

PRIVATE SHAREHOLDERS AND EFFICIENCY OF GERMAN MUNICIPAL UTILITIES

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Abstract

The aim of this paper is to investigate whether and to what extent ownership structure affects cost efficiency in a sample of mainly state-owned but partially privately controlled municipal utilities in Germany. Using an empirical approach which permits the joint measurement of efficiency and assessment of the effect of ownership structure we find significantly, sizeable and robustly larger efficiency of utilities when private control is present. The findings show that the mere presence of private shareholders is suitable to improve efficiency, irrespective of the number of the shareholders.

Keywords: Efficiency Measurement, Municipal Utilities, Private Control

JEL Classification: C14, H11, H82

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1. INTRODUCTION

The relationship between ownership structures of German public utilities and various political target variables is addressed by a number of recent empirical studies. Holstenkamp and Kahla (2016) and Bauwens (2016), e.g., focus on community energy companies as entities which can help to facilitate the acceptance of investments in renewable energy provision. Closely related is a second more indirect transformation towards community ownership of energy resources. Recent work by Wagner and Berlo (2015) documents an ongoing trend to remunicipalization of energy networks and supply in Germany where 72 municipal utilities were founded since 2005. Overall, there are currently about 950 municipal utilities (so-called Stadtwerke) in Germany, which assume an important role in supplying the population with water, energy and public transport. In the current transformation process towards a system based on renewable energy forms these utilities are key actors and the importance of decentralized local players is expected to increase substantially. While Feiock et al. (2012) emphasise the advantages of the Stadtwerke in involving citizens in energy-efficiency practices, the efficiency level of these companies in providing their services remains neglected and unaddressed.

In his survey on the determinants of productivity levels, Syverson (2011) outlines the importance of managerial practices to explain differences in firm productivity. In this regard it is asserted that ownership structure generally influences management behavior and firm performance consistently (Shleifer, 1998; Dewenter and Malatesta, 2001). However, there is little empirical evidence on how ownership structure and corporate governance contributes to productivity and efficiency. This lack of evidence is also given for the transformation of privately held local utilities into public entities known as remunicipalization. Consequently, Wagner and Berlo (2015) interpret the

current trend as a promising approach for which the long-term economic benefits need further research.

In order to better understand how ownership structure is overall related to efficiency and productivity we analyze a broad sample of German municipal utilities with public and partially private ownership. The core activities of these companies are the generation and distribution of electric power, heat and water to households and firms in their local distribution area in addition to waste management and the provision of public transport.

The number of studies on the relationship between performance and ownership is vast and the fundamental pattern of results is rather stable. As a general finding, performance is better when a larger stake is held by private shareholders. The evidence on the relation between ownership structure and efficiency is less clear and has only recently been addressed for economies with post-communist ownership models. For example, Su and He (2012) show for a cross-industry sample of exchange-listed Chinese manufacturing firms that firm efficiency is negatively related to state ownership while it is positively related to public and employee share ownership. In a paper with a similar focus as our research, Fabricio et al. (2007) provide evidence that in contrast to plants owned by private shareholders publicly-owned plants in the US electricity generating sector hardly improved their efficiency during 1981-1999.

In a more differentiated consideration, Kwoka (2005) argues that both public and private firms have comparative advantages with respect to different aspects of the bundle of services within the US electric power industry. Von Hirschhausen et al. (2006) analyze a sample similar to ours for Germany and argue that in the electricity sector efficiency considerations have played a particularly important role during liberalization processes in electricity transmission and electricity distribution. As liberalization and remunicipalization are accompanied by changes in ownership structure it is notable that von Hirschhausen et al. do not control for this factor. Also the other studies cited above

account for ownership primarily as a binary variable, which either indicates public or private ownership. However, the German electricity sector is characterized by public and mixed ownership structures with private shareholders holding minority shares. This particular environment allows us to examine whether even small privately-owned shares in otherwise publicly managed companies suffice to improve efficiency and support a system of only partial remunicipalization.

In this paper we provide evidence of the influence of private shareholders on the efficiency of German municipal utilities using an empirical approach which is designed to measure efficiency jointly with assessing the effect of explanatory variables. We proceed to present our data and variables together with explaining the estimation method in section 2, discuss the results in section 3 and conclude in section 4.

2. DATA AND METHOD

Our sample is drawn from the Dafne database provided by Bureau van Dijk Electronic Publishing and covers the period 2003-2010. Out of the total population of German municipal utilities we arrive at 435 observations with complete data for the productivity analysis which reduces to 354 observations when further control variables are considered.

