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This is the authors' final, accepted and refereed manuscript to the article published in
***Applied Economics*, 44(2012)2: 201-218**

DOI: http://dx.doi.org/10.1080/00036846.2010.502110

Value for Money? German Local Government Efficiency in a Comparative Perspective

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February 2010

Abstract

In this paper, we investigate the cost efficiency of German local governments in the state of Baden-Württemberg in 2004 using a stochastic frontier approach. Besides being the first study on German data, we add two elements to the literature. First, we provide a comparative perspective, allowing us to embed our results in the broader literature. Second, unlike most previous studies, we explicitly account for exogenous or non-discretionary influences when estimating municipal efficiency scores. The results suggest that disregarding such exogenous factors can lead to significant and systematic bias in the estimated inefficiency levels. Particularly, underestimation of efficiency occurs for municipalities with high tourist activity, while the reverse is true for municipalities with high unemployment.

Keywords: Technical Efficiency; Stochastic Frontier Analysis; German Municipalities

JEL-codes: H11, H40, R51

Acknowledgements: Support by the German Research Foundation (DFG) within its Priority Programme 1142 “Institutionale Gestaltung föderaler Systeme” is gratefully acknowledged.

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1. Introduction

While voters appreciate the provision of public goods, they often are much more reluctant to finance these goods when their tax bill arrives. The literature on vote and popularity functions, for example, clearly illustrates that taxation has a significant political cost for incumbents in the sense that it reduces their popularity or re-election odds (e.g., Niskanen, 1975; Peltzman, 1992; Vermeir and Heyndels, 2006; Geys and Vermeir, 2008a, b; Geys, 2010). This desire for public goods but reluctance to pay for them suggests that an efficient provision of public goods and services – understood in terms of a maximum amount of public good provision at given (fiscal) costs (or '*value for money*') – is likely to win voters' hearts.[1] As a result, government efficiency may be an important strategic tool for governments wishing to attract mobile factors of production.[2] Moreover, arguments in favour of fiscal decentralisation often implicitly depend on the efficiency of local governments' public good provision. Indeed, the economic benefits from a further decentralisation of tasks are likely to be negligible when tasks are shifted to inefficient local governments (see also Geys and Moesen, 2009a).

Despite this wide-ranging interest in efficient governments, studies measuring the efficiency of the public sector have thus far mainly focused on efficiency in particular areas of public good provision such as waste collection, police services, road maintenance, public libraries and so on (for reviews, see De Borger and Kerstens, 2000, and Worthington and Dollery, 2000). Still, exceptions exist in which researchers regard the overall performance of local-level (surveyed below) or higher-level governments (e.g., Afonso et al., 2005, 2010). Such 'composite' approaches do not restrict their attention to one specific public good, but rather allow for a more general view on government performance. Although they are more difficult to implement than single policy analyses, they have the explicit benefit of allowing an assessment of how effectively a government is performing its multitude of tasks (rather than one specific task).

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1 Obviously, voters might also care about government effectiveness, equity, responsiveness, adequateness, appropriateness, and so on (Dunn, 2004, 223-231). In this paper, however, we concentrate on one single aspect of government provision: namely, its efficiency.

2 The existence of geographic patterns in government efficiency in Belgium and Norway suggests that such competition is indeed at play (see Geys, 2006; Revelli and Tovmo, 2007). Moreover, the strategic importance of government efficiency is often implicitly acknowledged in theoretical models of tax and yardstick competition. The reason is that such models generally normalise the provision of public goods to one (cf. Besley and Case, 1995; Revelli, 2002; Geys and Vermeir, 2008c), which implies that "lower cost of provision can be interpreted as higher government efficiency" (Geys and Vermeir, 2008c, 472).

The present study adds to the literature assessing overall government performance in three ways.

- First, we focus on local governments in Germany (using a cross-section of 1015 German municipalities in the state of Baden-Württemberg for the year 2004). This setting has two main advantages: (1) the institutional setting is the same for all municipalities such that our analysis is unaffected by the institutional design of local governments, and (2) labour and capital costs are largely identical across the municipalities of one state such that factor price divergence – apart from property prices (for which we include a control variable) – is not an issue (which is important since the efficiency analysis is based on a cost function approach). Specifically, interest rate homogeneity is given by the fact that a) all municipalities have access to the same capital market and b) the federal government guarantees the absence of differences in risk premiums for all German jurisdictions. Wage homogeneity is guaranteed via uniform collective labour agreements.[3]
- Second, unlike previous studies, we provide an explicitly comparative perspective in the sense that we embed our results in the broader literature. While the efficiency levels estimated depend on the sample employed (and thus are not comparable across countries), important insights can nonetheless be gained from comparing the distribution of efficiency across various countries.
- Finally, we estimate municipal efficiency while explicitly accounting for exogenous or non-discretionary influences in the municipalities using the 'one-step procedure' proposed by Battese and Coelli (1995). This not only provides a more appropriate measure of local government efficiency, it also yields insights into the socio-economic and political influences on local government efficiency (in Germany).[4]

The results of our analysis show that, on average, German municipalities produce their output with costs approximately 21% to 24% above the efficient frontier. Controlling for background variables, this reduces to approximately 13% to 16%. This reduction in the average level of

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[3] A new collective wage agreement for public service at the municipal level (Tarifvertrag für den öffentlichen Dienst der Kommunen) became effective in 2005. This agreement allows for performance-oriented wages and thus undermines wage homogeneity, which is the reason our most recent data concern the year 2004.

[4] With the exception of Tanaka (2006), Geys and Moesen (2009b), Geys *et al*. (2010), Kalb (2010) previous studies of global local government efficiency use a two-step approach to explore how socio-economic and political influences affect efficiency (e.g., De Borger *et al*., 1994; Borge *et al*., 2008). They first estimate efficiency, and then asses how this result is affected by various socio-economic and political variables. This, however, has two downsides. First, it does not correct the efficiency estimates for the influence of these external forces. Second, recovering significant effects for the background variables in the second stage violates the assumption that the error term in the first stage is independent and identically distributed – leading to biased estimation results (see Kumbhakar *et al*., 1991; Reifschneider and Stevenson, 1991).

observed inefficiency by about one third indicates the importance of correcting the estimated efficiency levels for exogenous or non-discretionary influences. Although comparing these findings with results from other countries is complicated by various heterogeneity issues (e.g. different time periods, analytical tools, methodologies and input/output measures employed throughout the literature; see also below), the average German municipality appears to lag somewhat further behind the best-performing German municipalities than the average Australian, American, Belgian, Greek or Japanese municipality lags behind the ‘best practice’ in their respective countries. The reverse holds in comparison to Norway, Spain and Portugal. Note, importantly, that since efficiency is estimated based on the decision-making units within a given dataset and does not constitute an absolute indicator, one cannot interpret our findings as stating that German municipalities are less efficient than, say, Australian ones, but more efficient than, say, Japanese ones. It may indeed well be that the most efficient Australian (Japanese) municipalities are much less (more) efficient than the most efficient German ones, but this is impossible to evaluate using the employed methodologies (this will become clearer when we discuss the methodology in more detail in section 3.2). Hence, one can only make comparative statements regarding the *distance* between the most efficient municipalities in a given country (which are determined within the country-specific sample) and non-efficient municipalities. Finally, with respect to the effect of the exogenous municipality characteristics, we find that costs increase (and efficiency this is underestimated) with population density and touristic attraction, while the reverse is true for municipalities with high unemployment.

