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Abstract

We study the cost efficiency of basic welfare service provision in 353 Finnish municipalities in 1994-2002. First, Data Envelopment Analysis (DEA) is employed in calculating efficiency scores for municipalities. In DEA the outputs consist of six to ten volume indicators of services in health, social and education sectors. As the combined input, costs of providing (either producing or buying) these services were used. According to our results, there were considerable cost efficiency differences between the municipalities, and they remained fairly stable over time. The most efficient municipalities were rather small and mostly located in southern Finland, while the least efficient ones were in the peripheral northern parts of the country. The biggest cities showed rather varying performance. As the second stage, 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 and a 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, big share of services bought from private sector and high education level of inhabitants tend to increase efficiency. These results apply for 1994-2002 and also mostly for its sub-periods. Great state grants reduced efficiency in first years after the end of matching grant era in 1993. Later, during the block grant era our grant variable was unrelated to efficiency. Political variables and turnover in local elections did not explain efficiency differences.

JEL Classification: C14, H42, R59

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

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1. Introduction

Basic services (merit goods) are provided by the public sector in most developed countries. In some cases the public sector finances these services and 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, varies from centrally organized service systems to highly decentralized ones, which may have several tiers of government.

In Nordic countries Denmark, Norway and Sweden have all had three tier governments. Finland has only two tiers such that the provision of an extensive list of basic services is decentralized to more than 400 municipalities. Traditionally municipalities and their joint organizations have also acted as the producers of basic services. Outsourcing to private sector has been rather limited, but it has increased somewhat recently. State grants have been the fiscal link between central and local governments, which, in addition to municipal (mainly income) taxation and tax revenue equalization across municipalities, has enabled this structure financially. Reliance on user charges has been limited as most of the basic services have been provided free of charge or they have been heavily subsidized.

The purpose of this paper is to study differences in the efficiency of providing basic municipal services in Finland. The services considered cover basic education and health services, as well as social and cultural services, while specialized health services, transportation, land use and utilities are not included. Thus, our results do not cover all activities of municipalities. Also, the excluded sectors include activities, where economies of scale may be far more important that in basic services. It should be noted that unlike numerous sector specific studies, which consider schools, health centres etc. separately, we regard municipalities as multi-product firms, which provide (either produce or buy) several services under political and administrative decision making. Our approach is also different from the numerous studies, which have explained variation in total expenditure per inhabitant, since high or low per capita expenditure level does not necessarily tell anything about efficiency of provision.

In the first stage of our analysis, Data Envelopment Analysis (DEA) is applied to produce efficiency scores for municipalities. In DEA six to ten volume indicators of various basic services are used as outputs, and the single input variable is aggregate net cost of provision. In this setting, where service provision is carried out either by own production or by buying from other municipalities or the private sector, our efficiency concept is neither technical nor cost efficiency of production. We use the term cost

efficiency of provision. In the second stage, regression analysis is applied to explain the efficiency scores with 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. Our data covers 353 out of about 450 Finnish municipalities during 1994-2002. Due to eventual data problems, municipalities with population less than 2000 are excluded, as well as municipalities of the Åland archipelago. Also municipalities which merged during the study period are excluded.

Basic services are produced by schools, daycare centres, health centres and the like. There are for sure economies of scale in the production of basic services. For instance optimal class and school sizes cannot be very small due to fixed factors. On the other hand, diseconomies of scale and/or spatial distribution of demand (and transportation costs) limit the size of schools and other service units. Thus, the smallest municipalities in Finland may only have a single school, whereas bigger ones have a network of schools. In addition to economies of scale at "plant" level, they may be related to the size of the network of plants within each municipality. Furthermore, service sectors may be linked to each another via size related positive external effects or the use of indivisible fixed resources. These external effects and connections with the private sector may manifest themselves as positive agglomeration effects. They would make municipalities with a big population and large networks of public and private activities efficient.

On the other side of the coin, there are arguments against centralization. Besides reasons related to the "decentralization theorem" of Oates (1972), economies of scale may be limited both at plant and network level in the production of basic services. But even when economies of scale exist, they may not ensure efficient provision. Namely, in big units or at high level of government bureaucrats can more easily extract resources from provision of services to citizens for their own good or expand public sector organizations to promote their own interests (Niskanen 1971). Theoretically, it is impossible to say whether economies or diseconomies of scale dominate in municipal basic service provision.

