Local Politics and Inefficiency of Local Government in the Czech Republic*

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Abstract

We evaluate efficiency of local public spending of 202 Czech municipalities with so-called extended powers in 2003–2008 period. Municipalities at this level constitute micro-regions comprising typically exactly one town or city. We aim to find determinants of inefficiency with the main focus on political variables. Parametric approach of the stochastic frontier analysis is employed. We carry out two types of analyses: aggregate analysis evaluating efficiency and its determinants of a municipality as a whole, and spending-specific analyses where efficiency in different policies is assessed. We focus on provision of education, culture, environmental protection, industry and infrastructure and housing. On the aggregate level, we found that local legislatures where major left-wing parties prevail tend to be less efficient; districts where voters are more involved in local politics are more efficient; and local politicians tend to be less efficient in the year of elections, which is driven by an increase in expenditures. When individual policies are examined, ideological effect is weaker or even opposite for some policies, but local political cycle is always detected.

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1 Introduction

The analysis of the efficiency of local governments is a topic of recent interest in public and urban economics. Like previous studies, also this stream of the literature is related to the lasting discussion concerning an optimal decentralization of tasks from upper-level governments to the local governments. In the textbook decentralization theorem, Oates (1972) argues that policies should be decentralized in the absence of economies of scale or spillover effects, so as to match local policies with local preferences. Yet this recommendation has to be reconciled with an observation that local governments may perform tasks relatively inefficiently. Local governments may be less efficient than the central government due to lack of fiscal basis, or the absence of sufficient experience among local staff (Prud'homme 1995). They may be captured by local interest groups (Bardhan and Mookherjee 2000), or less disciplined in spending if being highly dependent on transfers from the central government (Rodden 2003). On the other hand, decentralization is argued to improve efficiency because higher electoral control reduces incentives for incumbents for rent-seeking (Seabright 1996) and yardstick competition puts pressure on local representatives not to waste resources.

We examine these effects by empirically assessing whether local governments differ in their efficiency, and seek key determinants of slack in their performance. Having certain resources at disposal, a government transforms the resources into publicly provided outputs. According to the conventional theory, this transformation takes form of an optimization where a government operates on the boundary of its production possibility set. This idea can be validated or rejected if we observe differences in performance that cannot be attributed to differences in inputs or outputs, only to differences in efficiency, implying that some governments actually do waste their resources, or generate publicly useless output such as private rent.

There is a range of famous studies analyzing the overall government efficiency across various countries, for example Afonso et al. (2005), Meon and Weill (2005), and Gupta and Verhoeven (2001). The cross-country comparisons of public sector efficiency nevertheless suffer from two major shortcomings: assumption on the homogenous production functions is overly restrictive due to large unobserved heterogeneity, and data incomparability stemming from different ways of measurement is neglected. Therefore, it is far more reasonable to focus on efficiency within a single country, where at least statistics reporting is more unified and reliable.

A vast amount of literature on local government's efficiency in advanced economies is thus related to the country-specific analyses in emerging economies. Kalb (2010), Geys et al. (2010) study efficiency in German municipalities; Loikkanen and Susiluoto (2005) focus on Finnish municipalities; Borge et al. (2007) analyze Norwegian municipalities; Vanden Eeckaut et al. (1993), De Borger and Kerstens (1996) and De Borger et al. (1994) explore the efficiency of Belgian municipalities; Geys and Moesen (2009) investigate Flemish municipalities; Arcelus et al. (2007), Balaguer-Coll et al. (2007) and Gimenez and Prior (2007) deal with the efficiency of Spanish municipalities; Afonso and Fernandes (2008) analyze Portuguese municipalities; Grossman et al. (1999) and Moore et al. (2005) study large U.S. cities, whereas Worthington and Dollery (2002) explore Australian municipalities. Other relevant empirics comes from purely sector-oriented literature, focusing on, for instance, social protection (Coelli et al. 2008), education (Afonso and Aubyn 2006; Ruggiero 2004), and health sector (Hollingsworth and Peacock 2008; Jacobs et al. 2006).

Concerning new EU member countries, to our knowledge there has not been carried out any analysis on efficiency of local governments yet. Therefore, the efficiency analysis of local governments may be a valuable contribution not only in the Czech Republic, but also in the entire post-communist region. The analysis of determinants will allow us to compare whether patterns of efficiency in municipalities of a post-communist country are different from those in a west European country, as our results may be compared with the studies above.

In this paper, we study cost efficiency of 202 municipalities with extended powers. These municipalities were established within the second stage of decentralization reform carried out in the Czech Republic at the beginning of 2003 and are assigned with the most state-delegated powers among all the municipalities. We perform two types of analyses: aggregate analysis evaluating efficiency of a municipality from the general point of view, and analyses in individual policies (education, culture, environmental protection, industry and infrastructure, and housing).

