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Municipality Size and Efficiency of Local Public Services: Does Size Matter?

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Abstract

Similarly to West Germany in the 1960s and 1970s, the eastern part of Germany has experienced a still ongoing process of numerous amalgamations among counties, towns and municipalities since the mid-1990s. The evidence in the economic literature is mixed with regard to the claimed expenditure reductions and efficiency gains from municipal mergers. We therefore analyze the global efficiency of the municipalities in Saxony-Anhalt, for the first time in this context, using a double-bootstrap procedure combining Data Envelopment Analysis (DEA) and truncated regression. This allows including environmental variables to control for exogenous determinants of municipal efficiency. Our focus thereby is on institutional and fiscal variables. Moreover, the scale efficiency is estimated to find out whether large units are necessary to benefit from scale economies. In contrast to previous studies, we chose the aggregate budget of municipal associations ("Verwaltungsgemeinschaften") as the object of our analysis since important competences of the member municipalities are settled on a joint administrative level. Furthermore, we use a data set that has been carefully adjusted for bookkeeping items and transfers within the communal level. On the "eve" of a mayor municipal reform, the majority of the municipalities was found to have an approximately scale-efficient size, and centralized organizational forms ("Einheitsgemeinden") showed no efficiency advantage over municipal associations.

Keywords: efficiency, local government, DEA, bootstrap, demographic change, local institutions

JEL Classification: H11, H72

Gemeindegröße und Effizienz der kommunalen Leistungen: Ist die Größe wirklich entscheidend?

Zusammenfassung

Seit Mitte der 1990er Jahre findet auch in Ostdeutschland – ähnlich wie in den 1960er und 1970er Jahren in Westdeutschland – ein noch keineswegs abgeschlossener Prozess mit zahlreichen Verschmelzungen auf der Ebene der Landkreise, Städte und Gemeinden statt. Die Ergebnisse in der ökonomischen Literatur sind uneinheitlich, was die behaupteten Ausgabeneinsparungen und die Effizienzgewinne durch Gemeindegebietsreformen betrifft. Aus diesem Grunde untersucht der vorliegende Beitrag die globale Effizienz der Gemeinden in Sachsen-Anhalt unter Anwendung eines doppelten Bootstrap-Verfahrens, das Data Envelopment Analysis (DEA) und trunkierte Regression kombiniert und in diesem Zusammenhang bislang noch nicht verwendet wurde. Dadurch wird es möglich, Umweltvariablen einzubeziehen, um so für exogene Bestimmungsfaktoren der gemeindlichen Effizienz zu kontrollieren. Der Fokus liegt dabei auf institutionellen und fiskalischen Variablen. Außerdem berechnen wir die Skaleneffizienz, um zu prüfen, ob große Gemeinden nötig sind, um von Skaleneffekten profitieren zu können. Im Gegensatz zu den Arbeiten anderer Autoren wurde bei kommunalen Verbänden („Verwaltungsgemeinschaften“) das aggregierte Budget als Untersuchungsgegenstand gewählt, da wichtige Entscheidungsbefugnisse der Mitgliedsgemeinden auf der gemeinsamen Verwaltungsebene angesiedelt sind. Außerdem wurde der verwendete Datensatz sorgfältig um reine Buchhaltungspositionen und Transferzahlungen innerhalb der Gemeindeebene bereinigt. Am „Vorabend“ einer umfassenden Gemeindereform erwies sich die Größe der Gemeinden mehrheitlich als annähernd skaleneffizient und stärker zentralisierte Verwaltungsformen („Einheitsgemeinden“) wiesen keinen Effizienzvorteil gegenüber Gemeindeverbänden auf.

Schlagwörter: Effizienz, Kommunen, DEA, Bootstrap-Verfahren, demographischer Wandel, Verwaltungsform

JEL-Klassifikation: H11, H72

1 Introduction

In the eastern part of Germany there has been a continuous trend of massive amalgamations among counties, towns and municipalities since the mid-nineties of the last century. The municipal territorial reforms in the former GDR follow the same spirit as the reforms during the late sixties and early seventies in western Germany. These municipal mergers in Germany have their counterparts mainly in the municipal reforms in Northern and Western Europe.

Since 2000 especially in Nordic countries – Denmark and Finland, but currently with the exception of Sweden and Norway – the municipal structure has undergone substantial structural reforms or at least a gradual process of merging municipal units. The Swedish municipal reforms of 1952 and 1974 reduced the number of municipalities from 2500 to about 1000 in 1952 and finally to 278 in 1974 (currently there are 290 municipalities in Sweden; Bäck 2005). Norway has also continuously reduced the number of municipalities from about 750 in 1930 to currently 430 (Wikipedia contributors 2011). Municipal amalgamations have also taken place e.g. in Israel (Reingewertz 2010), Australia (Dollery et al. 2008), in several Canadian provinces (Kushner and Siegel 2000), and in Japan (Yokomichi n.d.). The radical local government reform in the UK about 25 years ago left the country with the largest average local government size in Europe (in terms of population). Fox and Gurley (2006) also mention "government consolidation" reforms in Jordan, Sudan, Zimbawve or Lativa, whereas Italy has increased its number of local governments.

According to Fox and Gurley (2006), the declared main goals of municipal concentrations are falling service delivery costs, more even or equitable provision of services and better planning across a metropolitan area. For the Nordic countries Steineke (2010) concludes: "In all Nordic countries, a central argument in promoting municipal mergers is that public welfare services are more efficiently produced in larger municipalities."

These arguments usually neglect the effects of political institutions or the increasing heterogeneity in preferences for public goods with increasing municipality size on local government spending – cornerstones of the theoretical and empirical literature on fiscal federalism. Thus, in this paper we test empirically whether decentralized municipalities (municipal associations) are less technically efficient in public goods provision than centralized ones (individual municipalities) and whether municipal associations enable the member municipalities to realize economies of scale without losing their status as independent entities – even if coordination costs were higher in such associations.

To this end and in contrast to recent studies for Germany (Geys et al. 2010, Kalb 2010a, Kriese 2008), we use the nonparametric DEA-procedure to overcome the problem of missing input prices in flexible functional forms in SFA analyses. We account for the serial correlation of the efficiency scores by applying the two-stage bootstrapped-DEA

procedure suggested by Simar and Wilson (2007) to calculate non-parametric measures of global (technical) municipal efficiency and to control for the influence of certain environmental variables. The latter include especially indicators for municipal cooperation such as the organizational form or the number of member municipalities which were neglected in previous studies. Furthermore, we estimate the scale efficiency. Also deviating from recent studies for Germany (Geys et al. 2010, Kalb 2010a, Kriese 2008), we calculate an aggregate budget for municipal associations since certain tasks are delegated from the member municipalities to the joint administration so that outputs of the member municipalities cannot be compared to those of individual municipalities. We use a very detailed and unique data set for the German state Saxony-Anhalt. Moreover, we invested considerable effort to purge the municipal financial data from non-cost expenditures or double counting caused by inter-municipal cash flows or cash flows between municipalities and other levels of local government to increase the accuracy of our estimates.

The paper is organized as follows: In section 2 we discuss the existing empirical literature on municipal mergers and in particular the more recent research on global efficiency of local governments. Section 3 develops the theoretical background for our efficiency estimations. In section 4 we describe the institutional framework, the data and the methodology for the efficiency estimation. Section 5 presents the results and in section 6 we conclude and discuss further research perspectives.

2 Overview of the Empirical Literature on Global Municipal Efficiency Analysis

In contrast to the widespread "bigger is better" attitude of the promoters of municipal mergers the economic empirical literature is not conclusive about the expenditure or efficiency effects of municipal mergers.

First of all, there are a lot of empirical papers dealing with the relationship between several fiscal indicators and municipal size in general or with the pre-amalgamation or post-amalgamation effects on these fiscal indicators (expenditures, debts, revenues) in particular. The estimation results for expenditure functions – predominantly derived from a median-voter based model – usually indicate economies of scale or potentials for cost reduction only for small municipalities (e.g. Solé-Ollé and Bosch 2005, Welling-Hansen 2009). One exception is Reingewertz (2010) who found a 9% decrease in expenditures for Israeli municipalities compared to the pre-amalgamation situation and therefore concluded that municipal mergers would result in significant scale economies. Hence, the main research focus of these papers is how municipal size might influence the municipal per-capita expenditures or costs. As the underlying production technology is assumed to be efficient, the error term contains inefficiency components and statistic noise, which are not separable. Finally, the core problem of this econometric expendi-

ture- or cost-function approach is that despite of controlling for environmental variables the estimation results represent a mix of economies of scale in consumption ("economies of sharing") and economies of scale and scope in production.