The remainder of the paper is structured as follows. Section 2 gives an extensive overview of the existing empirical literature on ‘composite’ local governments’ technical or cost efficiency. Section 3 describes the empirical analysis including the methodological approach used and an introduction to the institutional setting of the local governments in German state of Baden-Württemberg. Finally, conclusions are drawn in section 4.

2. Literature review

As mentioned in the introduction, studies on the (in)efficiency of the public sector tend to concentrate on one particular area of public goods provision: say, waste collection, administration, road maintenance, public libraries, and so on (see De Borger and Kerstens, 2000; Worthington and Dollery, 2000; Hammond, 2002; Kalb, 2009). While interesting in their own right, such sector-specific studies do not allow determining overall local government efficiency. In effect, concentrating on "one particular element of service provision may be inadequate (or even misleading)" (Ashworth *et al*., 2006, 12) when the intention is to evaluate public sector performance more generally. The reason, obviously, is that local governments may specialize in certain areas of service provision (e.g., due to a particular socio-economic composition of the population), and score much better in this particular field than on various other segments of their public good provision. To evaluate overall local government efficiency, various aspects of local government service provision should be included in the analysis. Interestingly, such 'composite' approaches to local government efficiency have attracted only limited attention in the past and existing analyses are restricted to a rather small sample of countries. Table 1 provides an extensive review of this literature.

Looking first at Australia, Worthington (2000) investigates the cost efficiency of 177 local governments using both Data Envelopment Analysis (DEA) and a stochastic frontier approach (SFA).[5] It is shown that the mean efficiency score of the Australian municipalities is about 0.70 when using the DEA approach, indicating that the average Australian municipality could become (overall technically) efficient by reducing inputs (or costs) to approximately 70% of their current level. The SFA-scores suggest an average efficiency score of circa 0.87. Roughly similar findings are presented for Greece by Athanassopoulus and Triantis (1998), although the average efficiency levels are slightly lower for the Greek municipalities. In fact, the mean efficiency scores range from 0.60 when using DEA and 0.85 when using SFA. A similar difference in efficiency depending on the estimation method is also found in the high number of studies on Belgium. In this case, methods employed include COLS (i.e. 'Corrected Ordinary Least Squares'), FDH (Free Disposal Hull), DEA and SFA and the mean efficiency scores range from 0.50 to 0.97 depending on the method used. In this case, the SFA-scores suggest an average efficiency of circa 0.86.

Both existing studies of Brazilian municipalities (Sampaio de Sousa and Ramos, 1999; Sampaio de Sousa and Stosic, 2005) employ DEA and FDH methods. Although the two Brazilian datasets are ten years apart (i.e. 1991 and 2001 respectively), the conclusions are very similar. In both cases, smaller cities in Brazil tend to be less efficient than larger ones, while average efficiency tends to be relatively high low. Interestingly, Sampaio de Sousa and Stosic (2005) apply a "Jackstrap" approach in some calculations (i.e. a combination of

[5] These methods are discussed in more detail in section 3.2.

bootstrap and jackknife resampling methods) to reduce the effect of outliers and possible errors in the sample. This has an important upward effect on estimated efficiency levels.

Investigations on the technical or cost efficiency of the local governments of Finland, Korea and Portugal rely exclusively on DEA methods. The results show that the mean efficiency scores are very high in Finland (0.86 to 0.90 depending on the specification) and quite low in Portugal (0.23 to 0.73 depending on specification and sample). The Korean results vary drastically depending on the number of outputs included (although this is not very surprising given that DEA is quite sensitive to the number of inputs and outputs employed). In contrast, the only Japanese study, Tanaka (2006), employs only SFA and reports an average efficiency score of around 0.89. Importantly, to the best of our knowledge, this is the first study to directly control for the exogenous environment when estimating local government efficiency (Geys and Moesen, 2009b, Geys et al., 2010 and Kalb, 2010 recently followed this example). We will return to this below.

Four studies regard municipal efficiency in Spain: Gimenez and Prior (2007), Balaguer-Coll *et al*. (2007), Balaguer-Coll and Prior (2009), and Benito *at al.* (2010). The authors of all four studies use non-parametric (mainly DEA) estimation methods to investigate the technical efficiency of the Spanish municipalities. The results of these studies suggest efficiency ratings averaging to approximately 0.32 and 0.90 depending on the area under investigation (police, culture, etc.) and the specification used. Likewise, there are two studies on the US. Grosskopf and Hayes (1993) estimate Shepard-type distance functions for 154 municipalities in Illinois for the years 1982 to 1986, and show that inputs could be reduced by approximately 10% (given output levels). Grossman *et al*. (1999) examine 49 U.S. central cities using an SFA approach. Levels of technical efficiency in this sample vary between 0.45 and 0.97. Finally, one study analyses 362 to 384 Norwegian municipalities over the 2001-2005 period (Borge *et al*., 2008). Defining efficiency by relating total government revenues to a constructed measure of output, this inquiry illustrates that average output is approximately 35% below the most efficient level in the sample.