Internationally, the systems of basic service production (and provision) differ considerably. Within EU Finland is at the most decentralized end, whereas France and England rely much more on national systems and also give a bigger role to the private sector rather than to municipalities. On the other hand, the number of municipalities is huge (36 000) in France whereas in England the number of local authorities is less than 500. These examples indicate that there are remarkable differences in the degree of decentralization of basic service provision. The same is true for the forms of financing lower levels of

government, which range from heavy use of local taxation and user charges to cases (like the Netherlands), where state grants from central to lower levels of government are of greatest importance.

Alongside persistent diversity, the basic service systems have been reformed in many countries both on efficiency and equity grounds. In these reforms the tasks and the forms of finance at different levels of government have been renewed. There have been local tax and grant reforms. Also, the number of units at certain level of government has been changed either gradually (voluntary mergers) or related to grand reforms. In many countries the number of municipalities has been reduced by latter types of reform. For instance in Sweden the 1974 reform reduced the number of municipalities from about 900 to 278. One of the motivations for these reforms has been the search for more efficient modes of producing or providing basic services.

Also in Finland, there have been local tax and grant reforms during the 1990s, whereas the tasks and the structure of local government have remained much the same. Voluntary mergers of municipalities have reduced their number from 460 in 1990 to 432 in 2005. Despite the fact that the 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 suggestions of reforming the local public sector. During 2005, the Ministry of Interior has launched three new alternatives. One suggestion is to have only 80-100 municipalities. Another suggestion is that most of basic service provision and taxation would be the task of 20 new "regional municipalities" (an intermediate tier) such that the old municipalities would continue with limited tasks and loss of their own taxation. A third reform proposal suggests increasing municipality sizes by voluntary mergers. Also, the extension of voluntary cooperation between municipalities and giving a bigger role to the private sector in basic service production, have been suggested. One common motivation for all these proposals is to ease the financial difficulties of municipalities and make their service provision more efficient.

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 provision. 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 study is presented in section 7.

2. Studies on the efficiency of municipalities

In this section we make a selective survey of studies, which have evaluated the efficiency of municipalities covering several services provided by them. A traditional approach to evaluate efficiency differences of production units is to use its input and output indicators (quantities) to study productivity defined as the ratio of weighted outputs to weighted inputs. Market prices of outputs and inputs are used as weights. In case of public sector activities, market prices for outputs are typically unavailable. To overcome this problem, average unit costs are frequently used as weights. Once productivity differences 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 the Norwegian local government sector. The main outputs of each municipality are aggregated into a single output and divided by aggregate resources to get measures of efficiency for each municipality. Then 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. Non-parametric methods are often applied in this stage in a multiple outputs and multiple inputs setting and no price information. Thereafter, efficiency scores are explained by 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 the non-parametric Free Disposal Hull (FDH) method for deriving a frontier production function and efficiency scores for municipalities. Municipal service production is measured by three inputs, which are

number of blue and white collar workers and space of buildings. The five outputs 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. 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.

Already prior to De Borger et al. (1994) study, Van den Eeckaut et al. (1993) had studied efficiency of Belgian municipalities both with FDH method and DEA. In their case, the output variables were rather far proxies for the services of municipalities.

De Borger and Kerstens (1996) apply two non-parametric methods (FDH and Data Envelopment Analysis, DEA) and three parametric methods (one deterministic and two stochastic), for comparing results concerning efficiency of municipal service production. The single input variable is total expenditure, while the five outputs are as in De Borger et al. (1994). The respective frontier production functions and related efficiency scores for municipalities are calculated with each method. Efficiency scores produced by various methods lead to somewhat different levels of 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 whole, the level of taxation and education level are positively related to technical efficiency, while average income level and the ratio of grants to revenue are negatively related to efficiency.

Balaguer-Coll et al. (2002) use Spanish data in studying the extent of local government efficiency differences and whether they rise from factors beyond the control of these entities. 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. The effect of size of the entity on efficiency 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) used nonparametric activity analysis for estimating efficiency differences of local public governments in Valencia, Spain. The aim was 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 39 percent smaller resources.

