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No differences in efficiency between public and private utilities

By Astrid Cullmann, Maria Nieswand, Stefan Seifert, and Caroline Stiel

The increase in municipal economic activity in the utilities sector frequently comes under scrutiny. It is presumed that public utilities have less incentive to provide efficient service than private companies. This could result in excessive costs and prices for end users. New microdata on German energy supply companies allow to conduct an empirical analysis for the whole of Germany for the first time. The findings indicate that there is no difference in efficiency between public and private utilities. This applies to both the competitively structured electricity retail sector and regulated electricity distribution sector. General restructuring in the energy sector such as the increased competitive pressure or the introduction of a more stringent regulatory regime have led to changes in the efficiency of all energy supply companies. The dichotomy between public and private utilities that has been suggested in the (re)municipalization debate therefore appears to be exaggerated.

In the context of the increasing municipal economic activity in the energy utilities sector, energy and climate policy considerations as well as the economic aspects have been under heavy discussion. The latter was also the subject of recent detailed examinations by the Monopolies Commission and the Bundeskartellamt (Federal Cartel Office).

Apart from the general question as to what conditions justify business activity on the part of the state from an economic perspective, the debate focuses in particular on how efficiently municipal enterprises fulfill their remit and whether they have less incentive to provide efficient service than private companies.

The allegedly lower level of efficiency of municipal enterprises is often explained by the fact that—compared to private companies whose primary aim is to maximize their profits—they pursue a wider range of objectives. These include energy and environmental policy goals, for instance, as well as fiscal targets in the form of profit transfers to the local government budget, or cross-subsidization of loss-making sectors such as local public transport. One of the aims expressed by the municipalities is also to contribute to economic growth in the region through public enterprises. Economic theory states that inefficiencies can also arise because municipal enterprises are subject to lower budget constraints, are disciplined to a lesser extent by financial and capital markets, and a large number of stakeholders are involved in their decision-making processes.

Irrespective of intensity of competition and due to the differing objectives and interests of public and private...

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1 For more on this, see "(Re-)Municipalization trend among energy utilities: truth or myth?" in this issue of DIW Economic Bulletin.
EFFICIENCY DIFFERENCES

Measuring differences in efficiency using econometric production functions

In order to allow us to make comparative statements about the efficiency of an enterprise, the production process of the enterprises has to be mapped out using a production function. Here, the outputs produced by the energy provider (amount of electricity sold) is set against the inputs (labor input and external services). Other important factors that explain structural differences between the enterprises and consequently might have an effect on the quantity of goods produced are also taken into consideration. These include the customer structure of the electricity retailers (the ratio of industrial consumers to household consumers) and the amount of electricity supplied to other electricity suppliers as a share of total electricity supplied.

The latest structural econometric methods are used to estimate the production function on the basis of the entire panel dataset, i.e., by determining the coefficients of the input factors. Annual efficiency scores for each enterprise can then be calculated on the basis of the estimated production function. Based on this, the average of the annual efficiencies can be determined for all enterprises combined and separately according to whether they are public or private enterprises. The annual mean values can then be compared between the two groups. This enables us to analyze rates of change in average efficiency over the entire observation period for all enterprises combined and separately by ownership for the base year 2003.

Furthermore, the estimated production functions allow us to draw conclusions as to whether or not there is a direct correlation between the efficiency of an enterprise and the ownership by econometrically testing the statistical effect of the variable ownership on firm-specific efficiency.

1 Here, we refer only to enterprises’ productive technical efficiency, without taking into consideration costs and allocative efficiency. The Monopolies Commission notes in its report that it is primarily productive inefficiency which is more apparent in public enterprises and allocative inefficiency is less noticeable, see Monopolies Commission, Hauptgutachten XX, 459.


3 In this context, the efficiency of an enterprise is defined as the deviation of the firm’s realized output level from the average output of all firms that cannot be explained by other use of input factors.


6 Municipal infrastructure enterprises against the background of energy policy and demographic change (KOMIED) is a three-year research project funded by the Leibniz Association (www.diw.de/de/diw_d01.c.467702.de/forschung_beratung/projekte/projekt_homepages/komied/komied.html).

7 The electricity sector is characterized by three stages of the value chain: power generation, transmission and distribution, and sale to the end user. Municipal enterprises are involved in all three of these stages but the present report only focuses on the last two stages: distribution and sales.

8 Overall, we had access to 212 observations on pure electricity suppliers (65 public and 147 private enterprises) for the period 2003 to 2012. This means that our findings are based on a subset of German power suppliers.

No robust national analysis on efficiency differences between public and private enterprises in the energy sector is available for Germany to date. Using a recently compiled micro dataset as part of the project Municipal infrastructure enterprises against the background of energy policy and demographic change (KOMIED) for the electricity sector, which accounts for the lion’s share of municipal enterprises’ revenue, the link between public or private ownership and efficiency is examined in more detail. The efficiency of enterprises both in the competitively structured retail electricity and in regulated electricity distribution is estimated and compared in two separate analyses.