Table 1: Studies on local governments' cost or technical efficiency (composite approaches)

Author(s)	Method	Sample	Inputs (I) and Outputs (O)	Main findings
Australia				
Worthington (2000)	DEA, SFA	177 New South Wales local governments in 1993	I: Number of full-time equivalent employees, other physical expenses, financial expenses; input prices: Average municipal salary, physical expenditures divided by current assets, average interest rate paid on borrowed funds O: Population, properties receiving domestic waste management services, sewerage services and water services, length of urban and rural roads	Mean efficiency scores range from 0.70 (DEA) to 0.87 (SFA)
Belgium				
De Borger and Kerstens (1996a)	DEA, FDH, COLS, SFA	589 Belgian local governments in 1985	I: Total expenditures O: Number of beneficiaries of minimal subsistence grants and students enlisted in local primary schools, surface of public recreation facilities, total population, fraction of population older than 65	Mean efficiency scores range from 0.57 (COLS) to 0.94 (FDH)
De Borger and Kerstens (1996b)	FDH	589 Belgian local governments in 1985	I: Total expenditures O: Surface of municipal roads + outputs of De Borger and Kerstens (1996a)	Mean efficiency scores between 0.81 to 0.97 depending on specification
De Borger et al. (1994)	FDH	589 Belgian local governments in 1985	I: Number of white-collar and blue-collar municipal employees, capital stock O: Municipal road surface, Number of subsistence grants and students in local primary schools, surface of public recreation facilities, ratio of non-residents to residents in municipality	Mean efficiency scores range from 0.86 to 0.95 depending on specification
Geys (2006)	SFA	304 Flemish local governments in 2000	I: Total current expenditures O: Number of subsistence grants and students in local primary schools, surface of public recreational facilities, total length of municipal roads, share of municipal waste collected	Output can on average be increased 14% compared to most efficient
Geys and Moesen (2009a)	DEA, FDH, SFA	304 Flemish local governments in 2000	I: Total current expenditures O: Number of subsistence grants and students in local primary schools, surface of public recreational facilities, total length of municipal roads, share of municipal waste collected	Mean efficiency scores range from 0.50 (DEA) to 0.95 (FDH) and 0.86 (SFA)
Geys and Moesen (2009b)	SFA	304 Flemish local governments in 2000	I: Total current expenditures O: Number of subsistence grants and students in local primary schools, surface of public recreational facilities, total length of municipal roads, share of municipal waste collected	Mean efficiency score equals 0.86 (*before* accounting for exogenous controls)
Vanden Eeckaut et al. (1993)	DEA, FDH	235 Walloon municipalities in 1986	I: Total expenditures O: Length of municipal roads, Number of subsistence grants and students in local primary schools, total population, number of persons aged 65 and more, number of crimes registered	80% (20%) of the municipalities are efficient under FDH (DEA)
Brazil				
Sampaio de Sousa and Ramos (1999)	DEA, FDH	3756 Brazilian municipalities in 1991	I: Current spending O: Total resident population, domiciles with access to safe water, domiciles served by garbage collection, illiterate population, enrolment in primary and secondary municipal schools	Smaller municipalities are less efficient in the provision of public goods and services than bigger municipalities
Sampaio de Sousa and Stosic (2005)	DEA with "jackstrap", FDH	4796 Brazilian municipalities in 2001	I: Current spending, number of teachers, rate on infant mortality, hospital and health services O: Total and literate population, enrolment per school, student attendance per school, students who get promoted to the next grade per school, students in right grade per school, households with access to safe water, sewage system and garbage collection	Mean efficiency scores range from 0.52 (DEA) to 0.92 (FDH)
Finland				
Loikkanen and Susiluoto (2005)	DEA	353 Finish municipalities from 1994-2002	I: Sum of the net operating costs of providing health and social services, culture and education (evaluated at 1995 prices) O: Children's day care centres, children's family day care, open basic health care, dental care, bed wards in basic health care, institutional care of the elderly and handicapped, comprehensive schools, senior secondary schools, municipal libraries	Averages of the annual median efficiency scores range from 0.86 to 0.90 depending on the specification used
Greece				
Athanassopoulus and Triantis (1998)	DEA, SFA	172 Greek municipalities in 1986	I: Operating costs (expenditures on services, salaries, maintenance and material) O: Actual households, average house area, heavy industrial use area, tourist areas	Mean efficiency scores range from 0.60 (DEA) to 0.85 (SFA)
Japan				

Tanaka (2006)	SFA	317 Japanese municipalities in Kinki Area in 2001	I: Sum of labour, capital and non-personnel costs O: social assistance spending per household, children per nursery school, teacher-student ratio, length of road per area, municipal waste per capita, building fire per capita, population, area, share of <15, share of >65, labour input price	Inputs could be reduced by about 12% on average (*after* accounting for exogenous controls)
Korea				
Sung (2007)	DEA	222 Korean local governments from 1999-2001	I: Local servants per 100 persons, annual constant expenditures per capita O: Penetration rate of water supply, area of urban parks, ratio of road length to area, registered motor vehicles, sewage and refuse disposal, seating capacity of social welfare institutions, basic livelihood security recipients, building construction permits, civil affair and petition cases	Mean efficiency scores range from 0.57 to 0.99 depending on the specification used
Norway				
Borge *et al*., 2008	Ratio	362-384 Norwegian municipalities from 2001-2005	I: local government revenue O: constructed measure of aggregate output	Average output 35% below most efficient
Portugal				
Afonso and Fernandes (2006)	DEA	51 Portuguese municipalities in 2001	I: Total per-capita expenditures O: Calculation of a single municipal performance indicator from several municipal services	Mean efficiency scores range from 0.33 to 0.73 depending on the specification used
Afonso and Fernandes (2008)	DEA	278 Portuguese municipalities in 2001	I: Total per-capita expenditures O: Calculation of a single municipal performance indicator from several municipal services	Mean efficiency scores range from 0.23 to 0.65 depending on region and specification
Spain				
Gimenez and Prior (2007)	Non-convex frontier methods	258 Spanish local governments (located in Catalonia) in 1996	I: Material consumption and service acquisition, current transfers to decentralised organisations, total labour cost O: Urban area, total population, number of cars, number of buildings, ordinary refuse	The cost level of inefficient municipalities is on average 25% higher than the efficient level
Balaguer-Coll *et al*. (2007)	DEA, FDH	414 Spanish local governments (located in Valencia) in 1995	I: wages and salaries, spending on goods and services, current and capital transfers, capital expenditures O: Number of lighting points, population, waste collected, street surface area, public park area, quality	Mean efficiency scores range from 0.53 to 0.90 depending on the specification used.
Balaguer-Coll and Prior (2009)	DEA	258 Spanish local governments from 1992-1995	I: Total expenditures O: Number of lighting points, population, waste collected, street infrastructure surface area, surface area of public parks	Mean efficiency scores range from 0.62 to 0.76 depending on the specification used.
Benito *et al*. (2010)	DEA	31 Spanish local governments (located in the Region Murcia) in 2002	I: Costs of personnel, current consumptions, current transfers O: Different output indicators for the following areas of public good provision: police, culture, sports, green areas, refuse collection and water supply	Mean efficiency scores range from 0.32 to 0.84 depending on the area of public good provision.
United States				
Grosskopf and Hayes (1993)	Shepard-type distance function	154 municipalities in Illinois from 1982-1986	I: Weighted average salary for all uniformed employees (labour input), average yielded rates for the bond rating reported for the municipality (capital price) O: Ratio of population to crimes committed, median housing value in each municipality	Inputs could be reduced by more than 10% on average
Grossman et al. (1999)	SFA (production function)	49 U.S. central cities for the years 1967, 1973, 1977 and 1982	I: Total real market value of property tax base, classified property tax system, personal property in property base, total real municipal expenditures, total real expenditures on education, homes built in last decade, area, employment, African American population, median real income, intergovernmental real revenue, real non-property tax plus sales tax revenues, overlapping real state/county taxes, local real fee revenue, number of homes O: Aggregate market value of residential and business property	Technical efficiency varies between 0.45 and 0.97