In addition, Coffe and Geys (2005) study the effect of social capital on local government performance. According to the authors, use of local data as compared with country-level data provides a more stringent test of the effect of social capital. The performance level of 305 Flemish municipal governments in 2000 is investigated. The variable to be explained is the municipality's surplus for the fiscal year as a share of total revenues. Measures of associational life, voting activity and crime rate are used as indicators of social capital. According to the results, a higher level of social capital leads to a better quality of local government's financial management.

3. The role of municipalities in Finland

The Finnish public sector is a two-tier system with central government and more than 400 municipalities, the latter ranging in size from a few hundred to more than half a million people. 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 in Finland 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. Because the nationally dictated tasks of municipalities are broad and expensive, they co-operate in over 200 joint organizations, e.g. in 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. Finnish joint municipal authorities have no taxing powers of their own.

Municipalities levy a local income tax and minor property tax (since 1993) on residential and non-residential real estate. Tax base and deductions are determined by central government, but each municipality decides independently on its income tax rate and tax rates (within bounds) for different forms of property.

Earlier municipalities could tax corporate income directly, but after the tax reform of 1993 it became solely a central government tax. However, a share of the accrued corporate income tax revenue is paid to municipalities by portions that are fixed in the Income Tax Law. This share has been reduced over time.

In addition to tax revenues, there are state grants to municipalities. 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". Related to the economic crisis of early 1990s in Finland, the central government cut the grants throughout 1993 – 1996. They covered 50 % of net operating expenditure in 1993, whereas in 1998 they covered only 24 %. Fast income growth during late 1990s enabled the municipal sector to cover the grant reductions at least partly by relying on its own revenue sources.

Since the 1993 reform, block grants consist of general grants and sector based block grants, which together with received or paid tax equalization form 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 components of block grants. In the tax base equalization system the central government has been a net contributor and thus it is not a pure zero sum game between municipalities.

Briefly stated, Finnish municipalities 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 residents subjective rights to several basic services. Finally, we note that in Finnish municipal elections, votes are given to individuals rather than party lists. Furthermore, municipal governments include all parties represented in elected councils in proportion to the number of council members. Thus, there is no real opposition and municipal elections do not typically cause major changes in local politics.

4. First stage: Application of Data Envelopment Analysis

In this study we follow a two stage approach. In the first stage, we 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. In the second stage averages of efficiency scores during the whole period 1994-2002, its sub-periods, and annual scores are explained in regression models by characteristics of municipalities. The basic strategy of our study is thus similar to some earlier studies on efficiency at municipal level, surveyed in section 3.

4.1 Data Envelopment Analysis

Data Envelopment Analysis (DEA) is based on the work by Farrell (1957) and 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 practice 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), where the method is also introduced.

Several DEA studies of public sector efficiency have also been made in Finland. To take only a few examples, Kirjavainen and Loikkanen (1993, 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, while Luoma and Järviö (2000) studied productivity of health centres.

4.2 Data and the four DEA models

The aim of our study was initially to cover all 450 Finnish municipalities. However, this proved to be difficult for reasons of comparability and reliability. Consequently, we had to exclude municipalities of Åland archipelago, small municipalities with less than 2000 inhabitants and municipalities which merged during the study period. The final data consists of 353 municipalities with a median population of 6000 inhabitants, and it 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 of providing health and social services, culture and education each year, evaluated at 1995 prices. A proportional share of administrative costs in these activities was included in the expenditures, except in Model 4, which does not include any administrative costs. General administration costs of the municipality (city council, centralized planning etc.) were excluded from all models.

Municipalities can either produce basic services themselves or they can act as providers of services 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. 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 case of 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 we measured the costs of municipal production. Thus, our money-metric input concept measures partly expenditure and partly production costs. On output side, we will have volumes of services provided (produced or bought), and in this setting we use the term cost efficiency in basic service provision to describe what we are doing. As such our efficiency concept is not equal to technical efficiency or cost efficiency of service production.

As for output measures, we use information on volumes of basic municipal services in health, social services, culture and education sectors. We define four variants of DEA models with six to ten outputs or services. The outputs were measured as total annual sums. The outputs of the basic Model 1 and Model 4 are identical, but they differ with respect to administrative costs and weighting. Table 1 shows the outputs in each of the models. The only input, net operating costs (in fixed prices) is the same in all models. Specialized health care, local infrastructure, transportation and utilities are not included.

