grant variable was unrelated to efficiency.

Keywords: cost efficiency, local public sector, Data Envelopment Analysis

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1. Introduction

Basic education, as well as health, social and cultural services are provided by the public sector in most developed countries. In some cases the public sector not only finances most of the costs of these services, but also acts as the producer. In other ones, the private or non-profit sector is the main producer. Also, the level of government at which key provision/production decisions are made, can vary from a centrally organized service system to a highly decentralized system. For instance in France, health services in hospitals are provided by the national health system, which has a regional structure and its hospitals cover the whole country. Basic health services, however, are supplied by private doctors, whose customers' expenses are typically covered by insurance. Municipalities in France do not produce or provide health services, and the same is true for basic education.

In Nordic countries Denmark, Norway and Sweden all have a all had three tier governments during our study period. There, for instance health services have been provided at least partly by the intermediate level, although Norway has recently moved to a national hospital system. Finland differs from these countries by having a two tier government. The provision of an extensive list of basic services is decentralized to municipalities. Traditionally, this has also meant that municipalities and their joint organizations have acted as the producers of basic services. Outsourcing to private sector has been very limited but it has increased somewhat recently. State grants have been the fiscal link between central and local governments, which has enabled this structure financially, in addition to municipal (mainly income) taxation and reliance on user charges.

No matter what the organizational structure of government is in terms of the number of tiers and their role of provider or producer, basic services (merit goods) need a spatially dispersed network of a big number of public or private producers. Although they may also be privately produced, they are mostly publicly provided. With the growing demand for these income elastic and price inelastic basic services, which are labor intensive and tend to suffer from low productivity improvement, their share of GDP and public expenditure has increased in the past as suggested by Baumol (1967). These trends are supported by the ageing of population and its implications for health services and the demands for better basic education, both of which mostly publicly provided. Thus, there is a growing need to evaluate the performance of the service sector in general, although here we are mainly interested in basic services provided by the public sector. Given the Finnish two tier system of government, our focus is on municipal service provision.

There are various important view-points from which public service provision at the municipal level can be evaluated. In economics literature various studies have analyzed factors, which determine total and sector level expenditure with the aim of testing for instance the median voter model since the pioneering work of Barr and Davis (1966) or the fly-paper effect hypothesis related to the effect of grants from higher to lower level governments (Courant et al. 1979). These are mainly related to allocative efficiency at municipal level, studying whether the total amount and the mix of publicly provided services is optimal from the consumer-voter perspective. In Leviathan type models of the public sector efficiency in the use of resources becomes an explicit topic, if the analysis tests whether bureaucrats at local level can extract resources from provision of services to citizens for their own good or expand public sector organizations to promote their own interests (Niskanen 1971).

Quite a few studies consider producers/providers within one service (or merit good) sector and evaluate their performance from certain perspective. To give an example, schools have been evaluated and ranked on the basis of their achievements, like students' performance in tests. Alternatively, their resources (costs) have been studied with no direct link to outputs. A third approach considers both outputs and resources trying to assess the efficiency of schools. These three types of studies give answers to different questions. No matter how interesting rankings based on outputs like test scores in schools or their resources are, neither one of them alone tells about efficiency which is based on the ratio of (weighted) outputs to (weighted) inputs.

In this study we are interested in evaluating efficiency differences of Finnish municipalities in basic service provision. Furthermore, we wish to understand which factors might explain these differences. Instead of considering each service or sector at a time we regard municipalities like multi-product firms, which allocate resources to several sub-sectors. We confine our analysis, however, only to basic health, social services, education and cultural services, which in the Finnish system, unlike in many other countries, are mandatory tasks of the municipal sector. Thus, provision of local public goods such as infrastructure services and utilities are excluded from our analysis.

Methodologically, we use a two step procedure in empirical analysis. Our decision making units are municipalities. In the first stage, we only use information of their output and input volumes and apply Data Envelopment Analysis (DEA) to derive frontier production functions and related efficiency scores for each municipality. If a municipality is efficient (on the frontier) its score is one or 100 per cent. A lower score like 75 per cent indicates that with the same resources an efficient unit could have produced 25 per cent more. In the second stage we use regression models to explain the variation of efficiency scores among municipalities. Our covariates are indicators related to location, spatial structure and size of municipalities, diversity of service provision, share of own production vs. outsourcing from other municipalities or the private sector, income level and unemployment rate, age structure of municipal employees, political structure and share of costs covered by grants.

Our data covers 353 out of about 450 municipalities in Finland during 1994-2002. Smallest ones (population less than 2000) are excluded due to eventual problem in data. Also municipalities which merged during the period considered are excluded. The output variables (6-10 volume indicators in various models) in our DEA analysis are provided by Statistics Finland, which has collected them in connection of their "Productivity in the public sector" project since 1994. As measures of capital and labour inputs in municipal basic service production were unavailable, we use as a single input variable the total net current costs which could be allocated to the sectors considered. Thus, we are considering how efficiently municipalities use their money resources in the provision of selected services. As some services are produced and some services at least partly bought from outside the municipality, we would like to evaluate municipalities in two roles: as producers and providers of services. Unfortunately, we could not fully separate these roles and thus we have a mixed case, which we call an analysis of cost efficiency of municipal basic service provision.

The period 1994-2002 under consideration is rather special in the Finnish case. Financial liberalization and favourable export demand led to a boom in late 1980s. It was followed in early 1990s by an economic crisis, which led to a cumulative decrease of GDP by more than 10 percent. The year 1994 is the bottom of the bust after which economic growth accelerated, being on average by about 5 percent per year until it slowed down after the turn of the Millennium. Due to huge public deficits during and after the bust, also the municipal sector had to adjust to reductions in grants from the central government. There were also grant reforms, one in 1993 and another one in 1997 which changed the incentive structure of municipalities in providing services.

To the extent that we can find out efficiency differences and factors explaining them, our study may also contribute to the ongoing discussion about the need and form of reforms in basic service provision. Despite the fact that Finnish public sector has been receiving remarkably high rankings in international evaluations as a whole (see for instance Kuhry ed. 2004) and especially the Finnish school system has been celebrated by success of Finnish pupils in PISA tests, financial difficulties of municipalities have led to suggestion of reforms. The proposals have included increasing municipality sizes by mergers or increasing voluntary cooperation of municipalities to make them more efficient. In May 2005, the Ministry of Interior established a project "Structure of municipalities and services". Its duty is to consider both tasks of municipalities as well as well functioning structures and forms of cooperation of municipalities and the private sector. Our study on cost efficiency of municipal basic service provision

during 1994-2002 may contribute in policy discussions by locating where we stand before new reforms are undertaken.

The structure of the paper is as follows. In section 2, we make a short survey on the approaches and results of earlier studies, which have considered the efficiency of municipal service production. In section 3 we briefly describe the role of municipalities in the Finnish system of local government. In section 4, the DEA method is briefly described and our data as well as our four DEA models are introduced. Results of DEA models, average efficiency scores and their distributions are given in section 5. Section 6 starts with a discussion on what factors could be relevant in explaining cost efficiency differences among municipalities, leading then to estimation of regression models where the dependent variable is efficiency score and independent variables include various characteristics of municipalities. Summary of the work and a critical discussion on the interpretation of our results is presented in section 7.

2. Studies on the efficiency of municipalities

In this section we shall first make a selective survey on studies, which have evaluated the efficiency of municipalities covering all or at least several services provided by them. Only at the end, we shall refer to sector specific studies, and here we confine ourselves to studies concerning Finland.

A traditional approach to evaluate efficiency differences of production units is to use its input and output indicators (quantities) and their unit prices and to study productivity defined as the ratio of weighted outputs to weighted inputs. Market prices of outputs and inputs are used as weights if they are available. One of the basic problems in evaluating public sector activities is that market prices for outputs are unavailable, like in the case of basic education produced by municipal schools. To overcome this problem, average unit costs are often used as weights. Once productivity differences within a sector have been derived empirically, the second step is often to explain them with regression type models.

A recent study by Borge, Falch ja Tovmo (2004) is of this type. The authors study the effects of political and budgetary institutions on the efficiency of public service production within Norwegian local government sector. In the first stage they use national cost weights to aggregate the main outputs of each municipality into a single aggregate output. These outputs are divided by aggregate resources (measured in revenues) to get a measures of efficiency for each municipality. As a second stage of analysis the efficiency indicators are explained in a regression model by the characteristics of municipalities. According to the results, low efficiency level is associated to fragmentation of political power, socialist influence in municipal councils and high level of revenues at municipal level.