Therefore, parametric- or non-parametric methods of efficiency analysis are more promising options. These approaches allow for ignoring the question how a certain quantity of municipal output resulted from the political process and if it represents a welfare-maximizing optimum from the perspective of a benevolent social planer. They simply analyze whether either a given output quantity is produced with minimum input (input-oriented approach) or the maximum output is produced with a given input quantity (output-orientation).

The existing literature on municipal efficiency analysis can be divided into two branches: On the one hand, there are numerous analyses of individual public services: solid waste and sewage disposal (Worthington and Dollery 2001), water (Picazo et al. 2009, Byrnes et al. 2010, Zschille et al. 2010) and energy provision (von Hirschhausen et al. 2006), hospitals (e.g. Aksezer and Benneyan 2010, Blank and Valdmanis 2010), municipal savings banks (Conrad et al. 2009, Bresler 2007), public libraries (De Witte and Geys 2009), road maintenance (Kalb 2009), fire protection (Lan 2009 et al.), care for the elderly sector (Borge and Haraldsvik 2009), local police services (García-Sánchez 2009), public transportation (Walter and Cullmann 2008) or pre-school education (Montén and Thater 2010, Montén 2009[1]). For a survey of earlier studies see De Borger and Kerstens (2000) or Worthington and Dollery (2000). Also Kalb (2010b) contains an extensive list of efficiency studies of different public services. With respect to scale economies the aforementioned studies are very heterogeneous in their results. Even the vertically integrated network services such as water, sewage disposal or energy provision seem to have only very restricted potentials for size effects. Especially in the case of consolidation of urban and rural sewage or water districts the rise in output might be far more than outweighed by the additional costs of the distribution system. For Germany, a separate analysis of many municipal services (except for those organized in separate and independent organizational units such as municipal saving banks, public utilities or public transportation) could lead to biased results. The main problem is the impossibility to assign certain inputs to certain municipal tasks, especially inputs of central administration units, which represent overhead costs.

Thus, the approach of global municipal efficiency would be more appropriate for the focus of our study. The more recent empirical work covers Belgium (Geys and Moesen 2009, De Borger and Kerstens 1996), Finland (Loikkanen and Susiluoto 2005), Brazil (Sampaio de Sousa et al. 2005), Spain (Balaguer-Coll and Prior 2009, Gimenez and Prior 2007, Prieto and Zofio 2001), Portugal (Afonso and Fernandes 2008), Japan (Nijkamp and Suzuki 2009) and Germany (Kalb et al. 2011, Geys et al. 2010, Kalb 2010a, Kriese 2008, Geys et al. 2007). See again De Borger and Kerstens (2000) or Worthington and

1 *Montén* (2009) also analyzes general administration and city planning separately.

Dollery (2000) for surveys of earlier studies. The main results of these papers on the relationship between size and performance are rather mixed – if they deal with the question at all. Sampaio de Sousa et. al. (2005) found that for Brazil technical efficiency rises with population size. This result is probably a consequence of national characteristics, problematic input indicators (child mortality rate as input!) and not controlling for exogenous factors that influence efficiency. Increasing cost efficiency with increasing population was also a result of Gimenez and Prior (2007). In contrast, Loikkanen and Susiluoto (2005) found smaller municipalities to be more efficient.

The authors of the aforementioned studies on global municipal efficiency mostly apply a non-parametric approach (DEA, FDH). When exogenous variables are included then a simple, but rather problematic two-stage approach is preferred: 1) Calculation of the DEA or FDH efficiency scores, 2) Tobit-regression of the resulting efficiency scores on potential exogenous variables (e.g. Balaguer-Coll and Prior 2009, Gimenez and Prior 2007, Loikkanen and Susiluoto 2005, Afonso and Fernandes 2008, Sung 2007). An exception is Balaguer-Coll et al. (2007) who use non-parametric methods in the second stage analysis. The German studies and Geys and Moesen (2009) use a one-step Stochastic Frontier Analysis (SFA) to estimate global cost efficiency. A few studies compare SFA and DEA results (De Borger and Kerstens 1996, Worthington 2000); in these cases efficiency scores from both DEA and SFA are explained by environmental variables in a second stage by a Tobit model.

Our focus in this paper is on Germany for several reasons: The German municipal system offers a broad variety of municipal governance forms. Furthermore, the local governments traditionally play an important role in the German federal system. Finally, the current demographic pressure (population decline especially in eastern Germany) has again stirred up the debate on mergers, amalgamation or centralization of municipalities.

The cost efficiency analyses for Germany (precisely: the states of Baden-Wurttemberg and Saxony) mainly ignore the question of municipal size and efficiency and suffer from several methodological problems.

First, they apply highly aggregated cost data which either is not corrected for double bookings or for expenditures that are not costs in the usual sense[2] or the data contains expenditures which do not correspond to the output indicators[3]. The fact that the authors consistently neglect municipal enterprises or single-purpose municipal associations in their calculations is under some circumstances – as we will discuss in section 4 – only a minor problem if certain expenditure categories were deducted from the current expenditures.

2 Like the redistributed business tax revenues (*"Gewerbesteuerumlage")* which represent the share of the federal government in the local business tax revenues.

3 This is possible for cost refunding between municipalities or transfer payments to municipal units not included in the core budget.

Second, the unit of observation is always the individual municipality, although in Baden-Wurttemberg as well as in Saxony and most other German states small communities in rural areas are allowed to form municipal associations ("*Verwaltungsgemeinschaft", "Verwaltungsverband","Samtgemeinde", "Amtsgemeinde"* etc.) to benefit from economies of scale without losing their status as independent municipalities. While this focus on the individual municipality might be acceptable for dealing e.g. with voting patterns the results would be severely biased if we wanted to draw conclusions for efficient municipality sizes or global municipal efficiency at all because it is common that the members of such associations delegate (or are obliged to delegate) part of their tasks either to a central administration unit *("Verwaltungsamt")* or to the usually largest municipality of the association *("Trägergemeinde")* to carry out certain tasks on their behalf. Therefore, we aggregate the budgets of the members of municipal associations[4] to one budget.

Finally, the German studies have as a standard assumption no price variables included in their "pseudo-cost functions". Even in case we assume identical factor prices (which is quite reasonable for jurisdictions located in the same state), price data will only be irrelevant for the estimation of certain functional forms (e.g. Cobb-Douglas-type). However, for the usually more appropriate flexible functional forms (e.g. translog function) the omission of price variables might lead to serious omitted variable problems and misinterpretations of the regression coefficients.

All in all, the question of the existence of scale effects or the effects of decentralized organizational forms on municipal efficiency – and their consequences for local government size – is far from settled or solved.

3 Municipal Size, Centralization and Efficiency of Local Public Good Production

Evaluating efficiency differences between municipalities of different size, but equal organizational form or between municipalities of similar size, but different organizational form (centralized versus decentralized organization) leads to the general discussion about centralized versus decentralized provision of public goods. According to Oates' (1972) "Decentralization Theorem" decentralization makes sense in case of heterogeneous preferences among jurisdictions, the absence of cost savings from centralized provision and the absence of interjurisdictional spillovers.

4 The German *"Verwaltungsverband"*, *"Verwaltungsgemeinschaft"*, *"Samtgemeinde"*, *"Verbandsgemeinde"* or *"Amt"* are multi-purpose-organizations providing most of the core municipal services and should not be mixed up with single-purpose municipal associations which provide only one or two public services, for example water, sewage or solid waste disposal services.

If information costs and information asymmetries are taken into account, then information costs will be higher for higher levels of government compared to local governments as well as for smaller local government units compared to larger local governments. Information asymmetries and prohibitively high information costs may lead to over- or underprovision of certain public goods in large communities – even if benevolent politicians and bureaucrats are assumed. This is a further argument for decentralized provision.

The empirical efficiency analysis of local governments cannot answer the question whether the quantity of services provided is Pareto-efficient according e.g. to the Samuelson-Kaizuka rule for pure public consumption goods or pure public inputs – assuming cost- and technical efficiency of public goods production. Instead, we investigate if a given quantity of a public output is actually produced technically and allocatively[5] efficient. In this context the existence of significant economies of scale in local public good production is also tested. Unit cost reductions could result from economies of scale in the production technology. Moreover, lower costs per inhabitant – even for production technologies with constant returns to scale – could be the result of non-rivalry in consumption of the relevant good ("economies of sharing"). See Reiter and Weichenrieder (1997) for further details. Both effects usually decrease with increasing municipal size (economies of sharing wear out due to fixed resources – especially land – which have to be consumed to benefit even from pure public goods) and lead to the well-known u-shaped cost curve (per inhabitant) in the literature.