We use the total sales of these municipal utilities as the output variable for the efficiency measurement. The three inputs capital, labor and materials are represented by total fixed assets, total personnel expenditures and raw materials expenditures, respectively. Covariates used for explaining the efficiency measures are (a) indicators relating to the shareholder structure (the number of shareholders and a dummy variable to explain the participation of private shareholders), (b) the financial structure and performance (total assets, equity ratio, working capital per total output, EBITDA per total output, reinvestment rate, depreciation rate) and (c) regional variables matched via district codes (population growth, employment rate, industrial penetration, population density, a dummy variable for eastern German firms).

We use the means of the input and output variables over the second half of the sample period (2007-2010) for the efficiency analysis while the explanatory variables used in the regressions are computed as means over the first half of the sample period (2003-2006) in order to reduce endogeneity problems. Taking the averages of the inputs and outputs serves to reduce data errors.

We follow an empirical approach where efficiency is measured by data envelopment analysis (Charnes et al., 1978; Banker et al., 1984) and subsequently related to certain explanatory variables by means of regression on the second stage. Data envelopment analysis is a nonparametric approach for efficiency measurement which allows to determine the distance of input-output combinations of the municipal utilities to an endogenously determined piece-wise linear frontier function. The input-oriented version of this method under variable returns to scale amounts to solve the following linear programming problem for each observation $i \in \{1, \dots, n\}$

$$\min_{\theta, \lambda} \left\{ \theta : \theta \mathbf{x}_i \geq \sum_{j=1}^n \lambda_j \mathbf{x}_j, \mathbf{y}_i \leq \sum_{j=1}^n \lambda_j \mathbf{y}_j, \sum_{j=1}^n \lambda_j = 1, \lambda = (\lambda_1, \dots, \lambda_n)' \geq \mathbf{0} \right\} \quad (1)$$

With \mathbf{x}_i denoting the vector of the three inputs, \mathbf{y}_i the scalar output variable and λ a vector of weight factors. The efficiency measure obtained as the solution is denoted as $\hat{\theta}(x_i, y_i)$, and is bounded in the interval $[0, 1]$. This method requires no specification of the functional form of a production or a cost function and also requires no price information which is particularly beneficial in the public sector where prices are not determined on markets.

Simar and Wilson (2007) identify several deficiencies of the two-stage approach. They claim that the inputs and outputs used in the efficiency analysis are determined jointly with the explanatory variables for the second-stage regression by a unified data generating process and thus should be analyzed simultaneously. Ignoring this relatedness lets the regression residuals be serially correlated of unknown structure. In addition, the efficiency measures tend to be biased estimates of the true efficiencies as already noticed by Simar and Wilson (1998) and an improvement in estimation efficiency can be realized using bias-corrected efficiency measures.

Our principal aim is to estimate the parameters in β of the regression equation:

$$\hat{\theta}(\mathbf{x}_i, y_i) = \beta' \mathbf{z}_i + u_i \quad (2)$$

where the explanatory variables are collected in the vector \mathbf{z}_i and the error term is denoted by u_i .

The empirical approach suggested by Simar and Wilson (2007) is a sequential double bootstrap procedure which takes account of all these problems and leads to improved inference in the second-stage regression.²⁶ This algorithm consists of a bootstrap of the first-stage efficiency measurement to gain bias-corrected efficiency estimates followed by a further bootstrap of a truncated regression model to generate valid confidence intervals for the regression parameters. For our application we execute 1000 replications for the bias correction and 10000 replications for the regression inference because the estimation of confidence intervals requires more replications.