Another two step strategy is to estimate first a frontier production function and derive efficiency scores on the basis of relative distances of inefficient observations from the frontier. Then, as the second step, efficiency scores are explained by regression type models. In addition to estimating parametrically an aggregate production function where multiple outputs have been weighted e.g. by unit costs into a single output, non-parametric techniques have been used as the first step. Their virtue is that frontier production functions can be derived in a multiple outputs and multiple inputs setting without predetermined weights. Efficiency scores can then be explained by characteristics of municipalities in regression type models.

An example of the above strategy applied to municipalities is De Borger et al. (1994). They study the technical efficiency of 589 Belgian municipalities with cross-section data in 1985. In the first stage they use non-parametric FDH (Free Disposal Hull) method, which is an application of linear programming. It is used to derive a frontier production function and efficiency scores for municipalities. Municipal service production is measured by three inputs (number of blue and white collar workers and space of buildings)

and five outputs. The latter measure surface of roads, number of minimal subsistence grant recipients, students enrolled in primary schools, surface of public recreational facilities and a proxy for services delivered to non-residents. The last indicator was defined as log(number of non-residents)/log(total employment). When efficiency scores of municipalities are explained by Tobit-models it turns out that high efficiency is positively related to size of municipality and average level of education among population. Average income level and the ratio of grants to revenue are negatively related to efficiency. Variables measuring local political structures produce somewhat mixed and often statistically insignificant results. Also, the level of local taxation is statistically insignificant.

In another study De Borger ja Kerstens (1996) compare results from parametric and non-parametric studies on efficiency of municipal service production, using the same Belgian data. Here the single input variable is total expenditure and input prices are assumed to be the same in all municipalities, while the five outputs are as in De Borger (1994). The authors compare two non-parametric methods (FDH and Data Envelopment Analysis, DEA) and three parametric methods (one deterministic and two stochastic) by deriving with each method the respective frontier production function and related efficiency scores for municipalities. Efficiency scores produced by various methods lead to somewhat different levels on average efficiencies and rankings of municipalities. As a second step the five sets of efficiency scores are explained by regression methods and the results are then compared. These analyses produced surprisingly similar results. As a summary of joint results of alternative models, the level of taxation and education level are positively related to technical efficiency. Average income level and the ratio of grants to revenue are negatively related to efficiency. The results are mostly similar to those in De Borger et al. (1994).

The above mentioned studies give a good idea of approaches used in efficiency analyses concerning municipalities. Thus, we shall only shortly describe other studies on the same topic. Balaguer-Coll et al. (2002) used Spanish data in studying to what extent there were local government efficiency differences and whether they rise from factors, which are beyond the control of the entity. According to the results, a wide margin exists within which managers could increase local government efficiency levels, but a great deal of inefficiency is also due to exogenous factors. There was a size of the entity effect on efficiency, which however was not straightforward. High per capita tax revenue and high per capita grants tend to cause inefficiency, while a high amount of commercial activity has a positive efficiency effect. In another study Balaguer-Coll et al. (2003) first used nonparametric activity analysis for estimating efficiency differences of local public governments in Valencia, Spain. The measurement techniques made it possible to determine whether the inefficiencies were primarily overall cost, technical or allocative in nature. In the second stage, nonparametric smoothing techniques were used to identify some critical determinants of inefficiency, focusing both on political and fiscal policy variables. According to the results, inefficiency was largely attributable to allocative factors. Inefficiencies were also larger for smaller municipalities.

Afonso and Fernandes (2003) study expenditure efficiency of Portuguese local governments by the FDH method. They compute input and output efficiency scores for 51 Portuguese municipalities located in the region of Lisbon and Vale do Tejo (RLVT) in order to estimate the extent of municipal spending that seems to be 'wasted' relative to the ‘best-practice’ frontier. The results suggest that RLVT municipalities could achieve, on average, roughly the same level of local output with about 39 percent fewer resources, i.e. local performance could be improved without necessarily increasing municipal spending.

3. The role of municipalities in Finland

The aim of this section is to describe the role of Finnish local public sector and its relation to central government in a basically two-tier system with about 450 municipalities at the end of 1990s. Also major reforms, which have affected the operating environment of municipalities in basic service provision since early 1990s, are described.

In 2000 total expenditure of the public sector in Finland were about 49 % of GDP. Local public sector's (municipalities and their joint organizations) respective share of GDP was about 18 %, i.e. one third of total public sector expenditure. The main tasks of central government and social security funds mainly consist of providing national public goods, higher education and transfers, whereas the local public sector concentrates on local public goods and basic services (merit goods). The latter consist of social services and health care, education and cultural services, infrastructure maintenance and environmental protection. Nearly two-thirds of all public consumption and investment expenditure are used at local level in Finland.

One out of four employed people worked in the public sector in 2000. Central government employed some 128 000 people and the local public sector 416 000 people. About 80 % of employees in the municipal sector work in social, health and education services. Their employers, the municipalities range in size from a few hundred to more than half a million. Because there are a lot of small municipalities in Finland and their tasks are broad and expensive, they co-operate in different ways. In 2000 there were 226 joint organizations of municipalities, such that two or more of them provided jointly some services (e.g. health services and education). Unlike in Denmark, Norway and Sweden, where the intermediate level of government is responsible for much of health care, part of education and infrastructure, in Finland this level with its own tax powers and decision making units does not exist. Joint municipal authorities have no taxing powers of their own.

Municipalities levy a local income tax and property tax on residential and non-residential real estate. In addition, they receive an annual share of the revenues from corporate taxes. Each municipality decides independently on its income tax rate. Although the municipal income tax rate is set locally, the tax base is affected by nationally income tax allowances, decided by the government. The property tax was introduced in 1993. The municipal councils are free to set tax rates within statutory ranges for different types of real estate. Out of all local tax revenue, the share of property tax has not exceeded 5 %.

Before 1993 municipalities could tax corporate income directly - the tax rate for corporate income was the same rate that was locally decided for personal income. After the tax reform of 1993 corporate income was taxed with a fixed 25 % national rate (29 % in 2000) and it became solely a central government tax. However, a share of the accrued corporate income tax is paid to municipalities by portions that are fixed in the Income Tax Law. This share has been reduced over time as a result of the increase in corporate profits in late 1990s. Also state grants to municipalities have been both reformed and reduced since early 1990s.

Before 1993 about 99 % of state grants to municipalities were matching grants such that the matching rates varied by sector and characteristics of municipalities. In 1993 reform, grants became non-matching block grants based on so called "calculated expenditures". The purpose of the reform was to simplify the system and to give the municipalities an incentive to act cost-effectively. Furthermore, related to the economic crisis in Finland, the central government had cut the grants throughout 1993 – 1996. During this period the grants were cut altogether by 10 billion FIM. They covered 50 % of net operating expenditure in 1993, whereas in 1998 they covered only 24 %. On the other hand, during 1993-96 municipalities' tax incomes increased approximately 15 billion FIM, so that the municipal sector was on average able to cover the grant reduction by relying on its own revenue sources. However, grants from the government accounted for less than 20 % of total municipal sector income in 1998.

Since the 1993 reform block grants consisted of general grants and sector based block grants, which together with received or paid tax equalization formed the total grant amount allocated to each municipality. This total is lump sum money not tied to any particular activity. The 1997 grant reform revised the criteria for calculating sector specific block grants based on social and health care, education

and culture. Now each local government gets a sum of calculated per capita expenditure, deducted by the respective municipal financing share, which is the same for all municipalities. Then sector based block grants is obtained by multiplying this amount by the number of inhabitants.

The general grants are a sum of two components: grants per capita and tax revenue equalizing grants (or payments). The grant per capita consists of basic amount and supplements that take into account the special conditions of the municipalities: bilingualism, island municipality, remoteness and high population density.

In the tax base equalization system the tax equalization limit is 90 %. The sum by which a municipality's tax units/inhabitant figure falls short of the equalization limit - 90 % of the mean tax base per inhabitant - multiplied by the number of inhabitants and average tax rate, is paid to the municipality. If the municipality is above 90 % of the equalization limit, it must pay 40 % of the difference between it's (standardized) tax base and the equalization limit. If the municipality is above 144 % of the limit, it must pay 15 % of the (standardized) tax base over the 144 % limit. In this system most municipalities are net receivers of all transfers (sector specific grants + general grants), but in some cases the equalization payments exceed grants making them net contributors to the system. Also the central government has been a net contributor because the equalization system is not a zero sum game between municipalities. Despite the complicated manner in which different items are calculated, they are lumped together and as such the sum is not earmarked to any specific use at municipal level. The only exception is non-municipal service providers (like private schools), which get grant money on per pupil basis.