Nevertheless, the existence of economies of scale and economies of sharing does not justify per se amalgamations of small municipalities to larger units. Gordon Tullock (1969) has pointed out that small municipalities could benefit from economies of scale by contracting out at least some of their services – either to private suppliers, municipal enterprises or other (local) governments. As we have mentioned before, another way of "contracting out" is the association of small, but independent municipalities. These associations could either be multi-purpose associations like the German *"Verwaltungsgemeinschaft"* or single-purpose units[6] for the provision of e.g. water, sewage disposal etc. The efficiency gains from contracting out are limited by the transaction costs involved. Especially hardly tangible and measurable services might lead to moral hazard, adverse selection or low service quality. Another problem is services with high capital intensity and sunk costs. In this case long-term contracts between munici-

5 It should be stressed that in the efficiency and productivity analysis literature the term "allocative efficiency" is used differently from its usual meaning in public finance theory or welfare economics. From an input-oriented perspective, allocative (in-)efficiency measures how much the input quantities could be reduced proportionally (technically efficient production assumed!) to minimize input costs for a fixed output quantity. In this case, allocatively efficient input-output combinations are also cost efficient. For output-orientation the term allocative efficiency is used in a similar manner in the context of revenue efficiency. See *Coelli et al.* (2005, 51-57) for an introduction to the different efficiency concepts.

6 Examples are the German *„Zweckverband"* or the US-American school districts.

pality and provider are common practice and both sides have incentives for strategic behavior. Finally, the coordination costs between the member municipalities increase disproportionally with an increasing number of municipalities. Therefore, municipal associations including a large number of members might not be the best idea from an efficiency perspective.

We have already mentioned the problem of information asymmetries and their effect on efficient production of public services. Information asymmetries in principal-agent relations between voters and municipal council as well as between municipal council and bureaucrats or external providers might increase the agents´ leeway to follow their own interests. For given output quantities, politicians or bureaucrats have incentives for inefficient input employment. Vote-maximizing politicians might prefer inefficient capital use for prestigious investments ("state-of-the-art technology") or overmanning for social reasons. Furthermore, the local bureaucrats might also follow their own interests such as "budget maximization" (Niskanen 1971) or "slack-maximization"[7] (e.g. Wyckhoff 1990).

However, there exist two sanctioning mechanisms that could prevent local politicians and bureaucrats from abusing their information advantages in an environment of interjurisdictional competition: "Exit" and "Voice" of the citizens (Hirshman 1970). It seems reasonable to assume that interjurisdictional competition is more effective between large numbers of small municipalities than between ceteris paribus few large municipal units: The citizens' information costs and migration costs tend to be lower for small municipalities with decentralized organization. Most theoretical studies of the "second generation theory" (Oates 2005, Weingast 2009) of fiscal federalism that include election processes and exit options conclude that a decentralized provision of local public goods might be allocatively superior to the centralized provision. In the model of Besley and Coate (2003) the central government discriminates against certain regions as a result of so-called "pork-barrel-politics" and the budget externalities caused by the simultaneous access of the political agents to a "common pool". Similar suboptimal decisions in the provision of local public goods (or inefficiencies in production) are possible in more centralized municipalities compared to municipal associations of equal size. Seabright (1996) models elections as "incomplete contracts". In his model the centralization – decentralization decision is a tradeoff between gains in coordination (internalization of spillovers) and losses in accountability (here: probability that the welfare of the individual jurisdiction might influence government election). This tradeoff is similar to the spillover – preference heterogeneity tradeoff of Oates (1972) except for the fact that decentralization might be preferable even in case of homogenous preferences – if the gains in accountability exceeded the losses in coordination. Oates (2005, 359) assumes (without proof) that the introduction of Pigouvian matching grants to internalize the spillovers might even make this tradeoff disappear.

7 "Slack" refers to the surplus of the budget the sponsor (the local government) is willing to finance over the actual minimum costs.

Our theoretical considerations on the efficiency effects of size and the degree of centralization of local government organization can be summed up in the following two hypotheses:

Hypothesis 1: Municipal associations are ceteris paribus at least equally technically efficient and scale efficient as centralized local governments.

Hypothesis 2: Efficiency decreases with rising numbers of member municipalities in municipal associations.

Other aspects that might influence municipal efficiency could be subsumed under the term "fiscal illusion". From the five categories of fiscal illusion listed by Oates (1988) we are mainly interested in debt illusion and the effects of intergovernmental grants.

We have already mentioned the problems of spillover effects of local public goods which suggest that the "boundaries" of a public good should be equal to the boundaries of the jurisdiction providing it. According to Mancur Olson's (1969) "principle of fiscal equivalence", this includes that the jurisdictions should also have the right to decide if a certain public good is provided at all and if so, what output quantities should be produced and what inputs and production technologies should be employed. In practice – not only in Germany – municipal services are regulated to a considerable extent by higher authorities. For example, German parents are legally entitled to preschool education for their children. Consequently, the municipalities have to provide adequate kindergarten capacities whether there is demand for them or not and irrespective of the costs involved (output regulation). Furthermore, there are often detailed prescriptions concerning training and qualifications of kindergarten teachers as well as the teacher-children ratio (input regulation).

Fiscal equivalence also means that the jurisdiction providing the public good should not only have the right to decide how much of the good as well as how to produce it, but it (or its citizens) should also have to finance it. If this principle is violated (see the kindergarten example), then according to the general rule "who orders has to pay" the "ordering" jurisdictions will have to cover at least some of the costs of the regulated jurisdictions. However, intergovernmental grants might have a negative side-effect on efficiency which is known in the literature as the "flypaper effect" (Hines and Thaler 1995): If the output quantities were more or less fixed municipalities might have incentives to use inefficiently large input quantities (e.g. "representative" public buildings). This effect is supposed to stem from individuals (politicians) treating money on hand (grants) different than money that has to be raised by taxation of the own citizens. Alternatively, inefficiencies caused by transfer payments may be the result of "soft" budget constraints (Kornai, Maskin and Roland 2003) for local governments. Municipalities financed primarily with transfers from higher jurisdictions (as in eastern Germany) might find opportunities for "raiding the fiscal commons" and increase the size of their budget (Rodden 2003) as well as municipal inefficiency.

Hypothesis 3: Local government efficiency decreases with increasing grant (lump-sum or matching grants) availability.

Except for a world consistent with the Ricardo-Barro equivalence theorem of public debt, citizens tend to underestimate the future burdens of public debt. Therefore, especially vote-maximizing local politicians have incentives to shift the financial burden of the municipal expenses to future generations. As there usually are severe restrictions on debt-financing of current expenditures in many countries for local governments, mainly debt-financed investments might cause excess public capital stocks and expenditures. Especially municipalities on the eve of a merger (Jordahl and Liang 2010) might accumulate excessive debts under the illusion of a larger "common pool" of revenues in the future.

Hypothesis 4: Local government efficiency decreases with increasing debt burden.

To take heterogeneity among the municipalities into account, we include further control variables which have been shown to be relevant in the literature: population density, population change, unemployment, and age structure.

This selection certainly does not include all possible structural variables which might determine local government efficiency. One could think of other variables such as the share of foreigners, the share of people of a certain religious denomination or the presence of private non-profit organizations[8] which offer substitutes for local public goods and services. We do not include political variables (significance of left-wing parties or political fragmentation) for several reasons: First, it does not make much sense to calculate an aggregated Herfindahl-index or the aggregated share of left-wing seats for a municipal association with many independent municipalities. Furthermore, in small municipalities the number of councilors without party-affiliation or councilors that are members of independent voters unions is high – and the mayors are not even obliged to reveal their party affiliation in Saxony-Anhalt. Thus, it is difficult or even impossible to calculate and interpret the most popular political indicators for our chosen object of analysis.

8 It should be noted that the presence of e.g. kindergartens run by churches or other private non-profit organizations does not necessarily reduce municipal spending on those services. In fact, German municipalities are obliged to provide and finance certain services with a given quality and quantity. They have to compensate the non-municipal providers for their expenditures.