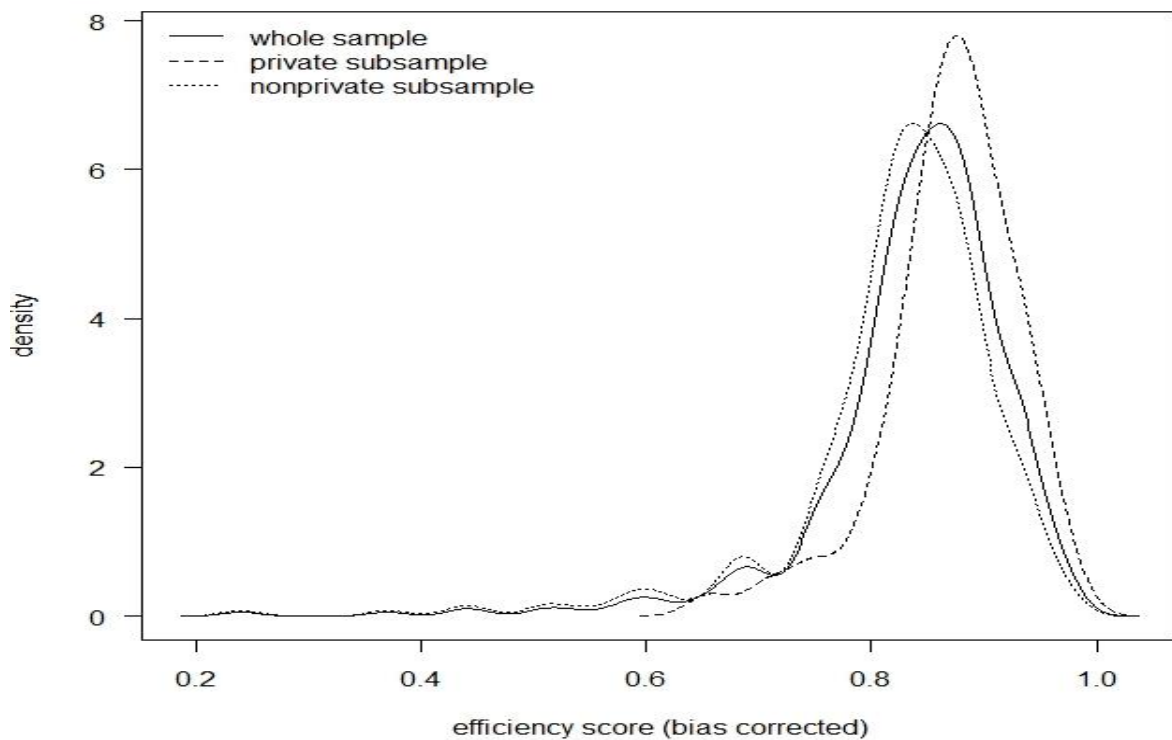
All computations are implemented in R using the packages "FEAR" (see Wilson (2008) for the documentation) and "truncreg" for computing the efficiency measures and the truncated regressions, respectively.

3. RESULTS AND DISCUSSION

For data description Figure 1 depicts nonparametric kernel density estimates of the bias-corrected efficiency measures for the entire sample of municipal utilities.

²⁶ Actually, we refer to their Algorithm #2 which we apply in this paper. See Simar and Wilson (2007, pp. 42f.) for a detailed step-by-step exposition of the algorithm. The algorithm is stated for the output-oriented case in that paper but can be straightforwardly adapted for the current input-oriented application. We use studentized bootstrap confidence intervals which provide an asymptotic refinement (see Davison and Hinkley (1997, p. 212)).

Figure 1. Density Plots of the Efficiency Measures



Bandwidth parameters are selected by the procedure suggested by Sheather and Jones (1991). Differences of the three densities for the whole sample ($n = 435$) and the subsamples with ($n = 142$) and without ($n = 293$) private shareholders are visible and also confirmed by a Wilcoxon rank sum test²⁷. We clearly observe the density of the private subsample is positioned to the right of the density of the nonprivate subsample implying overall higher efficiency when private influence is present.

The regression results obtained with the Simar-Wilson procedure are summarized in Table 1. Shown are coefficient estimates, t -statistics and 95% studentized confidence intervals of the coefficients. Significance on the 5 percent level is indicated by an asterisk.

Panel A of the Table 1 reports the results with only the governance-related variables, i.e. the number of shareholders and a dummy variable for a strictly positive share of privates. The results show that private minority influence is associated with a 5.2 percentage point higher efficiency on average. The number of shareholders as an explanatory variable has no significant effect on efficiency and the coefficient estimate is positive but rather small.²⁸ As measured by a likelihood-ratio index LRI , the explanatory power of this specification is quite low which points to the possibility of omitted variables.

Therefore, we also estimate an extended specification with a larger set of further control variables added. The results are shown in Panel B of

the table. Concerning the controls, we find a significantly positive influence of size measured by the log of total assets revealing that larger municipal utilities are on average more efficient even when we measure efficiency under variable returns to scale. The significantly negative influence of the working-capital-to-performance ratio can be interpreted as an indicator of management quality. Managers able to keep the stock of current assets small are not only more efficient in procurement, receivables management and storage planning but also show overall superior results.

We also observe that the impact of the depreciation rate is significantly positive, whereas the investment rate is not significant. The depreciation rate is defined as depreciation divided by total assets employed. This depreciation rate is high if either depreciation is large or the current value of assets employed is small (or both). A large amount of depreciation may be taken as a sign of a capital stock composed of rather new and technologically advanced vintages of capital goods which, however, is not transformed into more efficient production. The efficiency gains by new technologies may be overcompensated by high levels of capital consumption expressed by depreciation. Recent investment, however, delivers no significant contribution to efficiency in the presence of the depreciation variable. This pattern of results continues to hold when either the depreciation rate or the investment rate are exclusively included as explanatory variables.

Regarding the regional variables, population growth could be taken as significant at a level slightly above 5 percent. Thus, municipal utilities in regions with faster population growth tend to be more efficient. Likewise reasoning could be applied to the manufacturing share.

27 This result is confirmed by a further test of Li (1996) for the differences of the densities of the efficiency measures which is valid for both dependent and independent samples.