The above description of institutional framework of municipalities suggests that they nowadays have a lot of power in deciding how to allocate their own resources and lump-sum type transfers. Decentralization of power is, however, restricted since national laws determine the obligations of municipalities and give subjective rights to residents to several basic services.

To conclude, decisions at municipal level in Finland are taken by elected councils. Elections are every fourth year and votes are given to candidates. D'Hondt's method is used to determine how many council members each party gets, and then candidates with most votes in each party (not ranking position on party list) are chosen. Council members also elect municipal governments such that all parties in the council are proportionally represented in the governments. No major party is in opposition.

4. First stage: Application of DEA

In this study we shall follow a two stage approach. In the first stage we shall use Data Envelopment Analysis to determine cross-section frontier production functions and efficiency scores with data for each year during 1994-2002. Instead of a single model four DEA model variants are applied annually. As a second stage averages of efficiency scores during the whole period 1994-2002, its sub-periods, and annual average scores are explained in regression models by characteristics of municipalities. Before presenting our empirical DEA models, we present the basic idea of this method.

4.1. Data Envelopment Analysis

Data Envelopment Analysis (DEA), our non-parametric linear programming method of measuring (in)efficiency is fundamentally based on the work by Farrell (1957) which was further elaborated by Charnes et al. (1978) and Banker et al. (1984). This approach (see e.g. Färe et al.1985) has been widely used in empirical efficiency (or productivity) analysis especially in cases where the units (DMUs) use multiple inputs to produce multiple outputs, and there are problems in defining weights and/or specifying functional forms to be employed in analysis. As DEA does not require input or output prices in determining empirical efficiency frontiers based on best practise technology and related measures of inefficiency, it has become especially popular in the study of public sector. These applications include efficiency studies concerning e.g. schools, hospitals and theatres, also private sector applications have been numerous as can be seen e.g. from Seiford and Thrall (1990).

Several DEA studies of public sector efficiency have also been made in Finland. Kirjavainen and Loikkanen (1993, 1995, 1998) and Kirjavainen (1999) employed the method to investigating efficiency differences between senior secondary schools. Linna (1999) used the method to measuring Finnish hospital performance, employing also Malmquist indices, while Luoma and Järviö (2000) studied productivity of health centres. Also, the efficiency of government employment agencies (Martikainen 1994) and municipal courts Niemi (1994) has been studied by DEA.

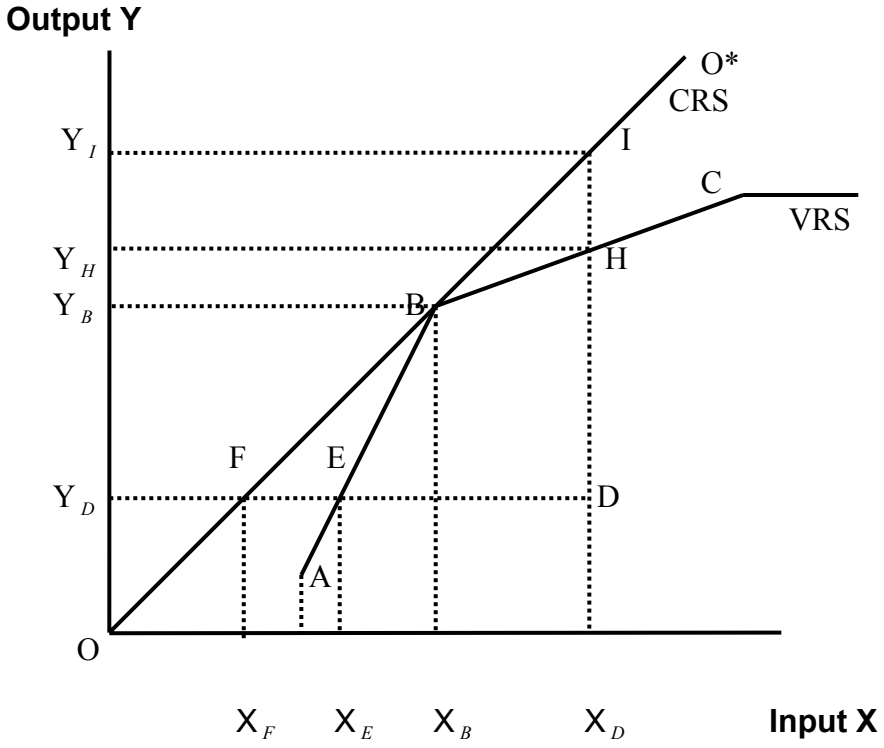
To keep this paper short, we shall not present mathematically the linear programming background for DEA. We shall only describe graphically the basic idea of the method in a one input and one output case.

Four decision making units (DMUs) are described in Figure 1 below; these are the points A, B, C and D. The DMUs use one input X to produce one output Y. Either constant returns to scale (CRS) or variable returns to scale (VRS) can be assumed for the frontier production function (efficiency frontier).

Under CRS, the most efficient unit is B, for which the tangent of the angle measured from the origin (output/input) is greatest (Y_B / X_B). Accordingly, the efficiency frontier under CRS is the line OO*. Compared with B, points A, C and D are clearly inefficient. Point D for example uses more of the input (X_D) to produce less of the output (Y_D) than point B. In order to be efficient, only X_F should be used to produce Y_D, or alternatively Y_I should be produced with input use X_D. From this we get X_F/X_D as the relative efficiency of D in the input direction; in the output direction the efficiency score is Y_D/Y_I. Under CRS these two ratios are equal, or $(X_F/X_D) = (Y_D/Y_I)$.

Under VRS the efficiency frontier passes through the points A, B and C. Consequently the relative efficiency of D is X_E/X_D in the input direction and Y_D/Y_H in the output direction, these ratios being generally unequal. In VRS efficiency can be further decomposed into scale efficiency and technical efficiency. Scale efficiency relates the size of the DMU to optimal size; in the input direction it is given by the ratio (efficient input use under CRS)/(efficient input use under VRS), or X_F/X_E in figure 1. Similarly, scale efficiency in the output direction is Y_H/Y_I. This efficiency loss is due to the in-optimal size of the DMU. The rest of the inefficiency of D is technical inefficiency, measured by X_E/X_D in the input direction, or Y_D/Y_H in the output direction.

Figure 1. Efficiency of decision making units in DEA, basic case



In the above description of DEA, nothing special was said about the DMUs. It is easiest to think, like in most referred Finnish DEA applications, that they represent production units such as plants of firms in the private sector or schools, health centres or the like in case of public sector. At this level there are typically economies of scale in the sense that very small units are technically inefficient even when all inputs can be optimised (long run). Whether there is an optimal size (like B in the observations of Figure 1) or an interval after which decreasing returns emerge, or continuous increasing returns is an empirical question.

In our application, however, the DMUS are not production units (schools, health centres etc) but municipalities. They are like multi-product firms, in the sense that multiple services are provided with a spatial network of "plants" in each sector. However, instead of profit motive in the interest of private owners, municipal decision making takes place in a rather complicated principal-agent setting, where elections and elected politicians, both at national and local level, have a role to play in addition to bureaucrats, who actually run the local service apparatus.[1]

Because services are typically delivered at the place of production, their spatial distribution depends on where people in municipalities (and their neighbours in case of cooperation) live. Assume that instead of

constant returns to scale, there are either increasing returns to scale or an optimal size in the sense of a technically efficient set of input-output combinations (one of which is also cost efficient given input prices). If the size of schools, health centres libraries etc. within a municipality varies because of varying population (and demand) in different parts of the municipality, there is no guarantee that each of them is of optimal size (if it exists) or utilizes economies of scale fully. This reflects the spatial efficiency and equity trade-off. In addition to scale economies at production unit level (or even lower level; class size) the may be economies of scale at network level. These may be based on the use of some common factor(s) available for all units or in case of costs, low prices of inputs when great amounts are involved. Also the opposite is possible, namely lower efficiency and higher costs due to bureaucracy.

In our application DMUs are municipalities and we only have information on volumes of their 6-10 basic services. On the input side, no information on the labour force and capital stock of municipalities used in basic service production was available for our purposes. Thus the input side is represented by costs of providing these services. In this multi-output and single input case we apply DEA assuming constant returns to scale as the first stage of analysis. In the second stage efficiency scores are explained in regression models which include among other variables population size. We do not have information on the network structures of service production units, although scale economics can be expected to manifest themselves at this level.