Note: COLS = Corrected ordinary least squares, DEA = Data Envelopment Analysis, FDH = Free Disposable Hull, SFA = Stochastic frontier analysis

To sum up, the existing literature on the ‘composite’ technical or cost efficiency of local governments suggests that substantial inefficiencies exist in the provision of public goods and services by local governments. While this is a consistent finding, the difference in average municipal efficiency – i.e. the efficiency level of the average municipality as compared to the country- and sample-specific 'best practice' – varies significantly across countries. One shortcoming of most of this literature, however, is the failure to account for exogenous or non-discretionary variables which may affect the performance of the municipalities (for exceptions, see Takala, 2006; Geys and Moesen, 2009b, Geys et al., 2010 and Kalb, 2010). Nonetheless, as pointed out by Stevens (2005), the performance of local governments also "partly [depends] on the particular environment where the authority operates. … It is therefore useful to consider the inefficiency of an authority net of these [background] factors" (Stevens, 2005, 93). This implies that most previous studies are likely to have provided biased – and most likely inflated – estimates of local government efficiency. In the remainder of this study, we address the importance of incorporating the socio-economic (and political) environment in studies of local government efficiency in order to draw more accurate inferences. We do so using a sample of 1015 German municipalities.

3. Empirical analysis

3.1 German local institutional setting

The German state Baden-Württemberg lies in the southwest of Germany and, after two municipal mergers in 2006 and 2007, consists of 1109 municipalities ranging in size from approximately 100 inhabitants in the smallest municipality (Böllen) to almost 600,000 inhabitants in the largest one (Stuttgart). In each case, the local government is composed of two political institutions: (1) the local council which is elected every five years and constitutes the main decision-making body of the municipality, and (2) the mayor who is directly elected for an eight-year term. Both institutions have their own statutory responsibilities, which are the same across all municipalities.

Though the municipalities constitute the lowest level of government in Germany, they have considerable autonomy in raising revenue and assume significant responsibilities at the expenditure side. Table 2 shows the most important revenue and expenditure categories of the municipalities as a percentage of total revenues and total expenditures respectively (for the year 2004). This reveals that local governments have three main income sources: Tax revenue (43.62% of total revenue), grants (from the federal and state level, from municipal equalization schemes, and so on; 29.18%) and revenue from user charges (9.48%). Note that local governments can independently decide on five types of taxes: Trade tax

(Gewerbesteuer), property tax (Grundsteuer), tax on keeping dogs, second residence tax and entertainment tax (of which the last two types are not raised by all municipalities). As can be seen from the bottom-left part of table 2, the trade and property tax jointly constitute more than half of local governments' tax revenues (47.79% and 13.35%, respectively). Another substantial part of tax revenues originates from taxes which are divided among the federal government (Bund), the states (Länder) and the municipalities: i.e. 33.93% from the income tax and 4% from the value added tax.

Table 2: Structure of municipal revenues and expenditures in 2004 (in % of total revenues (1) and total expenditures (2))

Revenues	(1)	**Expenditures**	(2)
Grants	29.18	General financial management	34.55
User charges	9.48	Public facilities, business development	11.36
Borrowing	2.92	Architecture, housing, traffic	9.89
Other revenue sources[a]	14.80	Social security	11.49
Taxes	43.62	Commercial companies, real and separate estate	6.28
Composition of tax revenue (in % of total tax revenue):		General administration	7.85
- Trade tax	47.79	Schools	6.61
- Property tax	13.35	Health, sport, recovery	5.20
- Share of income tax	33.93	Science, research, culture	3.67
- Share of value added tax	4.00	Public safety	3.11
- Other taxes	0.93		

[a] Other revenue sources include income from interest, administrative revenue, concession levies, support for debt service, shares in profit and capital gains. Note that payments between municipalities and imputed costs are not included.
Source: Statistical Office of Baden-Württemberg and own calculations

The revenue obtained by local governments serves to finance three types of tasks: (1) Voluntary tasks (e.g., libraries, theatres, museum, public swimming pools and so on), (2) duties without instructions by higher-level governments as to how local governments should perform the tasks (e.g., construction of municipal roads, fire departments, waste disposal and so on), and (3) duties with instructions of higher-level governments (e.g., running of local police authorities).[6] The right-hand side of Table 2 provides a detailed overview of the expenditure shares of selected tasks (for the year 2004). This shows that expenditures on general financial management (e.g., interest and amortization repayments) account for roughly one third of total expenditures (34.55%). Social security (11.49%), public facilities and business development (11.36%), and architecture, housing and traffic (9.89%) each require roughly 10% of the overall budget. The remaining budget posts are of minor importance.

[6] In the latter case, the state imposes detailed regulations on how municipalities should carry out these tasks. For a more detailed classification and description of these tasks see Gern (2005).

3.2 German local government efficiency

3.2.1 Estimation approach

Determining the efficiency of a given number of decision-making units (here: local governments) first requires the selection of a set of input-output combinations that designate efficient behaviour (i.e. those combinations where the inputs are most productively used). Then, in a second step, one can designate deviations from this 'best practice frontier' as inefficiency. Both steps can be addressed in a number of different ways (for an introduction, see Lovell, 1993). Specifically, the best practice frontier can be generated either parametrically or non-parametrically. In non-parametric approaches such as DEA (Farrell, 1957) or FDH (De Prins et al., 1984), the frontier is created as a piecewise linear envelopment of the data. Parametric approaches, on the other hand, determine the best practice frontier on the basis of a specific functional form using econometric techniques. In evaluating deviations from this best practice frontier, one might interpret any deviation as inefficiency (a deterministic approach). This, however, is problematic since observed levels of inputs and outputs in real-world applications may be subject to measurement errors or stochastic influences. Moreover, decision-making units may differ in natural (e.g. geographical), socio-economic (e.g. extent of unemployment etc.) or institutional restrictions, which will further distort the picture. To the extent that such disturbances exist, one should attempt to differentiate between these 'errors' and inefficiency by using a stochastic approach.