The main aim of the paper is to define determinants of inefficiency, whereas we focus mainly on political effects. We study how political concentration, ideology and voters' involvement influence inefficiency. Additionally, we aim to explore whether local political cycle can be found in the Czech municipalities (higher inefficiency in electoral year is the most probably caused by higher spending) and how effects differ across different types of spending. Political effects upon inefficiency of voters' involvement was analyzed by Geys et al. 2010. There are also some studies analyzing local political cycles, however, to our knowledge, none of them focuses on inefficiency (Veiga and Veiga 2007 studies Portuguese municipalities, Moreno 2005 analyzes municipalities in Mexico.)

The paper proceeds as follows: Section 2 outlines the methodology on estimation of efficiency scores, Section 3 presents the data on input, output and determinants, Section 4 gives the results of aggregate analysis followed by results of spending-specific analyses, and Section 5 concludes.

2 Methodology

Generally, there are two approaches how to measure efficiency of decision-making units, non-parametric and parametric. Any non-parametric approach generates best practice frontier by tightly enveloping the data, where this envelopment is achieved by solving a sequence of linear programs. The main advantage of this approach is that it does not require the specification of the functional form of the frontier. There are two main techniques used within the non-parametric approach, Data Envelopment Analysis (DEA) and Free Disposal Hull Analysis (FDH). DEA, initiated by Farrel (1957) and made widespread by Charnes et al. (1978), assumes the existence of a convex production frontier. FDH, suggested by Deprins et al. (1984), differs from DEA in that it drops the convexity assumption. These methods are fully deterministic, because the entire deviation from the frontier is interpreted as inefficiency.

Parametric approaches establish the best practice frontier on the basis of a specific functional form using econometric estimation. Moreover, the deviations from the best practice frontier derived from parametric methods can be interpreted in two different ways. While deterministic approaches interpret the whole deviation from the best practice frontier as inefficiency (corrected OLS method), stochastic frontier models proposed by Aigner et al. (1977) and Meeusen and van den Brock (1977) decompose the deviation of the best practice frontier into an inefficiency part on the one hand, and into a part arising from other stochastic influences or measurement errors, on the other hand.

In this paper, we employ the parametric approach of Battese and Coelli (1995) which allows to estimate efficiency scores in one step together with estimating determinants of inefficiency.

2.1 Stochastic Frontier Analysis

Stochastic frontier analysis (SFA) is an method for frontier estimation that assumes a given functional form for the relationship between output y and inputs $\mathbf{x}$ (costs and outputs for cost efficiency, respectively). Stochastic frontier production function model is given as (Aigner et al. 1977):

$$y_i = f(\mathbf{x}_i) + \epsilon_i, \quad \epsilon_i = v_i - u_i, \tag{1}$$

Statistical error ϵ_i is decomposed to noise v_i which is assumed to be i.i.d., $v_i \sim N(0, \sigma_v^2)$ and symmetric and non-negative inefficiency u_i having usually half-normal or truncated normal distribution (it has non-zero mean because $u_i \geq 0$).[1] It is also assumed that $cov(u_i, v_i) = 0$ and u_i and v_i are independent of the regressors. Hence, in contrast to DEA, a deviation from the frontier is not interpreted entirely as an inefficiency. When a cost function is estimated, decomposition changes to $\epsilon_i = v_i + u_i$. Figure 1 illustrates the decomposition of the statistical error.

Usually, functional forms such as Cobb-Douglas or Translog production functions are chosen. The Cobb-Douglas form is as follows:

[1] Exponential or gamma distributions are chosen less commonly. Different distributional assumptions can give rise to different predictions of technical efficiency. However, ranking is quite robust to distributional choice (Coelli et al. 2005).

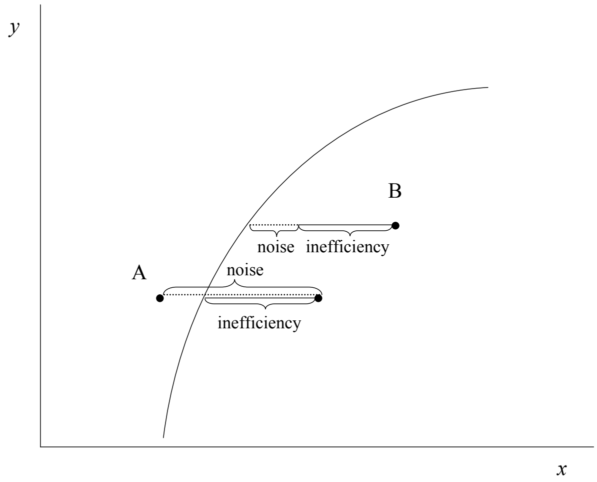

Figure 1. SFA efficiency frontier

$$\ln y = \beta_0 + \sum_{x=1}^{x=p} \beta_p \ln x_p$$

Translog form writes:

$$\ln y = \beta_0 + \sum_{p=1}^{P} \beta_p \ln x_p + \frac{1}{2} \sum_{p=1}^{P} \sum_{q=1}^{Q} \ln x_p \ln x_q$$