4.2. Data and four DEA models

Initially, our aim in this study was to cover the Finnish municipal sector as widely as possible, including all 450 municipalities of the country. However, this proved to be difficult and we had to exclude certain municipality groups. Firstly, and most importantly, small municipalities with less than 2000 inhabitants were excluded, the primary reason being that their bookkeeping and statistics might not be at a sufficient level of accuracy. Also, several of the services included in the DEA models were not produced at all in many small municipalities, bringing potential problems of estimation. Secondly, the municipalities of Åland archipelago were excluded because of data comparability problems. Thirdly, municipalities which merged during the study period were excluded. The number of these cases was small, although they include some of the bigger municipalities. The final data consists of 353 municipalities with a median population of 6000 inhabitants.

Application of DEA requires data on volumes of inputs and outputs of municipalities. Our data was obtained from Statistics Finland for the period 1994-2002. On the input side, no measures on labor or capital input use were available. Thus we had to use a single money-metric measure of municipal resource use in basic service provision. It is the sum of net operating costs in the health, social services and education each year, in the activities included in the study and evaluated at 1995 prices.. A proportional share of administrative costs in the included activities was included, while general administration costs of the municipality (city council, centralized planning etc.) were excluded from the expenditures.

A municipality can either produce a welfare service itself or it can act as provider of a service produced elsewhere (by another municipality, a joint municipal authority, a non-profit organization or a commercial firm). Ideally, efficiency could be evaluated from both the provider and producer points of view and the

[1] National politics through laws constrain the choices of municipalities in service provision and also affect their possibilities to finance local activities. At local level, bureaucrats run the service apparatus with their own interests. They are imperfectly monitored agents of politicians, who are typically assumed to be interested in re-election in setting their agenda in elections and when they act as local council and government members.

results could be compared. Unfortunately this was not possible, because the dual role of municipalities could not be separated in all service sectors. Consequently a mixed approach had to be followed. In the health and social services, we measured the cost of providing the services to the inhabitants (own production of the municipality plus purchased services minus services sold outside), while in education (here schools and municipal libraries) we measured the costs of municipal production. Thus, our money-metric input concept measures partly expenditure and partly production costs. Although the notion is not quite correct, we use the term cost efficiency in basic service provision to describe what we are doing.

As for output measures, Finnish municipal welfare services form a complicated whole, which cannot be completely covered with only a few main indicators. If the quality of same services varies across municipalities, this is likely to have an effect on measured efficiency results based on service volumes. In an ideal case, different qualities would be formulated as different services, but in practice this possibility is limited. In order to concentrate on more homogenous activities, in the case of health services, basic health care was included in the study, but specialist care provided by municipalities was excluded from both input and output side, although er the dividing line between them may be ambiguous in practice.

Changes in statistical concepts and classifications may have an effect on our measures and the DEA results. In particular, a new system of bookkeeping for municipalities was introduced in continental Finland in 1997. In 2000, small revisions in municipal statistics and the data system took place. Both cause potential comparability problems for efficiency results over time. This is why the DEA results (and regression results of section 6) are derived besides for the whole period 1994-2002 and for the three sub-periods 1994-1896, 1997-1999 and 2000-2002, also annually.

Statistics Finland has gathered information on the volume of municipal services since 1994. We use the annual volumes of basic health, social service and education sectors to define four variants of DEA models. In Table 1 the models have six to ten outputs (services), and as the only input, the net use costs (in fixed prices) of these services were used.

Table 1. Outputs of municipalities in four DEA models

		M 1: 6 outputs	M 2: 7 outputs	M 3: 10 outputs	M 4: Modi-fied M 1
1.	Children's day care centres, days	x		x	x
2.	Children's family day care, days	x		x	x
3.	1 & 2 combined		x		
4.	Open basic health care, visits	x	x	x	x
5.	Dental care, visits		x	x	
6.	Bed wards in basic health care, visits	x		x	x
7.	Institutional care of the elderly, days	x		x	x
8.	6 & 7 combined		x		
9.	Institutional care of the Handicapped, days		x	x	
10.	Comprehensive schools, hours of teaching	x		x	x
11.	Senior secondary schools, hours of teaching			x	
12.	10 & 11 combined		x		
13.	Municipal libraries, total loans		x	x	

DEA calculates the efficiency of a DMU by dividing a weighted sum of its outputs by a weighted sum of inputs. Weights of inputs and outputs are not given in advance, but they are determined as part of the solution to the optimizing problem. In the simplest case, each DMU is allowed to weigh its inputs and outputs freely to maximize its relative efficiency. In our case with just a single input, weighting concerns outputs only. Even in our case freely determined weights can be problematic. Namely, efficiency of a municipality is likely to be based on part of the outputs only if some outputs would get zero weights. This is inconsistent with the requirement that municipalities in Finland actually are obliged to provide the types of outputs we have in our list of outputs. Thus, we want to restrict the efficiency analysis by requiring positive weights for all outputs. In previous studies, this problem has been tackled in several ways (see Joro and Viitala 2004, Allen et al. 1997, Pedraja-Chaparro et al. 1997). Perhaps the most popular approach, also followed here, is to give upper and lower limits to the relative weights of inputs and outputs.

In principle the relative weights of inputs and/or outputs in DEA estimation could be based on expert judgment, assessing their relative importance in public service production. However, such an assessment would always be arbitrary and difficult to realize. The method followed here was to use unit production costs as basis of output weights. Data on unit costs was obtained from previous studies (Hujanen 2003, Hujanen et al. 2004, Tilastokeskus 2003). Each output was linked pair-wise to comprehensive school teaching hours, as this output has the largest total expenditure at the national level. The lower and upper limits of relative weights were set at 50 and 200 per cent of the fraction between the unit production costs of the corresponding two outputs (40 and 250 per cent in model 4).

The result was an estimation procedure where all outputs have an effect on the cost efficiency scores of municipalities, while each municipality is given limited freedom in weighing the individual services. We note that, as an inherent feature of DEA, tightening the variation range of weights tends to decreases average efficiency scores and the number of fully efficient units, which determine the efficiency frontier. In the extreme case with same predetermined weights for all DMUs, we are back in traditional productivity analysis.

4.3. Results from four DEA models

In empirical application, four DEA models (M1-M4) and related cost efficiency scores of municipalities were calculated for each year during 1994-2002 assuming constant returns to scale (CRS) for the efficiency frontiers. A first long run picture of cost efficiency was obtained by considering the average efficiency scores of municipalities by model type during the whole period 1994-2002. The four models gave a very similar picture on the relative cost efficiencies of the municipalities, correlation coefficients ranging from +0.87 to +0.99.

Table 2 shows that the number of efficient municipalities (on frontier) varied annually from 7 to 26, but only in case of Model 3, there were (three) municipalities, which were efficient each year during 1994-2002. Averages of annual median efficiency scores ranged from 0.856 to 0.898 suggesting that on average 10-15 % more output could be produced with given resources, if all municipalities were fully efficient (on the frontier). On the other hand, a good amount of efficiency variation is still left in the results.

One of the intrinsic properties of DEA is that the number of efficient DMUs and also average efficiency scores tend to increase the more inputs and outputs there are in the analysis. This explains at least partly, why the medians and lowest efficiencies tend to highest in Model 3, which also has the highest number of outputs.

Table 2. Average results from four DEA models 1994-2002

	Model 1	Model 2	Model 3	Model 4
Efficient municipalities on average	12	7	26	18
Municipalities efficient every year	0	0	3	0
Average of annual median efficiencies	0.858	0.856	0.898	0.871
Average of lowest efficiencies	0.571	0.599	0.617	0.587
Number of outputs	6	7	10	6
Number of inputs	1	1	1	1
Municipalities in model	353	353	353	353
Lower limit of population	2000	2000	2000	2000

In order to get an overall picture of cost efficiency in municipal service provision, we wanted to get an average score for each of them across models M1-M4. As DEA scores tend to rise with a larger number of outputs, we rescaled the efficiency score distributions. This was done as follows: First, average model specific scores for the period 1994-2002 were calculated for each municipality. Then, using these scores, four model specific variances of efficiency scores were calculated. Their average V* was chosen to be the bench-mark. Thus, efficiency scores of each model were scaled multiplying (1- efficiency score) by a constant which made their variance equal to V*. The four constants, which expanded or contracted the efficiency score distributions, keeping relative distances from score one (fully efficient) the same, were derived by iteration. These same four constants were also used, when annual average scores over models were derived for each municipality. Using these annual scores of municipalities, we get the long run view as their averages (final scores) over 1994-2002. Its distribution will be considered next.

5. Cost efficiency differences of Finnish municipalities 1994-2002, based on DEA results

In this section, we shall consider efficiency differences of municipalities on the basis of the averaged results of four DEA models (after scaling). First, we present results for the whole period 1994-2002, and then consider its sub-periods and rankings of municipalities in some detail.