In the competitively structured retail electricity sector …

The first analysis focuses on electricity retailers, known as electricity suppliers or electricity providers. These supply the end users with electricity and are responsible for billing them. The micro dataset compiled allows us to make a direct comparison of public and private enterprises for the period 2003 to 2012.4 The sources of the firm-level data are the Official Data on German Utilities and the financial statements from public funds, institu-
The increase in the first five years can be explained by considerable restructuring and company reorganization: the liberalization of energy markets in 1998—which left all consumers free to choose their electricity provider—and the European unbundling requirements (Directive 2003/54/EC), led to more competition and consequently a better input use.

Differences in efficiency between electricity retailers not down to ownership structure

First, the mean values of both groups were determined for the entire observation period. The mean values for public electricity retailers appear to be slightly higher than for private providers at first glance. However, a statistical test shows that the mean values of both groups do not differ statistically from each other (see Table 1). The findings of the test show that there is no difference between the levels of efficiency of public and private enterprises.

Using a further regression of efficiency on the ownership, it was also possible to confirm that the ownership factor did not explain the efficiency differences between the enterprises. No statistically significant effect was found for the coefficient of the variable ownership (public enterprises).

Several different models were used to test the robustness of the findings for the ownership effect. First, the specification of the production function was varied, which had no effect on the main result. Second, a further re-

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10 Since energy supply is considered to be a municipal function, it is mainly the municipalities that hold shares in the public enterprises; the Länder or federal states only hold a very limited number and the German central government has no shares in the energy supply companies included in the present study.

11 Unbundling refers to the legal requirement for separation of network operation and distribution by energy supply companies.

12 For the precise figures, see the relevant discussion paper, Stiel et al. "Productivity in Electricity Retail."
EFFICIENCY DIFFERENCES

Box 2

Measuring efficiency differences using benchmarking methods

The company-specific efficiency of the network operators was determined using a new semiparametric, multilevel benchmarking method. Here, in line with previous analyses, the production process of the enterprises is illustrated on the basis of the relevant output produced (amount of electricity transmitted and number of customers) and input factors (labor, capital), as well as environmental factors (features of the supply area). In the benchmarking method, efficiency refers to the ratio of output to input factors. The most efficient enterprises constitute what is known as the efficient frontier, against which all other enterprises are compared (benchmarked). The fewer input factors required to provide the level of output, the more efficient the enterprise. The approach also makes it possible to break down total inefficiency into a persistent component (inefficiencies that do not change over time) and a time-varying component (inefficiencies that change over time). The findings indicate that, in the period under review, inefficiencies are mainly determined by time-varying inefficiencies, changing over time in the individual enterprises, and there is no persistent inefficiency. Therefore, the focus in the following sections is on time-varying inefficiency.

1 The analytical approach is based on the semiparametric smooth coefficient stochastic cost frontier model developed by K. Sun, S. C. Kumbhakar, et al., “Productivity and Efficiency Estimation: A Semiparametric Stochastic Cost Frontier Approach,” European Journal of Operational Research 245 (2015): 194–202. Compared to previous approaches, this has the advantage that no strict functional assumptions have to be made concerning the production function and this can be estimated nonparametrically instead.

2 The main reason for this is the short observation period. Another reason is the restructuring and reorganization in the sector in response to the unbundling requirements and the incentive regulation.

In regulated electricity distribution, too ...

A second analysis focuses on possible efficiency differences among network operators, i.e., enterprises responsible for the distribution of electricity on the energy market. Due to the specific features of network operation, which do not permit any competition in this sector per se, the prices (known as network charges for the distribution of electricity) are regulated by the relevant national and regional authorities. Public and private enterprises are subject to the same regulatory requirements.

Against the background of expiring concessions, there has been some discussion in the public sector about buying back previously privatized networks. Critics have warned against this, since they believe public enterprises would operate their networks less efficiently than private ones, resulting in inflated prices for end users. For this sector, too, there has been an absence of robust empirical analysis for Germany to date explicitly examining the impact of ownership on efficiency.

Supplementing the microdata from the official statistics with network-specific data from the service provider Ene’t allows us to conduct a detailed efficiency analysis of German network operators for the period 2008 to 2012 with a total of 1,474 observations. These include 199 observations on private enterprises and 1,275 on public ones. The company-specific efficiency values of the network operators are calculated using benchmarking approaches (see Box 2).

... public and private network operators are more or less equally efficient

Table 2 shows the descriptive statistics on the efficiency values determined using the benchmarking method. The network operators achieve an average level of effi-

13 Electricity distribution is characterized by features of natural monopolies. What characterizes these monopolies is that the supply (distribution of electricity to end users) can be provided by a single enterprise at the lowest possible cost. Competition would lead to considerably higher costs here.