4 Institutional Framework, Data and Methodology

4.1 Institutional Framework in Saxony-Anhalt and Descriptive Statistics

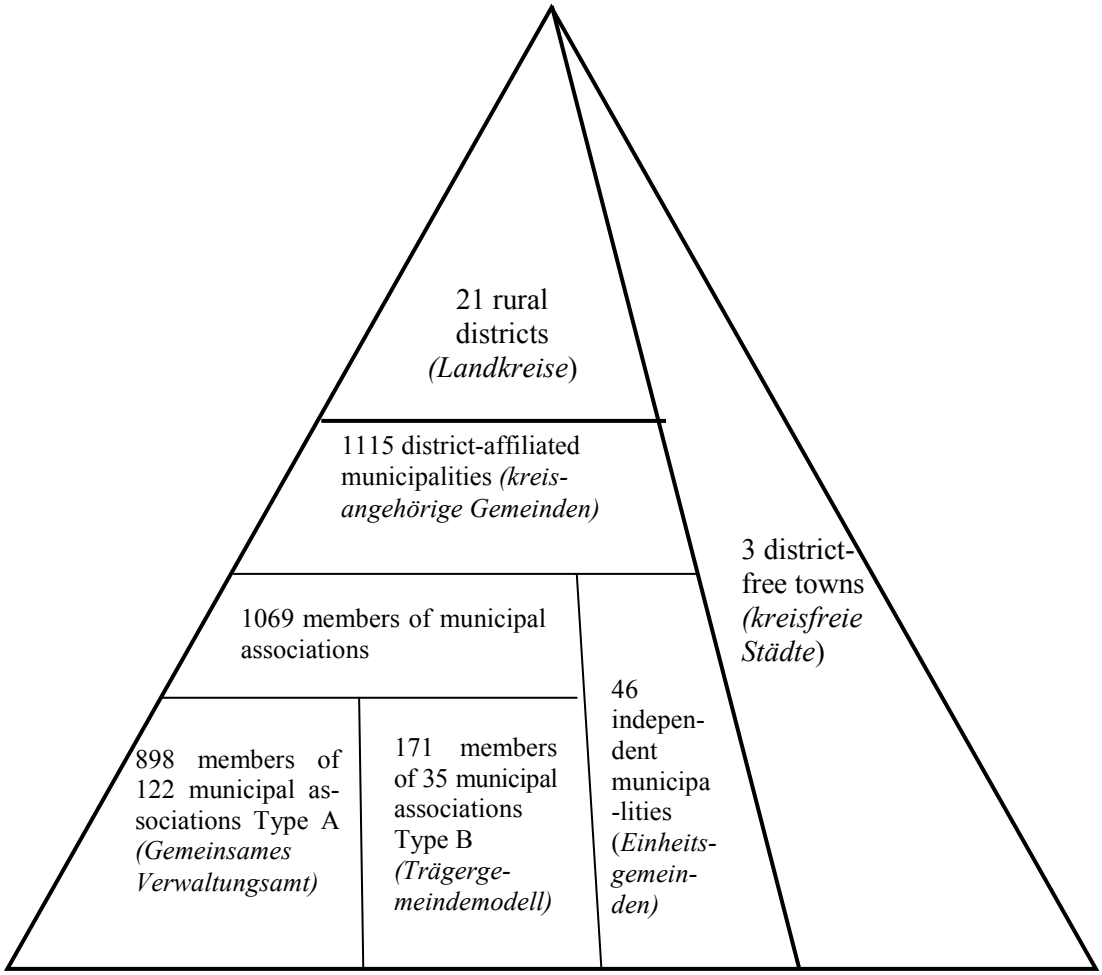
In 2004 the local government level in Saxony-Anhalt was divided into 21 rural districts (*"Landkreise"*) and 3 district-free towns ("*kreisfreie Städte"*: Halle, Magdeburg and Dessau). The rural districts consisted of 1115 district-affiliated towns and municipalities (*"kreisangehörige Städte und Gemeinden"*). Due to the great difference between district tasks and municipal tasks we restrict our efficiency analysis to the district-affiliated municipalities and towns. The district-free towns are also not included because they carry out both municipal and district tasks – without budget separation.

Saxony-Anhalt is well-suited for the efficiency analysis of district-affiliated municipalities. First, the range of municipal tasks is rather homogeneous – there are no district-affiliated towns with a special legal status *("Große Kreisstadt")* carrying out district duties as for example in Saxony or in Baden-Württemberg. Second, we are able to investigate the effect (if there is any) of three different municipal governance forms on global efficiency. On the one hand, there are independent municipalities carrying out the whole spectrum of municipal tasks on their own (*"Einheitsgemeinde"*).

On the other hand, especially the smaller communities are obliged by municipal law to join an association of several other municipalities, but without losing their legal status as an independent municipality. In 2004 two different forms of these municipal associations existed in Saxony-Anhalt: In the first case the members are obliged by municipal law to transfer the planning, organization, provision and control of the main municipal services to a central administration unit with a separate budget. This joint administration office *("gemeinsames Verwaltungsamt")* acts on behalf of the member municipalities. In the second case one (usually the largest) of the member municipalities (*"Trägergemeinde"*) provides own administration facilities to carry out the tasks transferred to the municipal association on behalf of its members, but without separate budgeting. In the following we will refer to the first case as "Type A associations" and to the second case as "Type B associations". In both cases the members pay contributions or compensations to refund the expenditures for tasks transferred to the joint administration. In contrast to the expenditure side the tax revenues as well as the transfers received from the municipal fiscal equalization system remain at the member level. Figure1 gives an overview of the local government administrative structure of Saxony-Anhalt.

Now in order to choose the relevant input and output variables we examine the municipal expenditure structure in Saxony-Anhalt. The following table 1 illustrates the composition of the current expenditures.

Figure 1:
Local government structure in Saxony-Anhalt 2004



Source: authors´ illustration

The table shows clearly that the expenditure categories financial management, social security and administration covered about 70% of the current expenditures in 2004. However, deviating from previous studies on German municipal efficiency the category financial management will be excluded from our further calculations – except for the category interest payments. Otherwise some problematic items of this category may cause distortions and misinterpretations because they are either compensations for expenditures of other members of municipal associations (e.g. transfer payments to the joint administration office: *"Verwaltungsgemeinschaftsumlage"*) or transfer payments of the member municipalities to their district *("Kreisumlage")* that do not correspond to any output at the municipal level or they even do not represent factor costs at all like the redistributed business tax revenues *("Gewerbesteuerumlage")*. Table 1 also illustrates the necessity to analyze the global municipal efficiency because the interest payments in category 9 as well as the expenditures of category 0 and some items of 7 and 6 represent overhead costs which otherwise had to be allocated pro rata to the particular municipal service – a rather arbitrary procedure.

Table 1:
Structure of current expenditures in the municipal core budgets in Saxony-Anhalt 2004 in percent (mean)
- District-affiliated municipalities -

Variable	Category number	All	Type A associations	Type B associations	Independent municipalities
Administration	0	15.62	13.74	24.57	13.79
Public safety	1	3.40	3.17	3.58	3.89
Schools	2	3.51	3.65	2.89	3.62
Science, research, culture	3	1.28	0.71	1.88	2.37
Social security	4	17.82	16.75	18.23	20.34
Healthcare, sports, recreation	5	2.95	2.50	3.39	3.81
Buildings, housing, traffic	6	6.11	5.73	5.71	7.45
Public facilities and economic development	7	7.50	6.99	7.04	9.21
Municipal enterprises, public utilities, public real estate and special assets	8	2.62	3.07	2.07	1.80
Financial management	9	39.24	43.70	30.64	33.94

Source: authors´ calculations

Another difficulty for the global municipal efficiency analysis is the existence of "shadow budgets". Several municipal services are usually provided by municipal enterprises or municipal special purpose associations and are not included in the municipality's core budget. Consequently, this might lead to underestimation of municipal expenditures. However, this rather seems to be a problem for the independent cities and districts than for the district-affiliated municipalities. Table A in the appendix lists all municipal tasks with a median greater than zero per cent, i.e. at least 50% of the district-affiliated municipalities and the municipal associations have positive expenditures in that category. The categories listed here cover on average about 88% of the current expenditures (financial management excluded). Table 1 and table A also reveal that expenditures for childcare services and overhead costs represent over 50% of the total current expenditures. We found 298 municipal enterprises and special purpose associations owned by the district-affiliated municipalities. About two thirds are mainly public utilities (sewage disposal, water, district heating, gas, electricity and public transport) and municipal housing companies. As there are no output indicators for public utilities and housing companies available we have to exclude these enterprises and their related current expenditures in the core budget (category number 8, except 88: administration of real estate) from our calculations. Especially if we deduct the expenditures for sewage disposal, which consist primarily of transfer payments or compensations to special purpose associations, from the current expenditures, this leaves only 23 municipal enterprises that might cause minor distortions if we neglect the municipal enterprise sector in our analysis.