Figure 2 shows a Salter diagram of efficiency scores (from high to low values) for all the 353 Finnish municipalities included in the study. As no municipality is fully efficient during all of the years from 1994 to 2002, none of them has the score one (100 per cent) for the whole research period. However, a few municipalities get very close to this, and a group of four top performers is found.

In Figure 2 there is a steeply declining tail in the cost efficiency distribution of Finnish municipalities. In eight municipalities average efficiency is below 70 per cent while some 30 score between 70 and 80 per cent. The lowest score is 62.4, suggesting that this municipality produces 38 percent less than an efficient municipality would produce. Alternatively, an efficient municipality would need 62 percent of the resources that the least efficient unit needs. Although these results indicate differences across municipalities, they cannot be taken too literally. One must bear in mind that when applying DEA, the variation of resulting efficiency rates depends among other things, inversely on the number of variables in the model and the assumption concerning the efficiency frontier (here CRS). The large majority of municipalities belong to the slowly declining part of the distribution, and they have an efficiency score from 80 to somewhat over 90 per cent. Median cost efficiency for 1994-2002 was 87.2 per cent.

Figure 2. 353 Finnish municipalities in order of cost efficiency, 1994-2002

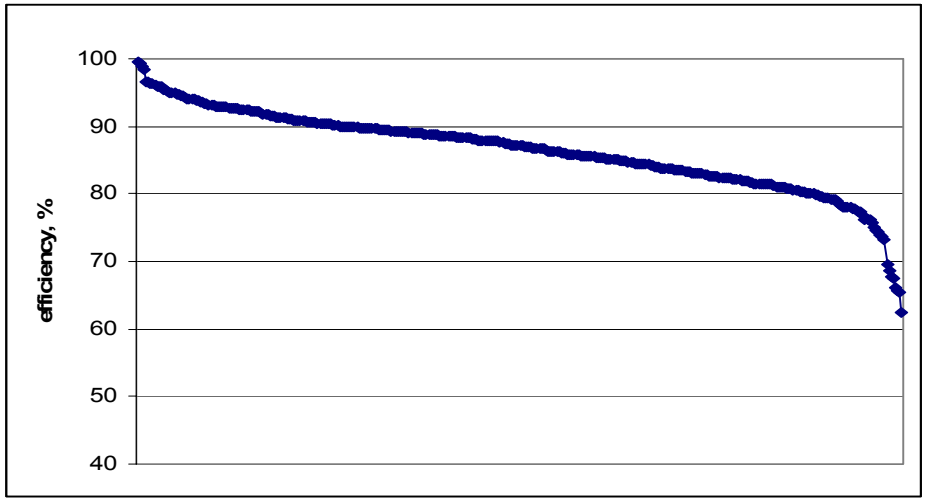


Figure 3. Stability of municipality cost efficiencies: DEA scores 1994-1996 and 2000-2002

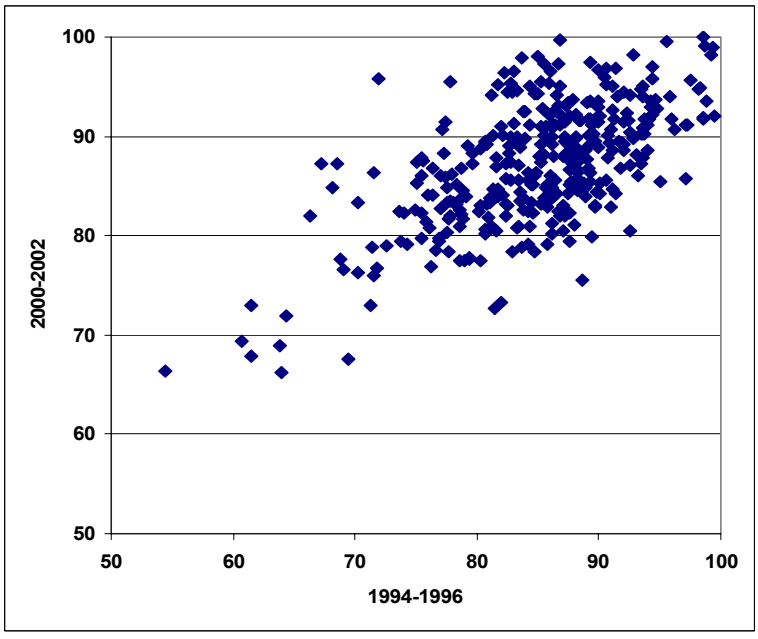
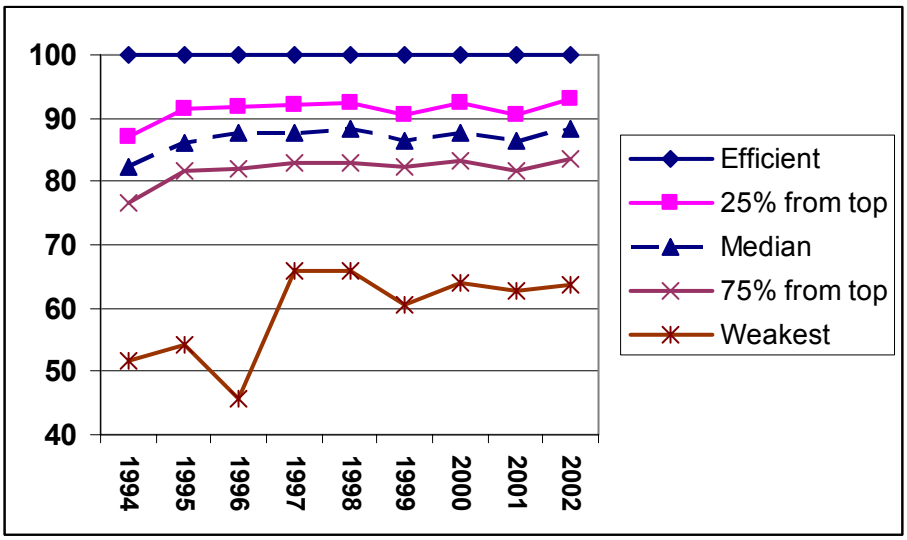


Figure 4. Development of the efficiency distribution 1994-2002



As to temporal changes and stability of the cost efficiency figures, it is seen that notable changes occur in the relative positions of municipalities, even though clear positive correlation (r = +0.63) exists between the average scores of 1994-96 and 2000-2002 (figure 3). In some cases shifts between the lower and upper end of the distribution take place; however this is not very common. Only in one tenth of municipalities the shift was more that 10 points and an average shift was 4.2 points. Positive correlation of results was evident also annually: for succeeding years the correlations were generally +0.8 or higher (with the exception of +0.71 in 1996/97), and between any single year and all other years +0.58 to +0.72.

Figure 4 describes the annual development of DEA scores by quartile averages. In 1994 efficiency scores were somewhat lower than in the other years; this could well have a connection with the preceding recession. In 1995-2002 the 25 %, 50 % and 75 % curves are quite smooth. We also note that the weakest scores in 1994-1996 concern about ten least inefficient municipalities, which also got very low scores in the years 1997-2002.

Municipalities in the "top ten" ranking list are all in Southern Finland (table 3). They are generally small by population (reflecting the general size structure of Finnish municipalities) and mostly have an urbanization rate and income level above median. The largest cities are missing from the top. Peripheral location is the most significant common factor of the weakest performing municipalities. The weakest ten are all in Northern Finland, six of them in Lapland. They all have low levels of urbanization, unemployment rates over 20 per cent and income levels around or below median. Their size structure is again typical of Finnish municipalities.

The biggest Finnish cities fall into two groups in cost efficiency (table 4). Tampere, Oulu, Lahti, Kuopio and Pori are in the top third of municipalities with 90 per cent efficiency or more. On the other hand, the three cities of the capital city region, namely Helsinki, Espoo and Vantaa are in the weakest third together with Turku and Jyväskylä.