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, days	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 maximization problem. In the simplest case, each DMU is allowed to weigh its inputs and outputs freely to maximize its relative efficiency. Even in our case of a single input, freely determined weights can be problematic, as some outputs could get zero weights, and the efficiency of a municipality would be based on part of the outputs only. This is inconsistent with the fact that municipalities in Finland are obliged to provide the types of outputs concerned. 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.

The method followed here is 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). This procedure guarantees that all outputs have an effect on the cost efficiency scores of municipalities. We also note that, as an inherent feature of DEA, tightening the range of weights tends to decrease average efficiency scores and the number of fully efficient units, which determine the efficiency frontier.

4.3. Results from four DEA models

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 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 other hand, a good amount of efficiency variation is still left in the results.

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

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 are highest in Model 3, which also has the highest number of outputs. Thus, before calculating averages across models and years to get an overall picture of efficiency, we rescaled the efficiency score distributions. 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. 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.

5. DEA results on cost efficiency differences of Finnish municipalities 1994-2002

The average efficiency scores of municipalities for 1994-2002 are shown as a Salter diagram of efficiency scores (from high to low values) for all the 353 Finnish municipalities included in the study (Figure 1). 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.

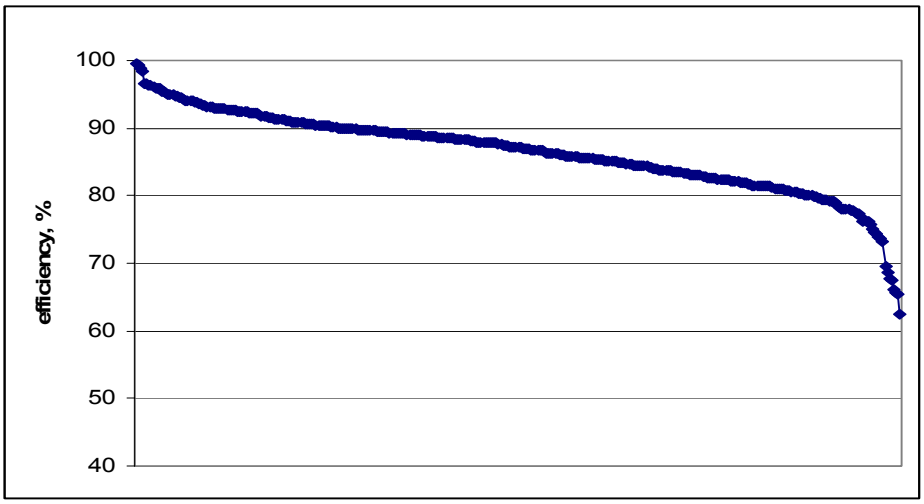
In Figure 1 there is a steeply declining tail in the cost efficiency distribution of Finnish municipalities. In eight municipalities average efficiency is below 70 per cent while some 30 score between 70 and 80 per cent. The lowest score is 62.4 per cent, suggesting that this municipality produces 38 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. The large majority of municipalities belong to the slowly declining part of the distribution, and they have efficiency scores ranging from 80 to somewhat over 90 per cent. Median cost efficiency of basic service provision for 1994-2002 was 87.2 per cent.

Municipalities in the “top ten” ranking list are all in southern Finland. Like most Finnish municipalities, they are generally small by population (range 2 500 – 22 800 inhabitants) and they mostly have an urbanization rate and income level above median. The largest cities are missing from the top list. 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 population ranges from 2 800 to 18 200 inhabitants, also a typical size range for Finnish municipalities.

The biggest Finnish cities fall into two groups in cost efficiency. Here the only immediately visible pattern is the modest performance of the three Capital Region cities Helsinki (rank 313), Espoo (268) and Vantaa (242). In addition to these cities, Turku (233) and Jyväskylä (303) are in the weakest third of municipalities. On the other hand, Tampere (rank 65), Oulu (80), Lahti (60), Kuopio (70) and Pori (100) are in the top third of municipalities with 90 per cent efficiency or more.

As to temporal changes and stability of the cost efficiency figures, a clear positive correlation (r = +0.63) exists between the average scores of 1994-96 and 2000-2002. 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 correlations ranged from +0.58 to +0.72. Some municipalities shift between the lower and upper end of the distribution over time, but this is not very common.