We build on the stochastic, parametric approach of efficiency measurement developed by Aigner et al. (1977) and Meeusen and van den Broeck (1977). Employing a translogarithmic specification, a parametric frontier model can be written as (dropping subscripts for decision-making units for convenience):

$$\ln C = \alpha + \sum_{r=1}^{s} \beta_r \ln y_r + \tfrac{1}{2} \sum_{r=1}^{s} \sum_{q=1}^{s} \lambda_{rq} \ln y_r \ln y_q + \underbrace{v + u}_{=\varepsilon}, \qquad (1)$$

where *C* designates the input indicator (which may represent the money equivalent of multiple inputs), y indicates the output indicators, *s* points to the number of outputs incorporated in the model and β_r and λ_{rq} are parameters to be estimated.[7] The crucial difference with the non-

[7] The translogarithmic function extends the more basic Cobb-Douglas type cost or production function, and thereby allows for a much more general functional form (i.e. relaxing the strict functional form assumed under Cobb-Douglas). Specifically, in a Cobb-Douglas function, the third term on the right hand side of equation (1) is absent: i.e. only the (logged) levels of the outputs are included and not the squared values, nor the cross-product terms. Obviously, the use of Cobb-Douglas versus translogarithmic functional form can be tested by assessing whether the coefficients λ_{rq} are jointly significantly different from 0 (see below).

parametric deterministic approaches mentioned above is that this parametric method allows one to distinguish between the effects of measurement error and inefficiency. This is achieved by introducing a composed error term consisting of a symmetric component (v) (generally assumed to be white noise) and a one-sided non-negative component ($u \geq 0$) representing inefficiency. The latter component is mostly assumed to follow a half-normal or a truncated normal distribution (cf. De Borger and Kerstens, 1996a; Méon and Weill, 2005). Both error components are assumed to be independent. While estimation of equation (1) provides values for the composed error term ($v + u$), Jondrow et al. (1982) show that, for any organisation i, the conditional distribution of u_i given ($v_i + u_i$) contains all available information about u_i. As a consequence, point estimates for the inefficiency component of any given decision-making unit i can be generated. One can thereby either build on the mean or the mode of this conditional distribution (see Jondrow et al., 1982), though both generally lead to comparable results in empirical applications (hence, we only report the results based on the mean of the conditional distribution in section 3.2.2). These point estimates indicate to what extent inputs can be reduced without reducing current output levels.[8]

Two possible problems should be mentioned. First, cost function based approaches along the lines of equation (1) need to account for potential heterogeneity of factor costs across the jurisdictions under scrutiny. Fortunately, factor price divergence is not problematic in our setting since the costs of labour and capital are identical for all municipalities of Baden-Württemberg (i.e. they face the same interest rates and wages). Interest rate homogeneity is given by the fact that a) all municipalities have access to the same capital market and b) the federal government guarantees the absence of differences in risk premiums for all German jurisdictions. As a result, no risk premium differences occur across German jurisdictions. Wage homogeneity is guaranteed via uniform collective labour agreements, which, until 2005, did not allow allows for performance-oriented wages. Consequently, the same work was always remunerated with the same wage (eliminating any potential wage heterogeneity). Moreover, we include a control variable which proxies property price divergence (see below).

Secondly, the efficiency estimates as derived from equation (1) treat all municipalities on the same footing. However, exogenous or non-discretionary influences may shape local government performance (e.g., Battese and Coelli, 1995), even though the municipal

[8] Building the best practice frontier based on the decision-making units at hand by definition implies that the ensuing efficiency measures are relative rather than absolute measures – and only have meaning within the specific sample employed. This clearly holds for all the procedures brought forward.

government cannot affect these elements in the short (or even long) run. Examples of such external forces are the geographic characteristics of the area or the socio-economic make-up of the population. Disregarding the effect of such background factors might well lead to an overestimation of government inefficiency. While previous works (at best) assess how such factors affect local government efficiency in a two-stage procedure (see note 3), we address this issue by assuming that the inefficiency term (*u*) in the error of equation (1) is a function of a set of background variables (cf. Battese and Coelli, 1995). In other words, and as discussed in Coelli (1996), *u* is "assumed to be independently distributed as truncations at zero of the $N(m_{it}, \sigma_u^2)$ distribution where $m_{it} = \delta z_{it}$" (p. 7). In this extension, z_{it} is a vector of background variables (for municipality *i* and time period *t*) which are expected to influence (in)efficiency and δ is a vector of parameters to be estimated. Hence, we estimate:

$$\ln C = \alpha + \sum_{r=1}^{s} \beta_r \ln y_r + \frac{1}{2} \sum_{r=1}^{s} \sum_{q=1}^{s} \lambda_{rq} \ln y_r \ln y_q + v + u \qquad (2)$$

$$u = \gamma + \sum_{i=1}^{I} \delta_i z_i + w, \qquad (3)$$

where the error term of equation (3), *w*, is defined by the truncation of the normal distribution with zero mean and variance σ^2 (Battese and Coelli, 1995). The latter assumption assures that the inefficiency component *u* can only take values bigger than or equal to zero.[9] This extension of the empirical model corrects the derived efficiency measures for the existence of non-discretionary factors and, at the same time, allows us to assess how these exogenous variables affect local government efficiency. As discussed in section 2, this correction is generally disregarded in previous studies investigating the 'composite' performance of local governments.

3.2.2 Definition of variables and description of data

We employ the above approach to examine the (in)efficiency of 1015 municipalities in the German state Baden-Württemberg in the year 2004 (data availability precluding inclusion of the remaining municipalities). To determine the input, output and background variables in the model, we rely on the previous literature (see table 1, section 2). Following this 'common standard' has the advantage that our results are to some extent comparable with these studies. Specifically, we employ total (net) current primary expenditures in the municipality in 2004

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[9] Complete coverage of all relevant y and *z* would be required to derive the real extent of inefficiency. As data limitations make this unattainable, we must be cautious to equate observed 'inefficiencies' with realisable cost savings. Nevertheless, even with an incomplete coverage, *u* offers valuable insights in the municipalities' 'value for money'.

as our prime input variable (*C*). These include all spending on the current budget minus the difference between interest and amortization repayments and income from financial investments. We do not include spending from the capital budget as the fluctuating payment profile of large scale infrastructure projects is likely to heavily distort our cross-section based analysis. To measure the level of local public good provision, we include six output variables relating to important social, educational, recreational and infrastructure responsibilities of the German local governments: (a) number of students in local public schools (primary and secondary education), (b) number of kindergarten places,[10] (c) surface of public recreational facilities, (d) total population, (e) share of population older than 65, and (f) number of employees paying social security contributions.[11] Clearly, these are rather crude proxies for the full range of services a municipality provides (as indicated in Table 2). Unfortunately, however, this is a common stumbling block of 'composite' local government efficiency studies (e.g., Levitt and Joyce, 1987; De Borger and Kerstens, 1996).