Battese and Coeli (1992) extend the original cross-sectional version of SFA in (1) to panel data. The model is expressed as:

$$y_{it} = f(\mathbf{x}_{it}) + \epsilon_{it}, \quad \epsilon_{it} = v_{it} - u_{it}, \tag{2}$$

where y_{it} denotes costs of municipality i in time t and $\mathbf{x_{it}}$ is vector of outputs of municipality i in time t. Statistical noise v_{it} is assumed to be i.i.d., $v_{it} \sim N(0, \sigma_v^2)$, and independent of u_{it}. Technical efficiency u_{it} may vary over time

$$u_{it} = u_i \exp[\eta(t - T)], \tag{3}$$

where η is parameter to be estimated, and u_{it} is assumed to be i.i.d. as truncations of zero of $N(\mu, \sigma_u^2)$.

The model above is estimated by maximum likelihood, for which parametrization of Battese and Corra (1977) becomes useful. They replace σ_u^2 and σ_v^2 with $\sigma^2 = \sigma_u^2 + \sigma_v^2$ and $\gamma = \sigma_u^2/\sigma^2$. If $\gamma = 0$, then all deviations from the frontier are due to noise, while $\gamma = 1$ means that all deviations are due to technical inefficiency.

SFA estimation relies on decomposing observable ϵ_{it} into its two components which is based on considering the expected value of u_{it} conditional upon $\epsilon_i t$. Jondrow et al. (1992)

derive the conditional distribution (half-normal) and under this formulation, the expected mean value of inefficiency is:

$$E[u_i|\epsilon_i] = \frac{\sigma\lambda}{(1+\lambda^2)}\Big[\frac{\phi(\epsilon_i\lambda/\sigma)}{\Phi(-\epsilon_i\lambda/\sigma)} - \frac{\epsilon_i\lambda}{\sigma}\Big], \tag{4}$$

where $\lambda = \sigma_u/\sigma_v$, $\phi(\cdot)$ and $\Phi(\cdot)$ are, respectively, the probability density function and cumulative distribution function of the standard normal distribution, $f(u|\epsilon)$ is distributed as $N^+(\frac{-\epsilon\sigma_u^2}{\sigma^2}, \frac{\sigma_u^2\sigma_v^2}{\sigma^2})$. If $\lambda \to +\infty$, the deterministic frontier results (one-sided error component dominates the symmetric error component in the determination of ϵ). If $\lambda \to 0$, there is no inefficiency in the disturbance, and the model can be efficiently estimated by OLS.

2.1.1 Effects of environmental variables

Identification of potential determinants of inefficiency is the logical step in efficiency analysis. There are several options how to include environmental variables in estimation of efficiency. In two-stage approaches, efficiency estimates are computed in the first step and regressed on environmental variables in the second step. The second-stage efficiency model is expressed as

$$u_{it} = \delta\mathbf{z}_{it} + w_{it}, \tag{5}$$

where $\mathbf{z}_{it}$ is a vector of environmental variables of municipality i in time t, δ is a vector of parameters to be estimated, and w_{it} is a random noise.

This approach is, however, based on assumption that elements of $\mathbf{z}_i$ are uncorrelated with the elements of $\mathbf{x}_i$. If this assumption is violated, efficiency estimates are biased due to the omission of the relevant variables $\mathbf{z}_i$ in the first stage. Additionally, assumption that inefficiencies are identically distributed in the first stage is contradicted in the second-stage regression in which predicted efficiencies are assumed to have a functional relationship with $\mathbf{z}_i$. The two-stage procedure is unlikely to provide estimates which are as efficient as those that could be obtained using a single-stage estimation procedure (Coelli 1996).

In one-stage approaches, efficiency and its determinants are estimated simultaneously (Deprins and Simar 1989; Kumbhakar et al. 1991; Reifschneider and Stevenson 1991; Huang and Liu 1994; Battese and Coelli 1995). We follow estimation technique by Battese and Coelli (1995) who expand Huang and Liu's (1994) model for panel data context. Equations (2) and (5) are estimated simultenously, and additionally, it is assumed that v_{it} is i.i.d., $v_{it} \sim N(0, \sigma_v^2)$, and independently distributed of u_{it}, u_{it} is independently distributed and obtained by truncation at zero of $N(\delta\mathbf{z}_{it}, \sigma_u^2)$, $u_{it} \geq 0$. Hence, environmental variables influence the mean of the truncated normal distribution of u_{it}.

3 Data

In this section, we provide the institutional context for the sample of municipalities analyzed, describe inputs and outputs, as well as give the summary statistics.