Figure 1. Salter diagram of 353 Finnish municipalities in order of cost efficiency, 1994-2002



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 and education level of inhabitants, 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 regional (municipal) variation in input prices could not be eliminated.

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. Besides income level, also user cost of capital (especially land) tends to be high where 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 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. We also have information on the age distribution of employees working in the basic welfare services in the municipality. 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 employees is better than work experience of older ones for efficiency.

Basic public services are produced in networks of schools, health centres 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.

In a dense settlement structure it is easier for municipalities to organize and utilize the service network, due to short distances. Thus, we expect that 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 be so big that it covers most of the functional region or it may form a centre 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, then 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 (varying transport costs, possibilities to get best human resources and 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 and all other domestic regions measures the peripherality of location. In this measure pair-wise distances between regional centres are weighted with the Gross Regional Product of the destination region.

Although all municipalities are legally bound to provide basic services, the structure and shares of these services may vary from one municipality to another. We constructed an indicator of variety of service provision, based on 32 expenditure classes of the service sectors considered. It measures 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 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 (JMA) and other municipalities, and purchases from private producers (either firms or non-profit organizations). On the basis of economies of scale, JMAs can be more efficient than municipalities themselves, but they may also suffer from bureaucracy. Private producers are typically expected to be more efficient than own production of municipalities if there is enough competition.

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 of local government spending. Here we are interested in whether they affect efficiency. The matching grant system, which meant the more grant

money the more you spent, ended in Finland in 1993. Its detrimental effects on efficiency may still be present during the first years of our study period 1994-2002. Later, and especially after the 1997 reform leading to even more clear system with non-earmarked lump-sum grants, we expect grants be more neutral with respect to efficiency.

As for politics, we test whether right/left, right/center/left etc. shares and dispersion of political power in municipal councils are related to efficiency, although we do not have any a priori hypotheses how these variables might affect. Also, turnover in municipal elections will be used as a covariate assuming that political activeness may enhance efficiency.

6.2. Results of regression analyses

Regression models explaining variation of efficiency scores among municipalities were estimated with ordinary least squares method (OLS). Because the DEA scores are in the (0,1] interval, the use of Tobit models would seem preferable. However, our DEA scores to be explained are averages of several models, and in addition to annual averages, we also average over periods. Thus, in many cases the maximal average scores are to varying degree below one, and the basic structure of Tobit model disappears. Furthermore, even when the maximum score(s) are equal to one, in our application there is no natural interpretation relying on latent variables, which cause jumps of scores from one to lower values. Finally, when Tobit models were experimented, the results were not very different from those reported in this paper.

The dependent variable in all regressions is 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. We present here results for the whole period 1994-2002, 1997-2002 and three 3-year sub-periods. For brevity, annual estimation results are not presented here. All models are thus cross-section models. Because of changes in municipal bookkeeping and statistics, we did not estimate panel regressions.

In the following, we present estimated models in which systematically insignificant (applying 95 % level in two tail test) 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. Neither did left or right side dominance of political parties in municipal councils or the centralization or dispersion of party structure (measured by the Herfindahl index) have an effect on efficiency. 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 each region. Neither did population change (either direction) have a statistically significant effect.

Table 3 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 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 3, 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 capital of Finland. Whether this is a pure size effect or represents size related unmeasured outputs and quality differences in service provision, or bureaucracy and inefficiently utilized network of service units, is an open question.

High income of the inhabitants was used as a proxy for wage level as suitable regional input price indices were not available. As expected, high income level is related with low cost efficiency. High education level of population (also proxy for education level of municipal workers) is related to high cost efficiency, also 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 also high t-values in all sub-periods. The distance factor accounts for the weak performance of municipalities in northern Finland (Lapland), but in itself it gives no information about how the distance mechanism works. Dense physical structure (high share of people living in urban centres) makes 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 gave a similar result).

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 the 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 (available upon request) give some support for this result.