Table 3. Municipalities with highest ad lowest DEA cost efficiencies 1994-2002

		DEA-%	Popu-lation	Province	Income, €/person	Unempl. rate, %	Urba-nisation rate, %
	Highest:						
1	Rusko	99,5	3 300	Vars.-Suomi	17 300	10,2	73
2	Raisio	99,2	22 800	Vars.-Suomi	17 800	13,3	98
3	Toijala	98,8	8 100	Pirkanmaa	15 200	17,8	96
4	Kihniö	98,3	2 500	Pirkanmaa	11 900	19,1	34
5	Lemi	96,6	3 100	Etelä-Karjala	13 300	15,1	44
6	Karjaa	96,5	8 800	Uusimaa	15 900	13,3	81
7	Masku	96,4	5 300	Vars.-Suomi	18 200	9,0	80
	Nakkila	96,4	6 100	Satakunta	14 900	16,2	75
9	Karkkila	96,1	8 700	Uusimaa	15 600	14,0	86
10	Rautjärvi	96,0	4 800	Etelä-Karjala	15 000	17,0	58
	Lowest:						
344	Vuolijoki	73,7	2 900	Kainuu	13 900	22,1	51
345	Suomussalmi	73,2	11 400	Kainuu	12 200	28,4	56
346	Puolanka	69,5	4 000	Kainuu	11 600	23,6	52
347	Sodankylä	68,6	10 200	Lapland	13 700	26,9	59
348	Kuusamo	67,7	18 200	P.-Pohjanmaa	13 400	22,9	63
349	Kolari	67,5	4 200	Lapland	12 900	26,8	45
350	Inari	66,1	7 600	Lapland	14 100	25,2	63
351	Enontekiö	65,6	2 300	Lapland	12 200	29,6	42
352	Muonio	65,4	2 600	Lapland	13 800	21,4	55
353	Kittilä	62,4	6 000	Lapland	13 000	24,5	49
Median		87,2	6 000		13 600	15,7	60

Relative performance in this group does not seem to be connected with size, neither is location a clear explanatory factor (for example Oulu is located peripherally in Northern Finland). As to income or education levels or urbanization rates, these are all above median in the largest Finnish cities, again not having a clear-cut connection with cost efficiency. The only clear dividing factor seems to be the capital city region, as its three cities all perform modestly. Higher wage and price level of the capital city region could be an explanatory factor, increasing production costs of services and consequently lowering cost efficiency. Another reason might lie in differences of services composition, assuming that the share of expensive high quality or expert services is higher in this region than elsewhere in the country. In the next chapter differences in DEA cost efficiency figures between municipalities are explained with regression models.

Table 4. DEA efficiency of ten largest cities 1994-2002

	DEA %	Rating /353	Population	Income, €/person	College degree educ., %	Unempl. rate, %
Helsinki	79,4	317	543 000	20 300	32,3	13,2
Espoo	82,5	268	205 000	24 100	39,5	9,5
Tampere	91,4	65	190 000	16 900	27,5	18,4
Vantaa	83,8	242	173 000	19 900	26,1	11,5
Turku	84,4	233	170 000	16 500	25,7	17,7
Oulu	90,6	80	116 000	17 400	30,3	17,9
Lahti	91,2	68	96 000	15 600	21,3	20,8
Kuopio	91,1	70	86 000	16 000	27,5	17,9
Jyväskylä	80,6	303	77 000	16 200	29,5	20,4
Pori	89,8	100	76 000	15 400	20,6	21,9
Median	87,2	177	6 000	13 600	15,5	15,7

6. Explaining municipal variation of cost efficiency by regression models

As the second stage of our two step analysis, differences in the DEA efficiency scores are explained by structural characteristics of municipalities. Our covariates are indicators related to location, spatial structure and size of municipalities, diversity of service provision, share of own production vs. outsourcing, income level and unemployment rate, age structure of municipal employees, political structure and the grant system.

6.1. Hypotheses concerning the effects of covariates on efficiency

In DEA analysis our input variable was net costs of providing the included basic services.
These costs were deflated over time, but there were no indices with which we could eliminate regional (municipal) variation in input prices. Service provision is labor intensive and thus by including average income level of inhabitants at municipal level, we wish to correct for missing regional deflators. We also note that besides incomes, also user cost of capital input (school buildings etc) tends to be high were incomes are high (big cities). Thus our income variable is expected to have a negative relation with efficiency.

Education level of inhabitants, besides being correlated with income can also have other roles. Educated inhabitants may be easier (less time consuming) customers. On the other hand, assuming that also municipal workers are also better educated when the general education level is high, they may be more efficient workers. Thus, we expect education level to be positively related to efficiency unless it is too highly correlated with income. Unlike with education and income, we have information on the age distribution of municipal employees working in services sectors. We construct three age groups (young, medium aged and aged workers) but it is hard to make a hypothesis to what extent for instance recent education of young is better than work experience of older employees for efficiency.

In section 3 we emphasized that basic public services are produced in a network of schools, health centre and the like. There are for sure economies of scale at “plant” level but the spatial distribution of population and its structure affects the size distribution of plants and their rate of utilization. For instance

in education, class sizes and school sizes vary within municipalities so that some may be efficient while other ones are inefficient of varying degree. There may also be economies of scale related to the size of the network, e.g. due to common fixed inputs shared by all, but there is also the possibility of bureaucratization of a big sector. Thus a priori it is hard to predict what effect the size of municipality has on efficiency. Also change in population (both directions) is tested assuming that stable conditions enhance efficiency.

If the population of municipalities lives in a dense settlement structure it is easier to organize and utilize (short distances) the service network. Thus, we expect that the efficiency is positively related to the proportion of inhabitants living in dense urban communities.

Municipalities in a region or a functional urban area can be divided into core and surrounding municipalities. The core may at extreme be so big that it covers the whole region or it may form a center surrounded by competing municipalities. Competition may lead to efficiency. Alternatively, if there are economies of scale at network level and bureaucracy problems can be avoided, the big municipalities covering the whole area may be efficient. We test these competing hypotheses with no a priori expectation by a variable measuring the population share of the core municipality in the region interacted with a dummy variable indicating whether the observation is a core or surrounding municipality.

Finland is a geographically large country, bigger than for example England but having much smaller population (5.2 million). Thus location may matter for various reasons (high transport costs, hard to get best human resources, but low local input prices) but it is hard to say which effects dominate. A weighted average of road distances between the economic region of the municipality to all other domestic regions measures the peripherality of location. In this measure pair-wise distances between regions are weighted with the Gross Regional Product of the destination region.

Although all municipalities are legally bound to provide basic services, their structure (shares) may vary from one municipality to another. We constructed a measure of variety of service provision using a more detailed classification of municipal services than that (6-10 outputs) used in our DEA analysis. There were in all 32 outputs and we measure the deviation of municipalities' service structure from an even distribution (sum of distances from 1/32). Higher values indicate lack of variety and we expect that this is associated with high efficiency, because with fewer outputs it may be easier to achieve efficient outcomes. On the other hand, low values may also indicate that our 6-10 output measures do not fully represent the quantities and qualities of services provided and this leads to low efficiency as the omitted elements are represented on the cost side.

Also a weak socioeconomic situation of municipalities may have a negative effect on efficiency if it leads to time consuming customer relations and need for special services which may increase unit costs of measured outputs. Unemployment rate was chosen as one of the socioeconomic indicator. Also the share of foreign born residents was tested.

The structure of service provision may affect efficiency. We tested whether the share of basic welfare services purchased from outside producers has an effect on cost efficiency. The purchased services were divided into two groups: purchases from joint municipal authorities and other municipalities, and purchases from private producers (either firms or non-profit organizations). Because outsourcing is voluntary, one would expect that using these options enhance efficiency compared to sole reliance on own production.

Several studies both in Finland and in the international literature indicate that state grants to municipalities as well as local politics affect allocation of resources at local government level. They may affect both the size (total expenditure) and internal structure local government spending. Here we are

interested in whether they affect efficiency. In the case of grants, the matching grant era ended in Finland in 1993, but its detrimental effects on efficiency may be still there at least in early parts of our study period which covers 1994-2002. Later, and especially after the 1997 reform leading to non-earmarked lump-sum grants, the grant system should be more neutral as grants no longer increase as a result of inefficient use of resources. As for politics, we test whether right/left, right/center/left etc. shares in municipal councils are related to efficiency, although we do not have any a priori hypotheses how these variables might affect.

6.2. Results of regression analyses

Regression models explaining variation of efficiency scores among municipalities were estimated with the 1994-2002 data its sub-periods including annual models OLS being the estimation method. We also estimated Tobit models which bound the dependent variable into the unit interval, but as the results were very similar (signs, t-statistics) we only report the OLS results over here.

The dependent variable in all regressions is based on the average (after scaling) annual efficiency score from four models, which is used as such in annual models, and averaged over years in case of longer time spans. Estimations with annual data are presented only in Appendix.

In the following we present estimated models in which systematically insignificant variables are excluded. It turned out that taxable income per person and variables related to the political power structure of municipalities did not explain efficiency differences. Left or right side dominance of political parties in municipal councils had no effect on efficiency, neither had the centralization or dispersion of party structure (measured by the Herfindahl index). Also, voting activity in local elections (and its change) was tested, but the coefficients were insignificant. The same was true for the variables measuring the population share of the core municipality in a region. Neither did population change (either direction) have a significant effect on efficiency.