Deducting certain categories of municipal services that either do not correspond to outputs at the municipal level or for which output indicators (e.g. rented flats of municipal housing companies) are not available is one way of adjusting the expenditure figures. But we also have to take expenditure or revenue flows between the municipality and either other local governments or private enterprises into account. A first (and also the main) step in this direction was the exclusion of the transfer payments in category 9. To correct for double cost counting caused by compensations and grants between municipalities which do not have to be members of the same municipal association, we deduct for every municipality the revenues from grants or cost refunding received from other municipalities from the input expenditures (including expenditures for grants or cost refunding to other municipalities.)

However, grants or cost refunds of the remaining categories to private or public enterprises or to private non-profit organizations (kindergartens!) are included in our input figures. The underlying assumption is that the receiving units provide local public services (or at least intermediate inputs for the municipality's administration) which the municipality would have had to provide itself otherwise.

4.2 Methodology

Two approaches to analyzing efficiency, the ability to transform inputs into outputs, have emerged: on the one hand, parametric approaches, in particular stochastic frontier analysis (SFA) (Aigner et al. 1977 and Meeusen and van den Broeck 1977), are employed and on the other hand, non-parametric methods like Free Disposable Hull (FDH) (Deprins et al. 1984) and Data Envelopment Analysis (DEA) (introduced by Charnes et al. 1978) based on the seminal work by Farrell (1957) are used. Although the SFA has the advantage of allowing deviations from the frontier due to measurement error or stochastic influences, it is usually not appropriate for measuring cost efficiency when price data are not available: In case of the mostly used flexible functional forms like the translog the omission of prices leads to omitted variable problems. As input prices are not available, the DEA is chosen here. Moreover, it is then not necessary to specify a functional form which is not obvious for public decision making units.

In the DEA model a convex hull is constructed from the data by applying linear programming techniques resulting in a piecewise linear frontier which represents the production possibilities. We choose an input orientation because municipalities are expected to have more discretion in choosing their input mix while certain outputs have to be provided.[9] Thus, the frontier is based on the observations that need the least inputs to generate their outputs. With a higher number of inputs and outputs the decision making units are compared along more dimensions which results in a larger number of efficient

9 Only under constant returns to scale the efficiency scores from input and output orientation are reciprocals (*Cooper et al.* 2007).

units. The number of inputs and outputs should therefore not be too high. All decision making units are subsequently radially compared to the frontier.

In our main analysis we assume variable returns to scale (BCC model, Banker et al. 1984). For the scale efficiency, we also calculate cost efficiency scores under constant returns to scale (CCR model, Charnes et al. 1978). Cost efficiency analysis requires information about input prices. These are not known, but are assumed to be the same for all municipalities. Since all municipalities within one state face the same collective wage agreement and have access to the same capital market, this is a plausible assumption. Cost- and technical efficiency are the same under these circumstances (Färe and Primont 1988) and the usual BCC-/CCR-models can be applied with input quantities replaced by expenditures for the inputs. We compute i=1,…, N linear programs, one for each municipality observed. The linear program to be solved for the i-th municipality producing p outputs with q inputs under the assumption of variable returns to scale is

$$
\begin{aligned}
&\min_{\theta,\boldsymbol{\lambda}} \ \theta \\
&s.t. \\
1) \quad &\theta \mathbf{C}_{\mathbf{i}} \geq \mathbf{C}\boldsymbol{\lambda} \\
&\mathbf{Y}\boldsymbol{\lambda} \geq \mathbf{y}_{\mathbf{i}} \\
&\boldsymbol{\lambda} \geq \mathbf{0} \\
&\mathbf{I}\boldsymbol{\lambda} = \mathbf{1}
\end{aligned}
$$

where θ is a scalar and the Farrell-measure of technical efficiency, $\mathbf{C}$ is the $q \times N$ input matrix containing costs for the q inputs of all municipalities and $\mathbf{Y}$ the $p \times N$ output quantity matrix. $\boldsymbol{\lambda}$ is a column vector of constants and $\mathbf{I}$ a $(1 \times N)$ vector of ones. For our purposes we use the input distance function, which is the reciprocal of the efficiency score θ. Thus, efficient units, lying on the frontier, receive an efficiency score of one; inefficient units have an efficiency score greater than one.

In order to analyze factors that constrain the input and output choices of municipalities and thus influence the efficiency, but that are not part of the production process, the calculated efficiency scores are regressed on environmental variables in a second step. Often a censored regression is used since the input distance function cannot take on values below one (e.g. De Borger and Kerstens 1996, Worthington 2000, Gimenez and Prior 2007, Afonso and Fernandes 2008). In this case the process that determines the probability of censoring and the process determining the uncensored observations are restricted to be the same. The process of censoring is, however, mainly governed by the finite sample property; the true model does not have a probability mass at one (Simar and Wilson 2007). Some additional problems are outlined by Simar and Wilson (2007). The efficiency scores are serially correlated in an unknown way because they depend on all observations in the sample. Moreover, inputs and outputs must be correlated with the environmental variables for a second stage analysis to make sense. But then the error

term of the second stage is correlated with the efficiency scores. These correlations disappear asymptotically, but the convergence rate is very low so that standard inference is not possible. The efficiency score itself converges to the true value very slowly, too. Another problem is that the efficiency scores are systematically biased downward. To overcome these problems, Simar and Wilson (2007) suggest using a truncated regression at the second stage and to base inference on a bootstrap procedure in which the efficiency score is bias-corrected and the serial correlation is taken into account. We therefore apply their second double-bootstrap algorithm with L1=100 replications and L2=2000 replications.

In addition, we calculate the scale-efficiency measure (this time without controlling for environmental variables) by the commonly used formula

$$2) \quad SE(\mathbf{C_i}, \mathbf{Y_i}) = \frac{d_i(\mathbf{C_i}, \mathbf{Y_i} | CRS)}{d_i(\mathbf{C_i}, \mathbf{Y_i} | VRS)} = \frac{\theta_{VRS}}{\theta_{CRS}} \geq 1$$

where *i* is the Index of the *i*-th municipality and *d()* is the input distance function under constant (CRS) or variable returns (VRS) to scale. For municipalities producing at optimum scale *SE* equals 1.

4.3 Data

The data set comprises all municipalities in Saxony-Anhalt except the three district-free towns at the end of 2004. Municipal budget data for 2004 are taken from the statistics of local government accounts. Other data are obtained from the Statistical Office of Saxony-Anhalt, too, as well as from the Federal Institute for Research on Building, Urban Affairs and Spatial Development (BBSR).

If municipalities belong to a municipal association, their budgets, including the budget of the association if existent, are aggregated. Overall, we thus analyze 46 independent municipalities and 157 administrative collectivities of which 122 are type A associations and 35 are type B associations.

In the statistics of local government accounts revenues and expenditures are listed according to category ("*Gliederung"*) (c.f.table 1) and type ("*Gruppierung"*). Our main input measures are based on municipal expenditures since input quantities and prices are not observed.

Regarding the type, the input measures are based only on the current account. As mentioned before, a few sectors of municipal government are excluded here because they either serve as redistribution of revenues or as grants and compensations to other (general financial management, category 9)[10] so that no corresponding outputs exist for the

[10] However, interest payments, which are part of category 9, are taken into account.

muncipality. To avoid comparison problems between municipalities with different degrees of outsourcing, some services are excluded which are often allocated to municipal enterprises (waste and sewage disposal (part of category 7) as well as the provision of electricity, gas, water, etc. (part of category 8)).

The first input, labor, is measured as expenditure for staff in all categories except those mentioned above. Labor expenditures on average account for more than half of the total expenditures. Capital expenditures are measured as the sum of interest payments and expenditures for rent and lease. This is a relatively small part of municipal expenditures. The third input is resources and intermediate inputs. As such it is a relatively broad input category making up a substantial part of the budget. A further breakdown into several more homogenous inputs, however, is not possible. Corresponding to the population, expenditures for all three inputs are the highest in independent municipalities and smallest in type A associations. An overview of the types that are used in the input construction is given in table 2 (a more detailed overview can be found in table B in the appendix).