Finally, and crucially, we include two sets of (exogenous or background) variables that describe the municipalities' production environment and political constraints. The former is accounted for via population density, unemployment rate and the number of tourist-accommodation facilities. Population density relates to the rural/urban divide and thus proxies the ability of the authority to concentrate local public service provision (Stevens, 2005) and the heterogeneity of property prices (which may affect the cost situation of municipalities). While high population density might entail cost advantages due to regional concentration of services, higher property costs in urban areas (and other problems of agglomeration) may render production more costly. The overall effect on municipal expenditures (and inefficiency) is therefore ambiguous. A similar ambiguity emerges for the unemployment rate since it implies a) higher spending on unemployment and housing benefits (a 'cost effect') and b) lower demand for high-cost (or high-quality) public services (demand for which is

[10] Only the total number of public *and* private kindergarten places of the year 2002 was available. While it would clearly be preferred to use only the number of public kindergarten places, such data were not available. Moreover, public kindergarten places make up a large fraction of total kindergarten places (44% in 2002).

[11] One might wonder whether and how population size, share of elderly and social security contributors depend on active local public policies or tap into municipal management. Still, population in our view proxies the extent of administrative tasks (such as issuing various types of documents) whereas the number of elderly indicates service provision to the elderly (e.g., retirement homes). The number of employees paying social security contributions proxies for infrastructure and business development services because such services are associated with employment. While we agree that more direct measures of local public policies in these areas (e.g., number of beds in nursing homes) would be valuable, these are unfortunately not available.

likely to increase with income levels; a ‘preference effect’).[12] Finally, the number of tourist-accommodation facilities is included since municipalities located in touristic regions (like the Black Forest or the region around Lake Constance) have a higher demand for high-quality public services (see Sampaio de Sousa and Stosic, 2005). An increase (decrease) in the number of tourist-accommodation facilities therefore is expected to increase (decrease) costs – and lead to an underestimation (overestimation) of efficiency if left unaccounted for.

As political background variables, we include a measure of political fragmentation and the share of seats of the left-wing parties in the local council. Political fragmentation is measured via the Herfindahl index using the seat shares of the main national parties (CDU, FDP, SPD, GRÜNE) and of the so-called ‘free voter unions’.[13] Specifically, it equals the inverse of the sum of the squared seat shares of these parties.[14] High concentration (or low fragmentation) represents low political competition and is therefore expected to reduce efficiency (cf. Ashworth et al., 2006). The share of seats of left-wing parties measures the impact of ideology on technical efficiency. Although left-wing governments are generally assumed to favour higher spending, it is a priori not clear whether this also leads to lower efficiency. Descriptive statistics for all variables are presented in table A1 in Appendix. Note that these exogenous variables clearly do not fully describe the production environment of German municipalities, but data constraints obviously restrict our opportunities here.

3.2.3 Empirical results

We present two sets of results. The first disregards the possible effect of the exogenous variables in the measurement of the local government (in)efficiency and could be seen as a ‘baseline’ model. It also represents the common approach in the foregoing literature (see section 2). The second set of results includes all exogenous variables. In each case, we estimate both a Cobb-Douglas and translogarithmic cost functional form and assess which provides the best fit. The results – more particularly, the estimates regarding municipal (in)efficiency – for each of these estimations are brought together in table 3 (full regression results are provided in table A2 of the Appendix).[15] Note that, by definition, municipalities on

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[12] Note that we decided to include the variables “unemployment rate” and “population density” as exogenous and not as output variables to the estimation equation, since these variables can hardly be considered as the result of active policies of the local governments. They rather describe the environment in which the local governments have to make their decisions.

[13] Technically, the Herfindahl index equals the sum of the squared seat shares of each party.

[14] ‘Free voter unions’ are loose federations of persons not belonging to specific political parties and exist only at the local level.

[15] Note that the output variable “students in public schools” has an unexpected negative sign in Table A2. This could be due to the fact that municipalities receive targeted annual grants per student under the municipal

the best practice frontier obtain efficiency scores of one, while all other municipalities receive scores larger than one (to indicate their excessive cost structure).

Table 3: Summary results for local government (in)efficiency in Baden-Württemberg in 2004

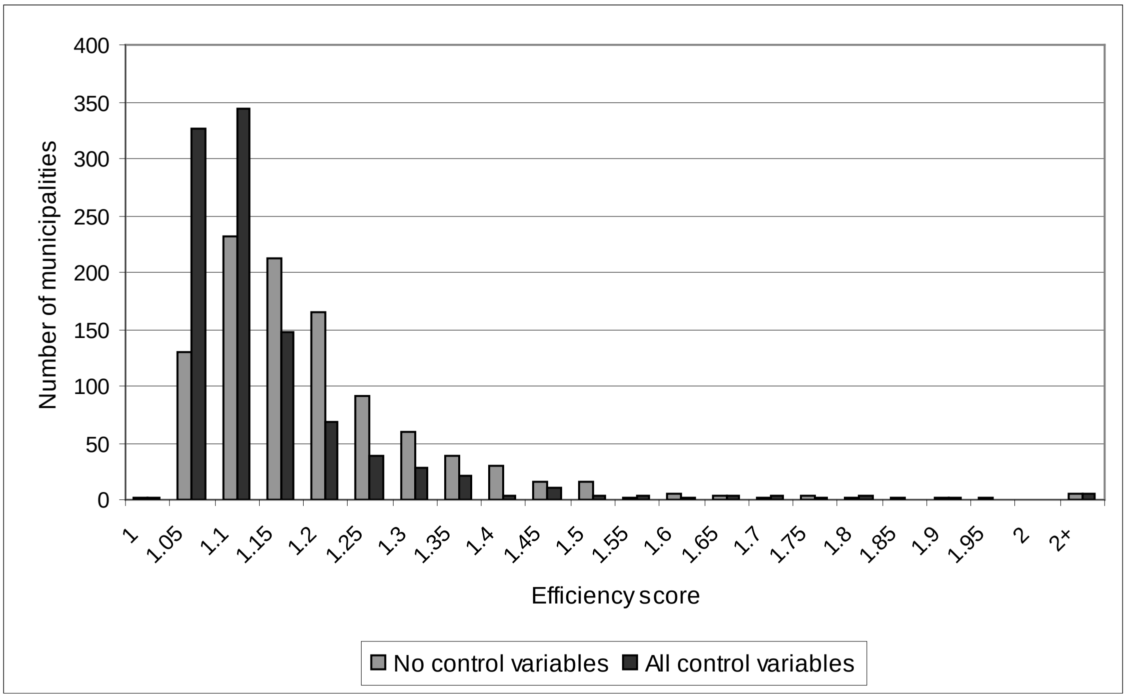
	Cobb-Douglas		**Translog**	
	No control variables (1)	All control variables (2)	No control variables (3)	All control variables (4)
Average	1.2045	1.1340	1.1722	1.1162
Standard deviation	0.2325	0.2314	0.1849	0.1937
Minimum	1	1	1	1
Maximum	4.4500	4.7232	4.0548	4.6086
Number efficient	1	1	1	1