28 Using the share held by private owners as a quantitative variable instead of the dummy variable does not lead to a significant finding. This implies that the size of private ownership is less important compared to the simple presence of private shareholders.

Table 1. Regression Estimates with the Simar-Wilson Procedure

	coefficient	t-statistic	confidence interval	
A: Regression with core variables without further conditioning variables				
Intercept	0.823	(78.193)	[0.802, 0.843]	*
no. of shareholders	0.008	(1.041)	[-0.007, 0.021]	
dummy share private > 0	0.052	(3.517)	[0.021, 0.080]	*
Σ	0.095	(21.217)	[0.085, 0.102]	*
In L	480.728			
LRI	0.022			
N	435			
B: Regression with core variables together with further conditioning variables				
intercept	0.289	(5.183)	[0.181, 0.404]	*
no. of shareholders	-0.010	(-1.617)	[-0.022, 0.002]	
dummy share private > 0	0.060	(4.949)	[0.035, 0.083]	*
ln total assets	0.041	(8.862)	[0.032, 0.050]	*
equity-to-assets ratio	0.004	(0.112)	[-0.060, 0.067]	
working capital / performance	-0.159	(-7.481)	[0.202, -0.115]	*
EBITDA / performance	0.003	(0.077)	[-0.079, 0.085]	
investment rate	0.031	(0.847)	[0.045, 0.103]	
depreciation rate	1.571	(9.754)	[1.229, 1.880]	*
population growth	1.889	(1.916)	[-0.082, 3.864]	
employment rate	-0.090	(-2.314)	[-0.167, -0.011]	*
manufacturing share	0.100	(1.809)	[-0.011, 0.210]	
population per square kilometer	0.019	(1.596)	[-0.006, 0.042]	
dummy for East Germany	0.021	(1.502)	[-0.007, 0.049]	
σ	0.068	(22.189)	[0.060, 0.072]	*
In L	499.596			
LRI	0.290			
n	354			

Note: Dependent variable is the bias-corrected DEA efficiency measure as described above. Shown in parentheses are t-statistics of the second stage regression, whereas 95 % studentized bootstrap confidence limits for the coefficient estimates are in square brackets. An asterisk indicates significance on a 5 % level

Furthermore, municipal utilities in regions with a higher unemployment rate tend to be more efficient. One reason underlying this finding may be that there is more demand for peak-load capacity in regions with higher employment which is usually produced less efficiently.

Concerning again the governance-related variables, the effect of private influence remains significant even when the other variables are controlled for and appears even stronger with a coefficient estimate increasing to 0.06. The effect of the number of shareholders turns negative but remains not significant at conventional levels. Altogether, the explanatory power of these conditioning variables also leads to a substantial improvement of the LRI.

4. CONCLUSIONS AND POLICY IMPLICATIONS

Our results show that municipal utilities in Germany are rather heterogeneous with respect to their degree of efficiency in production. These differences in efficiency indicate substantial potential for improvement to the benefit of customers, owners and the utilization of resources. If the choice of an efficient combination of input factors is currently not realized, municipal utilities could pursue different ways to improve their productivity.

A first approach for doing so can probably be achieved without changes in the governance structure of the public entities. Because of their regional focus the competition between municipal utilities is rather limited which should facilitate the exchange of information for benchmarking purposes. Thus, a simple forum for information exchange on production processes between municipal utilities of high and low efficiency to

identify the internal drivers of efficiency should be straightforward to organize. However, the sole collection of data on an anonymous level by a data service center which then provides average business ratios is not sufficient. Our results clearly show that there are a number of external factors influencing the efficiency of municipal utilities. To benchmark a given municipal utility in our dataset fairly, managers can use our results to identify the appropriate peer group and to conduct a proper comparison within this group.

If the owners of a municipal utility are willing to scrutinize their governance structure, an even more attractive way to improve efficiency is implied by our results. It appears that ownership structure matters for the efficiency of the production of services by German municipal utilities. According to our results, the presence of a privately held stake in a municipal utility is related to a higher degree of technical efficiency regardless of the size of this stake. Thus, even small minority stakes appear to be as important for improving efficiency as is a majority ownership by private shareholders. Completely publicly owned utilities and their decision makers may rethink their ownership strategy in the light of this finding. While remunicipalization is typically initiated to create a full public ownership, our results offer a new argument to keep some minority stakes in these newly founded entities. Private shareholders can provide new ideas for public managers to restructure their business models and production processes. This generates improvements in efficiency which then can partly be used to compensate these private shareholders.

As a roadmap for future research it seems to be promising to exploit the additional information

about the efficient peers from the efficiency analysis to cluster the utilities into different groups. This additional information can also be a starting point for a more detailed investigation of single utilities in the form of case studies.

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