Table 2:
Construction of inputs from the types of the municipal budget

Input	Explanation
Labor	type number 4 except 42 (pensions)
Capital	nr. 80 (except 809) and nr. 53; subtraction of nr. 202
Resources and intermediate inputs	nr. 50 to 79 and 84 except 53 (part of capital), except 673, 679, 68, 713, 72

Source: authors´ compilation

In contrast to other studies (e.g. Geys et al. 2007; Geys et al. 2008 and 2010; Kalb 2010a; Kriese 2008) we only use economically relevant types and correct the data for double counting. Imputed costs and internal offsets, for example, are made only for book-keeping purposes and cannot be related to any of the municipal functions. Financial aid for debt service to other levels of government, tax-revenue-sharing, general grants, general apportionments, and the allocation to reserves cannot be matched to measurable communal output, either. Furthermore, expenditures for covering deficits of the current budget of previous years are excluded since the analysis is restricted to one year and should not be confounded by previous years' financial management. Furthermore, allocations to the capital budget are left out to be consistent in restricting the analysis to the current account.

Besides, rent income from other municipalities is subtracted from the capital input, and all three inputs are proportionately reduced by reimbursements of expenditures and grants for current aims from member municipalities and counties[11]. By aggregating municipalities' budgets with the budget of the municipal association reve-

11 This includes type number 162 and 172.

nues/expenditures are counted twice if transfers within the municipal association are involved. Since the expenditure categories combine payments to the municipal association and payments to the county, we include these categories but subtract the corresponding revenue of the municipal association. The aggregation and adjustment of the inputs is closely related to the calculation formula of the statistical office of Saxony-Anhalt (2010).[12]

The outputs are geared to the municipality's functions and resemble those used in other studies (e.g. Geys and Moesen 2009, Geys et al. 2007, Kalb 2010a). Nevertheless, they can often be only a rough proxy.

On average 87% of the expenditures in category 4, social security, are made for child care. Moreover, almost all children visit a day care center while less than 1% is in family day care[13]. Therefore the number of approved places in child care centers in the municipality is an appropriate output[14]. Students in elementary school are a measure for category 2, which comprises mainly elementary schools. There are two municipal associations which do not have elementary schools, resulting in zero outputs.

Recreational area is used as a proxy for local public health, sport and recreation facilities, while traffic area serves as a measure of municipal street-related outputs. As the recreational area is relatively small and measured in the same terms as the traffic area, it is not used as a separate output, but combined with the traffic area.

Certain municipal services that are either public consumption goods for the private households or public inputs for the private enterprise sector (or both) cannot be measured properly (or adequate data is not published). This problem arises for services concerning public safety, but also for many other services such as economic development or business- related infrastructure. Thus, we assume that these unobservable public outputs are correlated with the population number (public consumption goods) and the number of employees subject to social security contribution (public inputs). An overview of the outputs is given in table 3.

At the second stage, the DEA score is regressed on environmental variables which are supposed to explain differences in the efficiency level as outlined in section 3. They are described in table 4.

12 *Statistical Office Saxony-Anhalt* (2009)

13 *Statistical Offices of the Federation and the States* (2008), calculated from tables 1 and 2.

14 These numbers are only available for 2006. The statistics show that the number of available/approved places has increased somewhat over the period 2002 to 2006 and also afterwards. No information on the actual number of children in child care centers is available before 2006. Thus, our output measure might be slightly biased upward (*Statistical Office Saxony-Anhalt* 2010).

Table 3:
Outputs

Output	Explanation
Population	Number of inhabitants of the municipality
Child care places	Number of approved places in the child care centers within the municipality
Children in elementary school	Number of children that visit the elementary schools in the municipality
Traffic and recreational area	Traffic and recreational area in hectare
Employees subject to social security contribution	Number of employees working in the municipality who are subject to social security contribution

Source: authors´ compilation

Table 4:
Environmental variables

Environmental variable	Explanation
Population density	Population divided by the total area in square kilometer
Share of senior citizens	Population aged 65 years and older as share of total population
Relative population change	Absolute value of the relative population change between 2000 and 2004
Dummy variables for type of municipality	Type A associations, type B associations, base group independent municipalities
Number of municipalities	Number of municipalities within the administrative collectivity, =1 for independent municipalities
Debt per capita	Total debt divided by population
Relative equalization transfers	Equalization transfers as a percentage of total adjusted current income
Unemployment rate	Number of unemployed in the municipality divided by population

Source: authors´ compilation

The institutional variables are dummy variables for the type of municipality and the number of member municipalities forming one municipal association. Base group of the dummy variables are the independent municipalities. They consist of just one member municipality. Municipal associations comprise up to 22 municipalities although more than 10 members are the exception. These large associations in term of member municipalities are all type A associations.

The flypaper effect is measured by equalization transfers (grants) as a percentage of total adjusted current income. On average they account for almost one third of the whole budget, representing an important part of the municipal income. Additionally, debt per capita is included as a fiscal control variable. All municipalities have debts. The average is about 950 € (per inhabitant) but the variation is very large, also within the different municipality types.

Table 5:
Descriptive statistics

Variable	All (N=203)				Type A associations (N=122)				Type B associations (N=35)				Independent municipalities (N=46)			
	mean	std. dev.	min	max	mean	std. dev.	min	max	mean	std. dev.	min	max	mean	std. dev.	min	max
Labor	2,894,448	2,894,205	460,538	17,700,000	1,906,379	727,513	460,538	5,455,255	3,553,194	2,997,824	838,418	11,500,000	5,013,759	4,670,322	696,016	17,700,000
Capital	428,926	502,415	48	3,222,858	297,304	272,798	32,422	1,554,030	527,368	512,312	77,307	2,054,030	703,108	776,742	48	3,222,858
Resources and intermediate inputs	2,212,260	2,430,012	347,249	17,800,000	1,202,676	500,390	474,753	3,440,724	4,059,374	3,251,919	1,009,206	12,500,000	3,484,440	3,282,082	347,249	17,800,000
Population	9,615.13	7,833.50	2,229.00	45,737.00	6,384.30	2,283.08	3,204.00	19,135.00	14,292.77	9,684.55	3,183.00	37,475.00	14,624.78	10,936.34	2,229.00	45,737.00
Child care places	443.08	340.29	102.00	2,046.00	311.11	119.47	102.00	906.00	648.83	440.92	176.00	1,915.00	636.54	464.88	131.00	2,046.00
Children in elementary school	235.81	194.76	0.00	1,179.00	158.20	74.23	0.00	531.00	334.94	223.54	74.00	852.00	366.24	276.27	57.00	1,179.00
Traffic and recreational area	465.15	219.86	67.00	1,191.00	456.47	213.57	136.00	1,191.00	505.40	199.45	200.00	1,046.00	457.54	250.52	67.00	1,096.00
Employees subject to social security contribution	2,508.83	3,169.39	213.00	17,918.00	1,147.19	728.97	290.00	4,115.00	4,081.17	3,491.75	437.00	13,500.00	4,923.78	4,641.03	213.00	17,918.00
Population density	141.90	169.63	21.16	1,216.41	78.13	47.04	21.16	305.98	201.36	207.17	28.48	916.13	265.80	247.62	45.60	1,216.41
Share of senior citizens	0.20	0.02	0.13	0.27	0.20	0.02	0.13	0.25	0.21	0.01	0.19	0.25	0.21	0.02	0.15	0.27
Relative population change	0.04	0.02	0.00	0.17	0.04	0.02	0.00	0.10	0.06	0.03	0.00	0.17	0.05	0.02	0.00	0.10
Number of municipalities	5.49	4.00	1.00	22.00	7.36	3.70	2.00	22.00	4.89	2.46	2.00	10.00	1.00	0.00	1.00	1.00
Equalization transfers	0.31	0.09	0.00	0.48	0.33	0.08	0.03	0.48	0.32	0.07	0.14	0.43	0.27	0.12	0.00	0.47
Debt per capita	942.90	657.11	24.14	4,041.48	952.34	697.66	101.39	4,041.48	991.02	636.87	167.93	3,752.36	881.28	563.13	24.14	2,843.86
Unemployment rate	0.10	0.02	0.01	0.15	0.10	0.02	0.01	0.14	0.11	0.02	0.06	0.15	0.10	0.03	0.01	0.14

Source: authors´calculations.

As demographic variables we include population density, the share of senior citizens which captures the ageing aspect and relative population change to account for overall population decline. Population density varies enormously between approximately 20 and 1200 inhabitants per square kilometer.