Table 5 reports regression results for the whole period of research 1994-2002, its three sub-periods (1994-96, 1997-99 and 2000-2002) as well as the sub-period 1997-2002. Most regression coefficients of included variables are statistically significant in case of the whole research period 1994-2002. The estimation results of the three sub-periods give them good support, even though all explanatory variables are not significant in all sub-periods. Changes in signs of coefficient do not occur, and R^2 values lie between 0,35 to 0,46.

According to table 5, big population of municipality is detrimental to cost efficiency in the provision of basic welfare services. Despite various efforts to find nonlinearities in this relation, a basic linear formulation of the population variable seemed to work best. However, as most municipalities in Finland are small (median size in the data is only 6000 people), the population variable is in practice important only for the large cities, and especially for Helsinki, the Finnish capital. Whether this is a pure size effect or represents size related unmeasured outputs or quality differences in service provision, bureaucracy related inefficiency or inefficiently utilized network of service units, is an open question.

High income of the inhabitants was used as a proxy for wage level, as sufficient local or regional information on the input price variation in service provision was not available. As expected, high income level is related with low cost efficiency. High education level of population (proxy for education level of municipal workers in the basic service sectors) is related to high cost efficiency, as expected. A narrow range of services makes higher efficiency possible; this is typically a factor detrimental to large municipalities, as they typically provide a wider range of alternatives than small ones.

Our location variable measuring the domestic GRP weighted distance of municipalities (squared) proved to be the most significant explanatory variable in our estimation results, getting high t-values also in all sub-periods. The distance factor accounts for the weak performance of Northern Finland (Lapland) municipalities, but in itself it gives no information about how the distance mechanism works. Dense physical structure (high share of people living in urban centres) seems to make higher efficiency possible in service provision, as could be expected. Big share of services produced by other municipalities or joint municipal organizations tends to reduce efficiency, while a big share of privately produced services enhances efficiency.

Employees of 35 to 49 years of age seem to be most beneficial to cost efficiency, compared with younger or older age groups. Difficult local socioeconomic situation measured by the unemployment rate decreases efficiency (using the share of population receiving municipal income support as an alternative produced a similar result).

Finally, we note that as for political variables, we could not present a priori hypotheses on their effects on efficiency, and they were also insignificant and excluded from final models. As for the grant system, a high level of state grants per capita is connected with cost inefficiency in the first years of the study. However, after 1997 such an effect cannot be found any more. This supports the hypothesis that in the years following the 1993 grant reform the detrimental effects of matching grant system were still present, but with the new lump-sum system, they faded away. Also estimations with annual data give some support for this result (see Appendix).

Table 5. Explaining DEA efficiency (in per cent) differences between municipalities with background variables, OLS 1994-2002 and its sub-periods

	1994-2002	1997-2002	1994-1996	1997-1999	2000-2002
Size-related factors:					
population, 1000	-0,0204	-0,0217	-0,0181	-0,0199	-0,0255
	(-2,54**)	(-2,60***)	(-1,71*)	(-2,22**)	(-2,93***)
earned income,	-1,16	-0,814	-1,87	-0,748	-0,827
1000 € / person	(-3,93***)	(-2,91***)	(-4,18***)	(-2,38**)	(-3,04***)
education level of	4,11	3,56	5,11	3,30	3,87
population, years	(3,13***)	(2,55**)	(3,07***)	(2,22**)	(2,67***)
lack of variety of	0,126	0,112	0,0796	0,115	0,0786
services, index	(2,48**)	(2,34**)	(1,21)	(2,39**)	(1,55)
Location and physical structure:					
distance,	-0,0251	-0,0248	-0,0252	-0,0247	-0,0259
1000 x km^2	(-8,28***)	(-8,08***)	(-6,02***)	(-7,47***)	(-8,12***)
urbanization rate, %	0,0555	0,0473	0,0724	0,0482	0,0416
	(2,65***)	(2,12**)	(2,70***)	(2,00**)	(1,84*)

Table 5 continuing:

Producer of services (% of all services):					
other municipalities and joint municipal organizations	-0,0247 (-3,25***)	-0,0330 (-4,07***)	-0,00786 (-0,83)	-0,0375 (-4,40***)	-0,0279 (-3,29***)
other (private) producers, %	0,164 (2,27**)	0,114 (1,80*)	0,974 (0,93)	0,177 (2,07**)	0,0950 (1,88*)
Age of employees, %					
Share of 35-49-years old employees	0,185 (2,04**)	0,147 (1,47)	0,223 (2,24**)	0,235 (2,51**)	0,0167 (0,16)
share of employees over 50 of age	0,0452 (0,57)	0,0144 (0,17)	0,102 (1,09)	0,0148 (0,17)	0,0255 (0,29)
Socioeconomic situation of municipality:					
unemployment rate, %	-0,254 (-2,92***)	-0,226 (-2,51**)	-0,323 (-3,07***)	-0,249 (-2,77***)	-0,210 (-2,19**)
Municipal economy:					
state grants, € / inh.	-0,0027 (-1,95*)	-0,0013 (-1,03)	-0,0048 (-2,53**)	-0,00087 (-0,60)	-0,00078 (-0,66)
constant	76,592 (7,97***)	76,535 (7,84***)	87,950 (7,16***)	71,416 (7,47***)	85,273 (8,20***)
R^2 (adj)	0,459	0,387	0,407	0,367	0,354
Heterosced: Br.-Pagan: P > chi^2	0,976	0,436	0,326	0,745	0,417
Ramsey RESET: Prob > F	0,443	0,812	0,235	0,987	0,958
Average. VIF	3,13	2,95	3,15	2,95	2,83
Max. VIF	8,82	8,10	9,07	8,19	7,51

In the regressions reported above, the municipal cost efficiency scores were obtained as averages of four different DEA model specifications. In order to see the effects of averaging (and scaling) on the OLS regressions, the regressions were also done for scores obtained from the single DEA models. In table 6, a comparison of the regressions based on the final (average) DEA scores (explained in the above regressions) and two of the separate models is shown. These two separate DEA models differ notably from each other what comes to the number of outputs, as model (1) has 6 outputs and model (3) 10 outputs. Still the regression results are close to each other and to the results obtained from averaging over the models. Again, no changes of signs occur and the significance levels of estimated coefficients are quite similar.

Table 6. The effect of averaging over DEA models on OLS regression results 1994-2002

	Average over the four DEA models	Separate DEA models: Model (1)	Model (3)
population, 1000	-0,0204 (-2,54**)	-0,0182 (-2,26**)	-0,0197 (-2,33**)
earned income, 1000 € / person	-1,16 (-3,93***)	-1,14 (-3,82***)	-1,18 (-3,80***)
education level of population, years	4,11 (3,13***)	3,76 (2,84***)	4,37 (3,15***)
lack of variety of services, index	0,126 (2,48**)	0,168 (3,30***)	0,0904 (1,69*)
distance, 1000 x km ^{2}	-0,0251 (-8,28***)	-0,0238 (-7,80***)	-0,0270 (-8,45***)
urbanization rate, %	0,0555 (2,65***)	0,0495 (2,34**)	0,0565 (2,56**)
Producer of services (% of all services):			
- other municipalities and joint municipal organizations	-0,0247 (-3,25***)	-0,0283 (-3,70***)	-0,0173 (-2,16**)
- other (private) producers, %	0,164 (2,27**)	0,184 (2,52**)	0,149 (1,95*)
Share of 35-49-years old employees	0,185 (2,04**)	0,162 (1,77*)	0,222 (2,32**)
share of employees over 50 of age	0,0452 (0,57)	0,0162 (0,20)	0,0695 (0,83)
unemployment rate, %	-0,254 (-2,92***)	-0,214 (-2,44**)	-0,272 (-2,97***)
state grants, € / inh.	-0,0027 (-1,95*)	-0,0044 (-3,24***)	-0,0017 (-1,19)
constant	76,592 (7,97***)	75,322 (7,78***)	79,318 (7,82***)
R^2 (adj)	0,459	0,483	0,429
Heterosced: Br.-Pagan.: P>chi ^{2}	0,976	0,917	0,541
Ramsey RESET: Prob > F	0,443	0,409	0,122
Average VIF	3,13	3,13	3,13
Max. VIF	8,82	8,82	8,82

7. Summary

We study the cost efficiency of basic service provision in 353 Finnish municipalities in 1994-2002. Smallest municipalities (population less than 2000) as well as recently merged municipalities, and those in Åland (a province with self government) are excluded from our analysis because of data problems. The basic services cover education, health and social services, which in the Finnish two tier system are provided by the local government level.

