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Article

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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,¹ 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*² and the *Bundeskartellamt* (Federal Cartel Office).³

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

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

² Monopolies Commission, chap. 5 in *Hauptgutachten XX: Eine Wettbewerbsordnung für Finanzmärkte* (Bonn: 2014), 439–511.

³ Bundeskartellamt, "Der Staat als Unternehmer – (Re-)Kommunalisierung im wettbewerblichen Kontext," background paper (Bonn: 2014): 17.

Box 1

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.¹ 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.² Annual efficiency scores for each enterprise can then be calculated on the basis of the estimated production function.³ 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*, 458.

² For details on econometric approach, see C. Stiel, A. Cullmann, and M. Nieswand "Productivity in Electricity Retail after Market Liberalisation: Analysing the Effects of Ownership and Firm's Governance Structure," *DIW Diskussionspapier* 1531 (2015). This approach is based on structural models to estimate production functions following G. Olley and A. Pakes, "The Dynamics of Productivity in the Telecommunications Equipment Industry," *Econometrica* 64 (6) (1996): 1263–1297; and Akerberg et al., "Identification Properties of Recent Production Function Estimators," *Econometrica* 83 (6) (2015): 2411–2451.

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.

enterprises as well as the resultant potential differences in efficiency, the *Monopolies Commission* and the *Bundeskartellamt* express fundamental reservations about the increase in state involvement in performing municipal functions such as energy supply. They fear that possible inefficiencies in the public sectors lead to higher costs and hence inflated prices for consumers. These conclusions are mainly based on older theoretical principles and empirical evidence from other countries.⁴ Yet international analyses show no indication whatsoever that public enterprises in the energy sector perform less well than private enterprises in general.⁵

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)*⁶ 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.⁷

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 2012.⁸ The sources of the firm-level data are the Official Data on German Utilities and the financial statements from public funds, institu-

⁴ See W. L. Megginson and J. M. Netter, "From State to Market: A Survey of Empirical Studies on Privatization," *Journal of Economic Literature* 39 (2) (2001): 321–389.

⁵ J. E. Kwoka, "The comparative advantage of public ownership. Evidence from US electric utilities," *Canadian Journal of Economics* 38 (2) (2005): 622–640; H. Mühlenkamp, "Öffentliche Unternehmen aus der Sicht der Neuen Institutionenökonomik," *Zeitschrift für öffentliche und gemeinschaftliche Unternehmen* (2006): 390 ff.

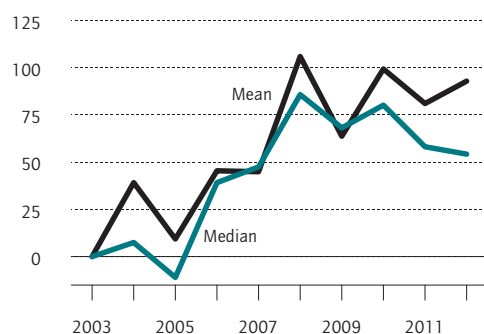
⁶ *Municipal infrastructure enterprises against the background of energy policy and demographic change (KOMIED)* is a three-year research project funded by the Leibniz Association (see www.diw.de/de/diw_01.c.467702.de/forschung_beratung/projekte/projekt_homepages/komied/komied.html).

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.

Figure 1

Efficiency growth rates over time (electricity retail) In percent



Source: Own calculations by DIW Berlin.

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Average efficiency increases over the years.

tions, and enterprises, both collected by the the statistical offices of the *Länder*.⁹

The company-specific efficiencies of the electricity retailers and the impact of ownership on differences in efficiency are estimated using a structural production function approach (see Box 1). In accordance with EU Directive 2000/52/EC, companies are considered to be public if public authorities (municipalities) hold more than 50 percent of voting rights or nominal capital.¹⁰

... efficiency increases observed over time for all electricity retailers

Figure 1 shows the development of efficiency over time and the average growth (mean and median) using 2003 as the reference year. The average growth rate of all electricity retailers primarily increases in the years from 2003 to 2008 and remains relatively stable from 2008 onward. A look at the growth rates by ownership of the electricity retailers shows more volatility but no fundamental differences between public and private enterprises over the course of time.