Independent municipalities exhibit the highest population density since many of these are medium-sized cities. However, there is also a significant difference between type A and type B associations, with type A having the smallest density. To account for possible nonlinear effects of population density, a square term is also included. Senior citizens are inhabitants aged 65 years and older; they are included as fraction of the total population. On average, this share is 20% with a maximum of about 27%. Population change is measured by the absolute value of the relative population change between 2000 and 2004. Only six municipalities grew within that period. All of them are located in the vicinity of the two biggest cities Magdeburg and Halle. On average, population decline amounted to 4.5%.

We also control for the unemployment rate, measured as the number of unemployed divided by total population. On average 10% of the population are unemployed. Although this is a relatively high number one has to keep in mind that it would be even higher if measured as percentage of the labor force. Descriptive statistics of all variables are presented in table 5.

5 Results

Using the inputs and outputs described in the data section we calculated the linear program allowing for variable returns to scale as given in Equation 1. Table 6 shows the results of the initial DEA program ignoring the bias of the estimated frontier. We find 36% of the observed municipalities to be efficient. The median municipality provides its outputs with an efficiency score of 1.07.

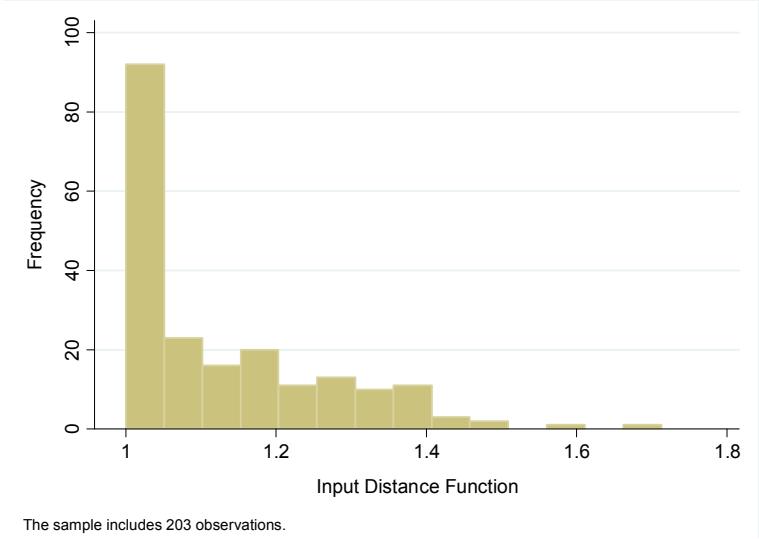
Table 6:
Technical efficiency

Obs	Median	Min	Max	Std. Dev.	Efficient Obs
203	1.07	1	1.71	0.14	74 (36%)

Source: authors´ calculations

This indicates that the median municipality could reduce its inputs by about 7% without output reduction if it produced efficiently. The histogram of the technical efficiency scores is given in figure 2.

Figure 2:
Histogram of the technical efficiency scores



Source: authors´ illustration

Furthermore, we evaluate the scale efficiency for each observation by calculating the ratio of its efficiency score calculated in the constant returns to scale model by its efficiency score under the variable returns to scale assumption. We find that about 20% of all observations operate at the optimal scale. The results of the scale efficiency measure defined above are given in Table 7.

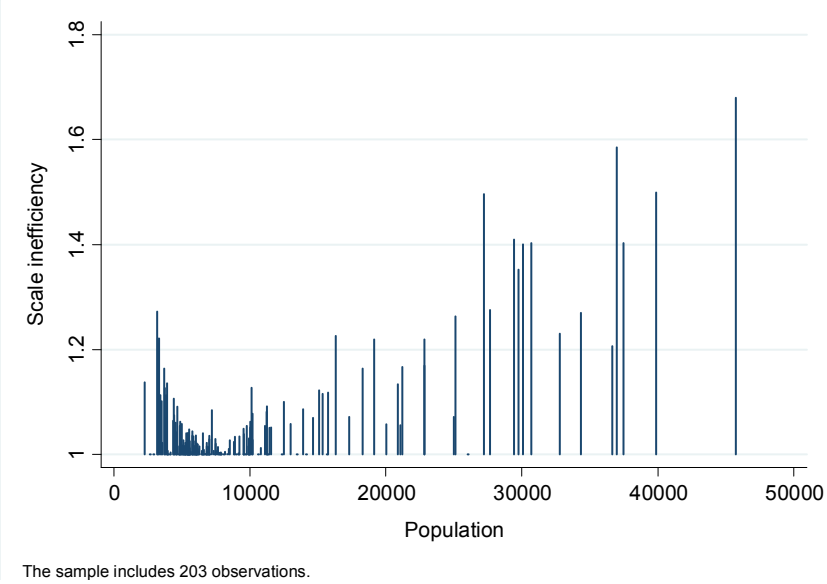
Table 7:
Scale efficiency

Obs	Median	Min	Max	Std. Dev.	Efficient Obs
203	1.02	1	1.68	0.11	40 (20%)

Source: authors´ calculations

To reveal the nature of the scale inefficiencies depicted in Table 7, we follow Färe, Grosskopf and Logan (1983, 1985) and evaluate whether or not the municipality observed operates in the non-increasing returns to scale area. We find that about 43% of all observations operate under decreasing returns to scale and about 37% operate under increasing returns to scale. The forgone interpretation of the results ignores the sometimes small scale of the scale inefficiency depicted in Table 7 and the fact that coincidence may be the cause in some cases. Figure 3 shows the relationship between scale inefficiency and population size graphically. At about 8,000 inhabitants the scale inefficiency is zero. The mean size of all scale efficient municipal associations is about 7,892 inhabitants. At the left as well as the right hand side of this population size scale inefficiency increases and we find a strong negative and positive correlation between both variables, respectively.

Figure 3:
Scale inefficiency and municipality size



Source: authors´ illustration

As described in the methodology section we perform the bootstrap procedure suggested by Simar and Wilson (2007) in order to correct the bias of the initial frontier calculation. The results are presented in Table 8.

Table 8:
Bias-corrected technical efficiency

Obs	Median	Min	Max	Std. Dev.	Efficient Obs
203	1.18	1.05	1.85	0.15	0

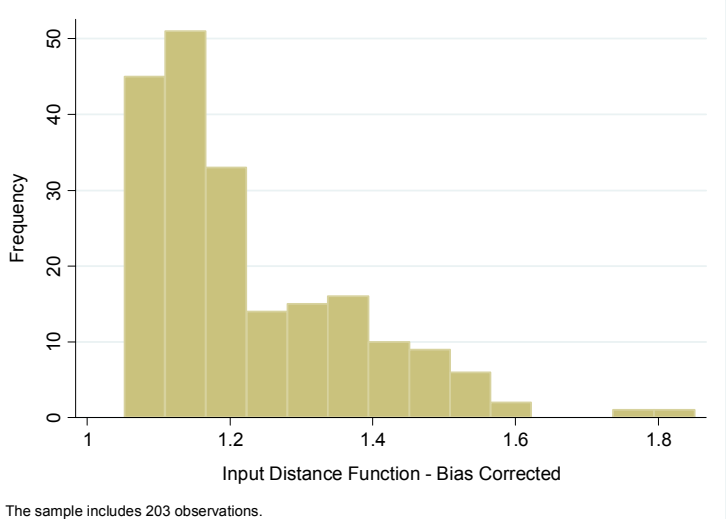
Source: authors´ calculations

By definition the bias-corrected convex hull constructed by the DEA program is further away from the observed data than the initial DEA frontier. That is why we will observe no efficient observation if we account for the bias. The histogram of those efficiency scores is given in figure 4. Our calculation shows that the mean square error is lower for the bias-corrected frontier estimation (Simar and Wilson 2000). Hence, the Simar and Wilson procedure is justified. Finally, we use the bias-corrected efficiency scores to evaluate the impact of environmental variables on municipal efficiency.

The parameter estimates and their 90% confidence intervall of the second stage bootstrap algorithm described in Simar and Wilson (2007) are given in Table 9. First of all, we find a significant negative dummy for type B associations. Since the base category designates independent municipalities this result supports hypothesis 1. The insignificance of the dummy indicating type A associations may be caused by compensating institutional effects of the decentralized administration in this kind of municipal associa-

tions described in section 3. Hence, less decentralized municipal associations are at least as efficient as more politically centralized ones.

Figure 4:
Bias-corrected efficiency scores



Source: authors´ illustration

Furthermore, we find empirical support for hypothesis 2. Hence, ceteris paribus the rising number of municipalities in municipal associations decreases their efficiency. The same is true regarding hypothesis 4 where a negative impact of the debt burden on efficiency is stated.