We proceed applying methodologically a two step approach. First, Data Envelopment Analysis (DEA), a non-parametric linear programming method, is employed in calculating a best practise production frontier and efficiency scores for municipalities. In DEA the outputs consist of six to ten volume indicators of the most important services in health, social and educational sector. As the combined input, total real costs of providing these services were used, and thus we use the terms cost efficiency.

According to our results average efficiency score was 87,2 per cent. As the level of scores depends on the number of variables in DEA models, this is not an absolute number. More interestingly, there were considerable differences in cost efficiency between the municipalities and they turned out to remain rather stable over time. A small group of peripheral municipalities scored clearly below the others. The ten municipalities ranking highest in efficiency were rather small and located mostly in Southern Finland. Biggest cities, mostly having universities, showed rather varying performance. Their efficiency scores ranged from 79,4 % to 91,4 % and ranking in efficiency distribution from 65 to 317.

As the second stage, differences in the DEA efficiency scores were explained by using regression models. It was found that peripheral location, high income level (high wages), large population, high unemployment, diverse service structure, big share of services bought from other municipalities and high share of cost covered by state grants tend to reduce efficiency of municipal service provision. Big share of municipal workers in age group 35-49 years, dense urban structure and high education level of inhabitants tend to increase efficiency.

In subsequent research we would like to get still better measures of output, which would take into account eventual variation in quality. On the input side, variables measuring the use of labor and capital inputs would be most welcome. The list of covariates used in explaining efficiency differences could also include measures related to service networks and managerial type variables. Also, testing of alternative empirical strategies instead of reliance on our two step methodology (DEA followed by regressions) might give mileage.

Despite all the caveats, we hope that our results offer an input besides for the research community, also for the Finnish government and its working groups, which are planning to reform the basic service provision system.

References

Afonso, A. – Fernandes, S. (2003): Efficiency of Local Government Spending: Evidence for the Lisbon Region. Papers of European Group of Public Administration (EGPA).

Allen, R. – Athanassopoulos, A. – Dyson, R. – Thanasoulis, E. (1997): Weight restrictions and value judgments in Data Envelopment Analysis: Evolution, development and future directions. Annals of Operations Research 73.

Balaguer-Coll, M. – Prior-Jimenez, D. – Vela-Bargues, J. (2002): Efficiency and Quality in Local Government Management. The Case of Spanish Local Authorities. Universitat Autonoma de Barcelona, Documents de treball 2002/2.

Balaguer-Coll, M. – Prior, D. – Tortosa-Ausina, E. (2003): On the Determinants of Local Government Performance: A Two-Stage Nonparametric Approach. University of New South Wales, Centre of Applied Economic Research, Working Paper.

Banker, R.D. - Charnes, A. - Cooper, W.W. (1984): Some models of estimating technical and scale inefficiencies in data envelopment analysis. Management Science, Vol. 9, No. 9, 1078-1092.

Barr, J.L. – Davis, O.A. (1966): An Elementary political and economic theory of the expenditures of local governments. Southern Economic Journal 33, 149-165.

Baumol, W.J. (1967): Macroeconomics of Unbalanced Growth: The Anatomy of Urban Crisis. American Economic Review, Vol. 57, 415-426.

Borge, L-E. – Falch, T. – Tovmo, P. (2004): Efficiency in public service production: the impact of political and budgetary institutions. Paper submitted to the 24. Conference of the European Public Choice Society, Berlin.

Charnes, A., Cooper, W.W. and Rhodes, E. (1978): Measuring the efficiency of decision making units. European Journal of Operational Research, Vol. 2, 429-444.

Cooper, W. – Seiford, L. – Tone, K. (2000): Data Envelopment Analysis. A Comprehensive Text with Models, Applications, References and DEA-Solver Software. Kluwer Academic Publishers.

Courant, D.F. – Gramlich, E.M – Rubinfeldt, D.L. (1979): The stimulative Effects of intergovernmental grants: Or why money sticks where it hits. In P. Mieszkowski and W.H. Oakland (Eds.), Fiscal federalism and grant-in-aid. Washington DC: The Urban Institute.

De Borger, B. - Kerstens, K. – Moesen, W. – Vanneste, - J. (1994): Explaining Differences in Productive Efficiency: An Application to Belgian Municipalities. Public Choice 80, 339-358.

De Borger, B. – Kerstens, K. (1996): Cost Efficiency of Belgian Local Governments: A Comparative Analysis of FDH, DEA and Econometric Approaches. Regional Science and Urban Economics, 145-170.

Farrell, M. (1957): The Measurement of Productive Efficiency. Journal of Royal Statistical Society, Series A 120 (III).

Färe, R. - Grosskopf, S. - Lovell, C. (1985): The Measurement of Efficiency of Production. Boston: Kluwer-Nijhoff.

Hujanen, T. (2003): Terveydenhuollon yksikkökustannukset Suomessa vuonna 2001 (Unit costs of health services in Finland in 2001). Aiheita 1/2003, Stakes.

Hujanen, T. – Mikkola, H. – Pekurinen, M. – Häkkinen, U. – Teitto, E. (2004): Terveydenhuollon menot ikä- ja sukupuoliryhmittäin vuonna 2002 (Health expenditures by age and gender in 2002). Aiheita 24/2004, Stakes.

Joro, T. – Viitala, E-J. (2004): Weight-restricted DEA in action: from expert opinions to mathematical models. Journal of the Operational Research Society, 55.

Kirjavainen, T. (1999): Efficiency of Finnish Senior Secondary Schools: Explaining High and Low Performance with Resources, Environmental, and Organizational Factors. Helsinki School of Economics and Business Administration, Working papers W-221.

Kirjavainen, T. - Loikkanen, H. (1993): Lukioiden tehokkuuseroista (On efficiency differences between senior secondary schools). Valtion taloudellinen tutkimuslaitos, tutkimuksia 16, Helsinki.

Kirjavainen, T. - Loikkanen, H. (1995): School Resources and Student Achievement: Evidence from Finnish Senior Secondary Schools. Valtion taloudellinen tutkimuskeskus, Discussion Papers 91, Helsinki.

Kirjavainen, T. - Loikkanen, H. (1998): Efficiency Differences of Finnish Senior Secondary Schools: An Application of DEA and Tobit Analysis, Economics of Education Review, Vol. 17, No 4.

Kuhry (ed.) (2004): Public Sector Performance. Social and Cultural Planning Office of the Netherlands. The Hague.

Linna, M. (1999): The impact of health care financing reform on the productivity change in Finnish hospitals. Reports and Working Papers of the Systems analysis laboratory, Helsinki University of Technology.

Loikkanen, H. A. – Susiluoto, I. (2002): An Evaluation of Economic Efficiency of Finnish Regions by DEA and Tobit Models. Paper presented at the 42. Congress of the European Regional Science Association, Dortmund 27-31. August 2002.

Luoma, K. – Järviö, M-L. (2000): Productivity Changes in Finnish Health Centres: A Malmquist Index Approach. Valtion taloudellinen tutkimuskeskus. Discussion Papers 218, Helsinki.

Martikainen, M. (1994): Työvoimatoimistojen tehokkuus 1992-1993 (Efficiency of government employment offices). Valtion taloudellinen tutkimuskeskus, keskustelualoitteita 79, Helsinki.

Niemi, M. - Luoma K. - Sarho R. - Östring T. (1994): Alioikeuksien tehokkuuserot Suomessa vuonna 1991 (Efficiency differences between Finnish district courts in 1991). Valtion taloudellinen tutkimuskeskus, keskustelualoitteita 72, Helsinki.

Niskanen.; W. (1971): Bureaucracy and Representative Government. Chicago: Aldine-Atherton.

Pedraja-Chaparro, F. – Salinas-Jimenez, J. – Smith, P. (1997): On the Role of Weight Restrictions in Data Envelopment Analysis. Journal of Productivity Analysis 8.

Seiford, L. - Thrall, R. (1990): Recent Developments in DEA. Journal of Econometrics, Vol. 46, 7-38.

Susiluoto, I. – Loikkanen, H. A. (2001): Seutukuntien taloudellinen tehokkuus 1988-1999 (Economic efficiency of regions 1988-1999). Helsingin kaupungin tietokeskuksen tutkimuksia 2001:9.

Tilastokeskus (2003): Kuntien talous ja toiminta 2002. SVT Julkinen talous 2003:7.