Table 3 indicates that, in the absence of exogenous control variables, local governments on average should reduce their net current primary expenditures by approximately 17% to 20% – without reducing their current output levels – in order to stand at the same level as the most efficient German municipalities (columns 1 and 3). Compared to other countries, this distance between the 'average' and 'best practice' municipalities in Germany is slightly larger than in Australia, Belgium, Greece and the US. It is smaller, however, than in Norway, Spain or Portugal. While it is impossible to compare the efficiency levels across various datasets (given that the efficiency estimates are constructed from the particular dataset employed and are relative rather than absolute measures), this suggests that the German municipalities tend to portray a relatively large dispersion of (in)efficiency. Of course, one should be careful in making such inference since significant heterogeneity in terms of time periods (although a majority of studies in Table 1 regards one or more years in the 1999-2005 period, as does our own analysis), methodologies and input/output variables exists across these studies. A true comparative project would require a simultaneous analysis of various countries using the same analytical tools, time frame and variable definitions. Although a much more ambitious project, it would clearly constitute a very relevant research objective in future analyses.

fiscal equalisation scheme in order to equalise the differences in spending among the municipalities (see also Ministry of Finance of Baden-Württemberg, 2006, p. 39). Since schools are located (mainly) in larger municipalities, the subsidy received for an additional pupil might actually exceed the marginal cost for this pupil (e.g., due to decreasing fixed costs); this would lead to an (overall) negative effect of the variable "students in public schools". Note also that the baseline effects of the variables "kindergarten places" and "surface of public recreational facilities" remain statistically insignificant. Yet, the majority of the interaction terms including either of these variables *are* highly significant, underlining the importance of the inclusion of these variables in the estimation model (as well as the use of the translogarithmic approach to pick up non-linearities and interaction effects).

Importantly, once we include the exogenous control variables (see columns 2 and 4), estimated inefficiency substantially declines. In this case, the average municipality now only needs to reduce costs with 11% to 13% to settle itself on the 'best practice' frontier (slightly above the Japanese and Belgian estimates; see section 2). This constitutes a reduction by about one third. Although we should be cautious to equate these inefficiencies with potential cost cuts (see note 9), it is clear that ignoring the potential impact of exogenous constraints can have a significant effect on the inferences from the model. Moreover, the bias from disregarding exogenous constraints not only affects the estimated level of inefficiency, it also has a strong impact on the heterogeneity of German local governments' 'value for money'. This variation is represented in figure 1, where we show the number of municipalities (on the y-axis) with a given level of inefficiency (on the x-axis) using the results from the translogarithmic specifications. Light-grey cubes reflect the distribution when disregarding control variables, black cubes give the distribution when controlling for background variables. Clearly, the mass of the distribution shifts powerfully towards the left (i.e. towards higher efficiency) when controlling for exogenous influences, and centers more strongly around these low-inefficiency values. Also, while the tail of the distribution does not get shorter, it gets noticeably thinner (thus supporting the decrease in the standard deviation reported in table 3).

Figure 1: Baden-Württemberg local governments' cost inefficiency in 2004



Note: Results based on translogarithmic cost function.

Before we conclude this section, we briefly describe the findings for the non-discretionary variables included in the model (see table A2 of Appendix A for details). As mentioned, including these exogenous variables not only provides a 'corrected' measure of local government efficiency, it also yields insights into the socio-economic and political influences on local government efficiency in Germany. Specifically, our results show that the unemployment rate has a statistically significant negative sign, suggesting that the preference effect (i.e. reduced demand for high quality public goods) outweighs the cost effect (i.e. higher spending on unemployment-related benefits).[16] The effect of population density, on the other hand, is not clear, since in the translogarithmic specification the cost disadvantages resulting from, say, higher property prices appear to outweigh agglomeration advantages, whereas in the Cobb-Douglas specification it is the other way round. The statistically significant positive effect of tourist-accommodation facilities indicates that more touristic regions have a higher demand for high-quality services (in line with theoretical expectations). Finally, concerning the political constraints, it is found that high levels of political concentration or monopolization (i.e. low values for the Herfindahl index) are associated with low efficiency; this effect is highly statistically significant in both specifications. On the other hand, an increasing share of seats of left-wing parties in the local council seems to decrease efficiency; the coefficient is, however, only significant in the Cobb-Douglas specification.

4. Conclusion

In this paper, we investigated the cost efficiency of German local governments in the state of Baden-Württemberg in 2004, and put the results in a comparative perspective. Moreover, we explicitly account for exogenous, non-discretionary factors when estimating (in)efficiency. This, in contrast to most previous work, not only provides a more appropriate measure of local government efficiency, it also yields insights into the socio-economic and political influences on local government efficiency (in Germany). Our results indicate that the average municipality in Baden-Württemberg produces its output at costs that are 17% to 20% higher than the 'best practice' – or 11% to 13% once we control for the exogenous or non-discretionary constraints on municipal production. This leads to two conclusions. First, in

[16] Note that there are two administrative units at the local government level in Germany (i.e. counties and municipalities), both of which have their own responsibilities. Counties constitute the higher administrative level; they are associations of a fixed number of municipalities. Since it is mainly the responsibility of the counties – and not of the municipalities – to finance housing and/or welfare benefits to the unemployed, another possible reason for the negative sign of the variable "unemployment rate" could be that the counties are the main bearers of the costs for the unemployed (and not the municipalities).

relation to previous work, the distance between the ‘average’ and ‘best practice’ municipalities in Germany is somewhat larger than in Australia, Belgium, Greece, Japan and the US. It is smaller, however, than in Norway, Spain or Portugal. Although suggestive, one should keep in mind here that heterogeneity across studies in terms of time periods, methodologies and input/output variables makes a strong interpretation of these differences inadvisable. A true comparative project – i.e. a simultaneous analysis of various countries using the same analytical tools, time frame and variable definitions – remains a relevant, though ambitious, research objective for future work. Second, the strong reduction in measured (in)efficiency once controlling for exogenous constraints convincingly illustrates that the modeling of such production constraints should be an indispensable element in ‘composite’ efficiency analyses. Disregarding these background variables leads to an excessively unfavorable view of public sector efficiency.