⁹ For a more detailed description of the data, see C. Stiel, "Official Data on German Utilities (Energistatistiken der amtlichen Statistik) 2003-2012," *DIW Data Documentation Series* 80 (2015).

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.

Table 1

Testing mean equality of efficiency scores between public and private firms (electricity retail)

Mean public firms	Mean private firms	Mean all firms
0.59	0.548	0.576
Hypothesis test p-value		
0.332		

Source: Calculations by DIW Berlin.

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No significant difference between mean efficiency scores of public and private electricity retailers.

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—combined with the European unbundling requirements (Directive 2003/54/EC),¹¹ 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).¹²

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-

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."

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.¹ 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

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.

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.² Therefore, the focus in the following sections is on time-varying inefficiency.

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.

gression was used to test whether efficiency differences might not be due to the difference between public and private enterprises *per se* but instead be linked to their legal form. In the energy sector, the most common form for both public and private enterprises is a limited liability company (*GmbH*). The regression showed no statistically significant difference between the two groups. No difference between public and private GmbHs was found in terms of their efficiency.

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,¹³ 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't¹⁴ 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.¹⁵ 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.

Table 2

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

	mean	median	25% quantile	75% quantile
2008	0.869	0.874	0.862	0.890
2009	0.887	0.891	0.883	0.901
2010	0.863	0.864	0.852	0.876
2011	0.846	0.852	0.836	0.862
2012	0.866	0.879	0.860	0.893

Source: Calculations by DIW Berlin.

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

ciency of 0.867 (87 percent). This means that, on average, approximately 13 percent of the input could be saved if all enterprises measured their performance against the most efficient (benchmarks) in the sector.¹⁶

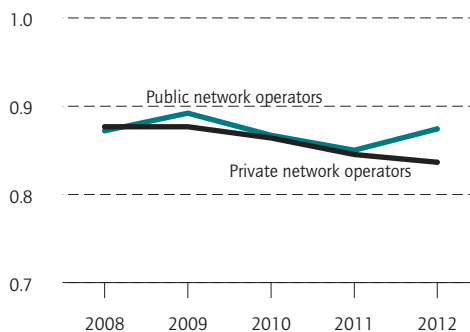
Between 2008 and 2012, taking the average (mean value and median) across all network operators, there were virtually no changes in efficiency. The range of estimates (i.e. the differences between the minimum and maximum efficiency values), however, indicates considerable differences in efficiency between the network operators.

If we look at efficiency values over time subdivided by ownership (see Figure 2), it becomes apparent that the differences cannot be attributed to the ownership structure. Except for the year 2012, efficiency values for public and private firms do not differ notably.

Table 3 shows the descriptive statistics on efficiency values subdivided by ownership structure. The findings of a formal test to ascertain whether or not the distributions are equal (Mann-Whitney-Wilcoxon test) lead us to conclude that public and private network operators are subject to the same distribution and so also have the same mean values. Consequently, public network operators do not show lower efficiency values than private ones.

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.

Figure 2

**Yearly average efficiency values
of network operators by ownership structure**


Source: Own calculations by DIW Berlin.

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Efficiency values of public and private electricity distributors show the same trend over time.

Table 3

**Descriptive statistics of efficiency values
of network operators by ownership structure**

	mean	median	25% quantile	75% quantile
Private distributors				
2008	0.877	0.889	0.868	0.921
2009	0.877	0.889	0.868	0.919
2010	0.864	0.868	0.852	0.899
2011	0.845	0.856	0.823	0.871
2012	0.836	0.873	0.811	0.911
2008-2012	0.860			
Public distributors				
2008	0.872	0.877	0.865	0.892
2009	0.892	0.895	0.887	0.903
2010	0.867	0.867	0.856	0.878
2011	0.850	0.855	0.842	0.865
2012	0.874	0.882	0.866	0.896
2008-2012	0.870			

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.

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

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 gen-

erally 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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