Table 3. Explaining DEA efficiency scores of municipalities with background variables, OLS 1994-2002 and its sub-periods[1]

	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*)
Producer of services (% of all services):					
other municipalities and	-0,0247	-0,0330	-0,00786	-0,0375	-0,0279
joint municipal organizations	(-3,25***)	(-4,07***)	(-0,83)	(-4,40***)	(-3,29***)
other (private)	0,164	0,114	0,0974	0,177	0,0950
producers, %	(2,27**)	(1,80*)	(0,93)	(2,07**)	(1,88*)
Age of employees, %					
Share of 35-49-years old	0,185	0,147	0,223	0,235	0,0167
employees	(2,04**)	(1,47)	(2,24**)	(2,51**)	(0,16)

[1] The dependent variables are DEA efficiency scores in percentages, t-values below estimated coefficients in parentheses, significance at 90 %, 95 % and 99 % levels are denoted by *, ** and ***, respectively.

share of employees	0,0452	0,0144	0,102	0,0148	0,0255
over 50 of age	(0,57)	(0,17)	(1,09)	(0,17)	(0,29)
Socioeconomic situation of municipality:					
unemployment rate, %	-0,254	-0,226	-0,323	-0,249	-0,210
	(-2,92***)	(-2,51**)	(-3,07***)	(-2,77***)	(-2,19**)
Municipal economy:					
state grants,	-0,0027	-0,0013	-0,0048	-0,00087	-0,00078
€ / inhabitant	(-1,95*)	(-1,03)	(-2,53**)	(-0,60)	(-0,66)
constant	76,592	76,535	87,950	71,416	85,273
	(7,97***)	(7,84***)	(7,16***)	(7,47***)	(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 scaled averages of four different DEA model specifications. In order to see the effects of averaging and scaling on the OLS regressions, they were also done for scores obtained from the single DEA models. In table 4, a comparison of 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) has 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 4. The effect of averaging over DEA models on OLS regression results 1994-2002[2]

	Average over the four DEA models	Separate DEA models: Model (1)	Model (3)
population, 1000	-0,0204	-0,0182	-0,0197
	(-2,54**)	(-2,26**)	(-2,33**)
earned income,	-1,16	-1,14	-1,18
1000 € / person	(-3,93***)	(-3,82***)	(-3,80***)

[2] The dependent variables are DEA efficiency scores in percentages, t-values below estimated coefficients in parentheses, significance at 90 %, 95 % and 99 % levels are denoted by *, ** and ***, respectively.

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, € / inhabitant	-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 (by own production or buying from outside) in 353 Finnish municipalities in 1994-2002. Smallest (< 2000 inhabitants) and recently merged municipalities, and municipalities in Åland are excluded from our analysis. The basic services cover education, health and social services, which in the Finnish two tier system are provided and mostly also produced by municipalities.

Methodologically, we apply a two step approach. First, Data Envelopment Analysis (DEA), is employed in calculating a best practice production frontier and efficiency scores for municipalities. In DEA the outputs consist of six to ten volume indicators of the most important basic services. As the combined input, total net operating cost of providing (producing or buying) these services was used.

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. 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 showed rather varying performance. Their efficiency scores ranged from 79,4 % to 91,4 % and their ranking in efficiency distribution from 65 to 317.

As the second step, 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, big share of services bought from private sector and high education level of inhabitants tend to increase efficiency. Political variables and turnover in local elections did not explain efficiency differences. The same was true for relative change (both directions) of population and the population share of core municipality within each functional region.

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.

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.

Coffe, H. – Geys, B. (2005): Institutional Performance and Social Capital: An Application to the Local Goverment Level. Journal of Urban Affairs, Vol 27 (5).

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. (1998): Efficiency Differences of Finnish Senior Secondary Schools: An Application of DEA and Tobit Analysis, Economics of Education Review, Vol. 17, No 4, 377-394.

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.

Luoma, K. – Järviö, M-L. (2000): Productivity Changes in Finnish Health Centres: A Malmquist Index Approach. Government Institute for Economic Research, Discussion Papers 218, Helsinki.

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

Oates, W.E. (1972): Fiscal Federalism, New York: Harcourt, Brace, Jovanovich.

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.

Tilastokeskus (2003): Kuntien talous ja toiminta 2002 (Municipal economy and activity 2002). SVT Julkinen talous 2003:7.

Van den Eeckaut, P. - Tulkens, H. - Jamar, M.-A. (1993): Cost Efficiency in Belgian Municipalities. In Fried, H., Lovell, C. and Schmidt, S. (eds.). The Measurement of Productive Efficiency: Techniques and Applications. New York, Oxford University Press, 300-334.