Although, compared to most former studies, our approach provides a more realistic quantification of (in)efficiency, we have indicated throughout the manuscript that one should nevertheless be careful to equate the estimated inefficiencies with potential cost cuts for four reasons. First, the output indicators employed in this study are rather crude proxies for the full range of services a municipality provides. While a common stumbling block of ‘composite’ local government efficiency studies, future research should try to augment the output side by incorporating information on quality indicators (resulting, for example, from surveys concerning citizens’ satisfaction with municipal services). Second, we do not establish a ‘true’ best-practice frontier, but rather generate it from the data. This implies there is no a priori definition of ‘best practice’, but rather one that is inferred form the observations employed. Unless a commonly accepted theoretical definition and operationalisation of ‘efficient behaviour’ can be agreed upon, it is hard to see how this natural limitation of any real world dataset could be overcome in future. Third, we clearly do not fully describe the production environment of German municipalities, but data constraints are an obvious restriction on how far one can go in this respect. Finally, a replication (and extension) of the analysis relying on sufficiently lengthy time-series cross-section data would allow incorporation of time trends and additional controls for fixed municipality-specific effects.

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Appendix A

Table A1: Descriptive Statistics (1015 municipalities for the year 2004)

Variable	Mean	Standard Deviation	Minimum	Maximum
Input variable:				
Net current primary expenditures (in million euros)	20.80	83.30	0.36	2080.00
Output variables:				
Students in public schools	629.55	1261.87	0	25774
Kindergarten places	403.28	807.00	25	17195
Surface of public recreational facilities (in are)	2557.66	5969.37	0	110841
Total population	10418.54	26674.55	247	589231
Share of population older than 65	17.04	2.53	8.57	35.62
Number of employees paying social security contributions (at place of work)	3664.61	14511.83	10	344311
Other control variables:				
Unemployment rate (in %)	6.55	1.12	3.75	11.35
Population density (inhabitants per hectare)	3.35	3.35	0.21	28.42
Accommodation facilities	6.59	11.58	0	150.00
Herfindahl index	0.53	0.26	0.21	1
Share of left-wing parties (SPD+GRÜNE) (in %)	15.78	14.35	0	57.14

Source: Statistical Office of Baden-Württemberg

Table A2: Results of the multi-output frontier estimation

Variable	Cobb-Douglas		Translog	
	(1)	(2)	(3)	(4)
	Stochastic Frontier			
Constant (β_0)	7.1603**	7.2133**	13.6610**	11.9115**
	(52.8036)	(57.6389)	(7.0040)	(7.5934)
A: Students in public schools	-0.0225**	-0.0186**	-0.1132	-0.1562
	(-2.5423)	(-2.2751)	(-0.5372)	(-0.7634)
B: Kindergarten places	0.0108	0.0181	3.4725**	3.2519**
	(0.3494)	(0.6286)	(4.7262)	(5.1468)
C: Surface of public recreational facilities	0.0114	0.0084	0.1497	0.1460
	(1.3567)	(1.2173)	(0.7454)	(0.7545)
D: Total population	0.8447**	0.8498**	-3.7848**	-3.2652**
	(24.4878)	(26.3039)	(-4.5046)	(-4.5838)
E: Share of population older than 65	0.0728*	0.0769**	0.4061	1.1333
	(1.8844)	(2.1005)	(0.4681)	(1.5511)
F: Number of employees paying social security contributions	0.1646**	0.1521**	1.1325**	0.9211**
	(13.8156)	(13.8627)	(4.7334)	(4.2481)
A^2			-0.0057	-0.0056
			(-0.7986)	(-0.8227)
B^2			-0.0007	0.0073
			(-0.0143)	(0.1616)
C^2			0.0026	0.0002
			(0.4061)	(0.0414)
D^2			0.5131**	0.4808**
			(4.5563)	(4.6589)
E^2			-0.2352*	-0.3073**
			(-1.7762)	(-2.5293)
F^2			0.1074**	0.0965**
			(7.9511)	(7.4321)
F * E			-0.0131	0.0249
			(-0.1785)	(0.3716)
F * D			-0.3956**	-0.3537**
			(-6.2927)	(-6.0459)
F * C			0.0159	0.0118
			(1.0900)	(0.8278)
F * B			0.1851**	0.1712**
			(3.1404)	(3.1007)
F * A			-0.0229*	-0.0242*
			(-1.7587)	(-1.9223)
E * D			0.5023**	0.3840**
			(2.7232)	(2.2363)
E * C			0.1082*	0.1035*
			(1.8086)	(1.8172)
E * B			-0.7794**	-0.6922**
			(-4.1923)	(-4.0480)
E * A			0.0348	0.0313
			(0.6076)	(0.5688)
D * C			-0.1058**	-0.1027**
			(-2.0523)	(-2.1267)
D * B			-0.3728**	-0.3732**
			(-2.4278)	(-2.5938)
D * A			-0.0187	-0.0047
			(-0.4103)	(-0.1094)
C * B			0.0445	0.0522
			(0.9712)	(1.2326)
C * A			0.0124	0.0138
			(1.0833)	(1.2652)

Table A2 (continued): Results of the multi-output frontier estimation

B * A			0.0576	0.0450
			(1.0635)	(0.8731)
Inefficiency model				
Constant (δ_0)		-6.3782**		-3.8440**
		(-2.5801)		(-3.3920)
Unemployment rate		-0.2057**		-0.1326**
		(-2.6566)		(-2.8109)
Population density		0.0302**		-0.0620**
		(3.7267)		(-2.8253)
Accommodation facilities		0.0474**		0.0387**
		(3.0251)		(3.9383)
Herfindahl index		2.7049**		1.0770**
		(2.9643)		(3.6500)
Share of left		0.0077**		0.0008
		(3.2401)		(0.3992)
Sigma-squared ($\hat{\sigma}^2$)	0.0730**	0.7856**	0.0588**	0.5216**
	(15.9550)	(2.6211)	(14.7417)	(3.6687)
Gamma (γ)	0.8652**	0.9843**	0.8361**	0.9780**
	(42.1071)	(152.2754)	(31.0693)	(156.6916)
Log-likelihood	330.58	388.67	412.39	455.94
Cobb-Douglas vs. translogarithmic	-	-	163.63 **	134.54 **

Note: N = 1015. All variables are in natural logs excepting the variables of the inefficiency model; ** (*) denotes significance at 5% (10%) level. Cobb-Douglas vs. translogarithmic tests the restriction that the coefficients for all quadratic and cross products terms are jointly insignificant (and has a Chi^2-distribution). The results are obtained using FRONTIER 4.1 (Coelli, 1996).