14 Ene’t is a service provider of professional databases on electricity and gas network usage. For the present study, we use the “Netznutzung Strom” database (see https://download.enet.eu/uebersicht/allgemein).

15 Due to data protection regulations, the minimum and maximum values cannot be subdivided according to ownership structures.
Efficiency differences

EFFICIENCY DIFFERENCES

Table 2
Descriptive statistics of efficiency values for the whole sample (electricity distribution)

<table>
<thead>
<tr>
<th></th>
<th>mean</th>
<th>median</th>
<th>25% quantile</th>
<th>75% quantile</th>
</tr>
</thead>
<tbody>
<tr>
<td>2008</td>
<td>0.869</td>
<td>0.874</td>
<td>0.862</td>
<td>0.890</td>
</tr>
<tr>
<td>2009</td>
<td>0.887</td>
<td>0.891</td>
<td>0.883</td>
<td>0.901</td>
</tr>
<tr>
<td>2010</td>
<td>0.863</td>
<td>0.864</td>
<td>0.852</td>
<td>0.876</td>
</tr>
<tr>
<td>2011</td>
<td>0.846</td>
<td>0.852</td>
<td>0.836</td>
<td>0.862</td>
</tr>
<tr>
<td>2012</td>
<td>0.866</td>
<td>0.879</td>
<td>0.860</td>
<td>0.893</td>
</tr>
</tbody>
</table>

Source: Calculations by DIW Berlin.

Average efficiency values do not change much over time, considerable difference exist, however, among single distributors.

Table 3
Descriptive statistics of efficiency values of network operators by ownership structure

<table>
<thead>
<tr>
<th></th>
<th>mean</th>
<th>median</th>
<th>25% quantile</th>
<th>75% quantile</th>
</tr>
</thead>
<tbody>
<tr>
<td>Private distributors</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2008</td>
<td>0.877</td>
<td>0.889</td>
<td>0.868</td>
<td>0.921</td>
</tr>
<tr>
<td>2009</td>
<td>0.877</td>
<td>0.889</td>
<td>0.868</td>
<td>0.919</td>
</tr>
<tr>
<td>2010</td>
<td>0.864</td>
<td>0.868</td>
<td>0.852</td>
<td>0.899</td>
</tr>
<tr>
<td>2011</td>
<td>0.845</td>
<td>0.856</td>
<td>0.823</td>
<td>0.871</td>
</tr>
<tr>
<td>2012</td>
<td>0.836</td>
<td>0.873</td>
<td>0.811</td>
<td>0.911</td>
</tr>
<tr>
<td>2008-2012</td>
<td>0.860</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Public distributors

<table>
<thead>
<tr>
<th></th>
<th>mean</th>
<th>median</th>
<th>25% quantile</th>
<th>75% quantile</th>
</tr>
</thead>
<tbody>
<tr>
<td>2008</td>
<td>0.872</td>
<td>0.877</td>
<td>0.865</td>
<td>0.892</td>
</tr>
<tr>
<td>2009</td>
<td>0.892</td>
<td>0.895</td>
<td>0.887</td>
<td>0.903</td>
</tr>
<tr>
<td>2010</td>
<td>0.867</td>
<td>0.867</td>
<td>0.856</td>
<td>0.878</td>
</tr>
<tr>
<td>2011</td>
<td>0.850</td>
<td>0.855</td>
<td>0.842</td>
<td>0.865</td>
</tr>
<tr>
<td>2012</td>
<td>0.874</td>
<td>0.882</td>
<td>0.866</td>
<td>0.896</td>
</tr>
<tr>
<td>2008-2012</td>
<td>0.870</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Results from Mann-Whitney-Wilcoxon test.
Null hypothesis: observations come from the same distribution (and have the same mean).
p-value: 0.787, Null hypothesis cannot be rejected.
Source: Own calculations by DIW Berlin.

There are small differences in the efficiency values. However, they are not statistically significant.

16 Compared to the efficiency values used by the Federal Network Agency in incentive regulation, we obtain a lower average efficiency level. This can be partly explained by the fact that the final efficiency values provided by the Federal Network Agency are based on the highest value of several models and, across the board, no efficiency value lower than 60 percent is attributed to enterprises.
**Conclusion**

Using newly available microdata on German energy supply companies, two empirical analyses have addressed the question as to whether public utilities differ from private enterprises in terms of efficiency. The empirical findings indicate that there are no efficiency differences among electricity retailers or network operators. According to the findings, public enterprises do not generally operate any less efficiently than private enterprises, as is sometimes assumed in the (re)municipalization debate. From an efficiency perspective, there is no reason to argue against further involvement of municipalities in the energy supply sector. Despite sometimes disparate objectives and various stakeholders, these public enterprises are able to provide their service just as efficiently as their private counterparts.

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