Concerning hypothesis 3 the parameter estimated is not in line with our theoretical considerations. We find a weak, but significant positive impact of equalization transfers on municipal efficiency. Hence, there is no empirical support for the flypaper effect or potential negative efficiency effects of soft budget constraints. This might be caused by weak incentives to use additional municipal income efficiently due to strong equalizing transfers on the municipal level.

Finally, the parameter estimates of the other control variables given in Table 9 are in line with findings in the previous literature and induce further research on those issues not addressed in our paper.

Table 9:
Parameter estimates of the second stage regression

	5%	Parameter		95%
Constant	0.4953	0.7615		1.0295
Dummy type A association	-0.1271	-0.0545		0.0233
Dummy type B association	-0.2542	-0.1668	*	-0.0831
Population density	-0.0011	-0.0007	*	-0.0003
Population density squared	0.0000	0.0000		0.0000
Number of municipalities	0.0002	0.0077	*	0.0152
Share of senior citizens	1.7855	3.1402	*	4.4709
Debt per capita	0.0000	0.0001	*	0.0001
Unemployment rate	-1.5280	-0.2955		0.9456
Absolute value population change	-0.6271	0.5989		1.9204
Equalization transfers	-0.0082	-0.0057	*	-0.0032
Number of Observations: 203				

Source: authors´ calculations

The demographic change did not cause significant efficiency effects: Even in municipalities with high population decrease excess-capital stocks and staff in childcare centers or primary schools were reduced. Furthermore, the slightly efficiency-enhancing effect of the population density indicates some “economies of density” or “econonomies of sharing” in the provision of municipal services. Thus, due to the significantly lower population density a type A association transformed into an independent municipality might never be as efficient as an independent municipality with equal population number, but higher population density.

The negative efficiency effect of a higher share of senior citizens might be explained by the fact that older people do not benefit from the main municipal expenditure categories (child care, primary schools) and hence, are not interested in enforcing the efficient production of these services. But this is only an educated guess and needs further research work.

6 Conclusion

Not only in the eastern part of Germany, but also in many other countries we can witness processes of municipal amalgamations which are supposed to lead to cost savings and higher efficiency. In this paper, we analyze whether size effects have an impact on global municipal efficiency. Size effects consist of scale effects in municipal production

as well as effects of decentralized or centralized municipal organizational structures on technical efficiency. We applied DEA to municipal data from Saxony-Anhalt in a cross-section analysis. The median efficiency score is 1.07 indicating that there might be some potential for efficiency improvement. After correcting for the bias using the Simar and Wilson (2007) approach, the median rises to 1.18, suggesting somewhat larger inefficiencies – though still not necessarily huge efficiency deficits. Furthermore, the median value of 1.02 for scale efficiency indicates that at least 50% of the municipalities have already reached an approximately optimum size. Hence, the potential increases in municipal efficiency by further amalgamations seem to be limited.

In a second step we analyzed which exogenous factors influence the efficiency scores. Deviating from similar articles this is – at least to our knowledge – the first study which explicitly takes into account the effects of different organizational forms – especially of municipal associations. The results show that one type of municipal associations (type B) is more efficient than independent municipalities whereas we could not find any significant differences in technical efficiency between type A associations and independent municipalities. Thus, the structure and organization of municipalities are relevant aspects and should not be neglected in empirical analyses. Furthermore, we found significant effects of some commonly used fiscal indicators. We showed that higher debt results in an increase in inefficiency and in line with Geys and Moesen (2009) that higher equalization transfers have a positive effect on efficiency. Hence, the municipalities are affected by some kind of fiscal illusion, but not by the flypaper effect or "soft budget constraints".

While these results suggest that forming type B municipal associations will reduce inefficiencies, further research is necessary to determine the specific factors which make these associations more efficient. As these type B associations usually have less members than the type A associations this efficiency advantage might indicate a sort of u-shape relationship between the number of member municipalities and overall municipal efficiency. Probably there is a tradeoff between effectiveness of control and coordination costs with increasing number of member municipalities. Also it should be kept in mind that the output indicators are (partly) very rough measures. Nevertheless, these findings suggest that the trend towards forming relatively large and centralized municipalities is not justified from an efficiency perspective, especially when many small, dispersed municipalities are merged. This should be taken into account in future municipal territorial reforms.

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Appendix

Table A:
Structure of current expenditures and municipal enterprises of district-affiliated municipalities in Saxony-Anhalt 2004

Category number	Category name	Mean Saxony-Anhalt [a]	Median Saxony-Anhalt [a]	Number of municipal enterprises/ special purpose associations in this category	Provision of output to the citizens or provision of intermediate products (overhead cost) to other administration units?
46*	Facilities of youth welfare: mostly kindergartens, nursery schools and day nurseries	23.8%	25.770%	5	output
02	Internal organization (including personnel administration, public relations and legal office)	9.5%	9.720%	0	overhead cost
03	Financial administration	4.7%	5.312%	0	overhead cost
77	Auxiliary service units (vehicle fleet, building yard)	4.7%	5.163%	4	overhead cost
211	Primary schools	4.0%	4.551%	0	output
60	Administration of civil engineering	3.9%	4.038%	0	overhead cost
11	Public order	3.5%	3.462%	0	output
00	Municipal council, mayor	2.9%	3.396%	0	overhead cost
63+670 +675	Municipal street maintenance, street lighting and -cleaning	4.8%	3.049%	1	output
88	Administration of real estate not allocated to other tasks	1.0%	2.639%	0	overhead cost
13	Fire protection	2.2%	2.053%	0	output
70	Sewage disposal	4.5%	2.016%	65	output
56	Sport facilities	1.3%	1.081%	0	output
69	Flood protection, water engineering (not including provision of drinking water or sewage disposal)	0.9%	1.068%	0	output

Category number	Category name	Mean Saxony-Anhalt [a]	Median Saxony-Anhalt [a]	Number of municipal enterprises/ special purpose associations in this category	Provision of output to the citizens or provision of intermediate products (overhead cost) to other administration units?
58	Parks and gardens	2.1%	0.906%	5	output
05	Special units of the central administration	0.8%	0.703%	0	overhead cost
06	Jointly used facilities of the central administration	6.4%	0.591%	0	overhead cost
75	Cemeteries	1.1%	0.569%	0	output
76	Other public facilities	0.9%	0.429%	0	output
37	Church affairs	0.5%	0.274%	0	partly output
61	Urban planning, surveying and building regulation	1.1%	0.248%	0	both
355	Adult education	0.8%	0.248%	0	output
57	Public swimming baths	1.5%	0.245%	5	output
43*	Other social facilities	0.3%	0.023%	5	output
73	Markets	0.2%	0.006%	1	output
59	Other recreational facilities	0.5%	0.004%	3	output
		N=203	N = 203	N = 98	

Notes: [a] Ratio of current expenditures of the particular category to total current expenditures (except current expenditures for financial management).

Source: authors' calculations

Table B:
Type numbers used in input construction

Input factor	Type numbers	Explanation
Labor	40	Expenditures for voluntary work
	41	Wages and salaries
	43	Contributions to pension funds
	44	Social security contributions
	45	Financial support
	46	Incidental staff expenditures
Capital	80	Interest expenditures
	Not 809	Internal offsets
	-202	Interest payments received from other municipalities
	53	Rents and leases
Resources and intermediate inputs	50	Maintenance of property and buildings
	51	Maintenance of other immoveable property
	52	Equipment, basic commodities
	54	Management of property and buildings
	55	Expenditures for motor vehicles
	56	Special expenditures for civil servants
	63	Further administrative and operating expenditures, expenditures for transport of students
	64	Taxes, insurances, claims
	65	Business expenditures
	66	Further general business expenditures
	84	Further financial expenditures
	67	Reimbursement of expenditures of the current account to others
	Not 679	Internal offsets
	-162	Reimbursement of expenditures of the current account by other municipalities
	71	Grants for current aims to others
	-172	Grants for current aims by other municipalities
	73	Payments of social welfare to people not in institutions
	74	Payments of social welfare to people in institutions
	75	Payments to war victims and similar eligible people
	76	Payments of youth welfare outside institutions
	77	Payments of youth welfare in institutions
	78	Other social payments
	79	Payments according to the law about payments for asylum-seekers

Source: authors' illustration

Table C:
Excluded type numbers

Type number	Explanation
42	Pension benefits
68	Imputed costs
72	Help for debt service
81	Tax-sharing (expenditures)
82	General grants (expenditures)
83	General apportionments (expenditures)
85	Reserve
86	Allocations to the capital budget
892	Deficits of the current budget of previous years

Source: authors' illustration