3.1 Municipalities

We analyze efficiency of the specific administrative tier in the Czech governmental system—municipalities with extended powers. Each municipality in the Czech Republic exercises independent competencies and specific delegated powers, the extent of latter differs with municipality administrative type. Municipalities with extended powers are the municipalities executing state-delegated powers in the largest extent. They constitute a center of a district they administer and are superior to other municipalities in the district having less state-delegated powers.[2]

Independent competencies of a municipality include provision of primary schools and kindergartens, primary health care, local police, fire brigade, public utilities, territorial planning, maintenance of local roads, and garbage collection. Delegated responsibilities of municipalities with extended powers comprise mainly administration of population register, issuance of identity cards, travel documents, driving licenses, water and waste management, environmental protection, management of forestry, local transportation provision, roads maintenance, social benefits payments, and social care services. Concerning revenues, municipalities are heavily dependent on the state budget, as they do not have large own revenue-raising capacity. The largest share of municipality revenues are tax revenues directly transferred from the state budget to a municipality budget based on a formula reflecting only its population size.

The municipalities with extended powers were established within a reform of territorial public administration initiated in 2000. The reform proceeded in two stages. Firstly, 14 regional governments were established and a wide range of responsibilities, originally exercised by the national government, were transferred to the regions (NUTS 3 level). The regions effectively began operating in 2001 after the first elections took place. In the second stage, original 76 administrative districts were abolished at the end of 2002[3] and their former state-delegated powers were transferred to regions (20%) and 205 municipalities with newly assigned "extended administrative powers" (80%).

When assessing efficiency, it is necessary to have a sufficiently homogeneous sample of municipalities. That is the primary reason why we selected municipalities with extended powers: they are similar in size, have same competencies, constitute a regional center, and the sample is large enough for a cross-sectional analysis.[4]

[2] Figure A1 shows division of the Czech Republic into the districts administered by the municipalities with extended powers.

[3] These territorial districts, however, remain an important units of reference for some administrations, such as collection of statistical data.

[4] We carry out cross-sectional analysis and compute DEA efficiency scores for each year separately.

Efficiency analysis is employed for 202 municipalities with extended powers with population ranging from approximately 3,000 up to 100,000, the list of municipalities is provided in Table A1 in the Appendix. We exclude the capital city of Prague, which is one of the 14 regions of the Czech Republic and hence provides a different mix of public services than other municipalities. For homogeneity reasons, three other largest cities in the Czech Republic—Brno (371,000), Ostrava (308,000) and Plzen (170,000) are additionally excluded, as they are substantially larger than the rest of our sample. Figure 2 shows the distribution of municipalities according to size in 2008. We can see that the most of municipalities have less than 20,000 citizens.

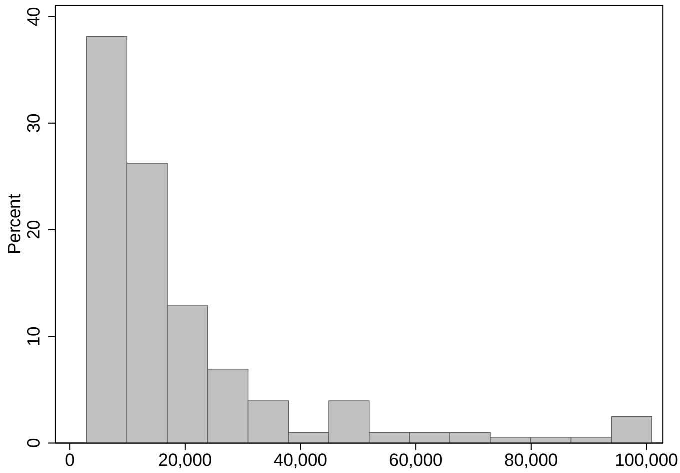

Figure 2. Sample distribution: population

3.2 Inputs

The crucial task in computation of efficiency is to properly define outputs and inputs. We approximate input by total current spending adjusted for inflation. The Ministry of Finance provides the complete database of municipality budgets ARIS providing a very detailed overview of municipality expenditures.[5] We aggregated detailed data on current expenditures into 10 groups of spending: agriculture; industry and infrastructure; education; culture and sports; health; housing and regional development; environment protection; social and labor market policy; public safety; and general administration.

[5] http://www.mfcr.cz/cps/rde/xchg/mfcr/hs.xsl/aris.html

Table 1. Summary statistics - expenditures

	Mean	Min	Max	%
Administration	73782	18608	413069	32.06
Agriculture	1604	0	34134	0.7
Culture and sports	29433	0	282169	12.79
Education - discretionary	24410	2802	156127	10.61
Environmental protection	20246	0	175700	8.80
Health	2663	0	62300	1.16
Housing and regional development	31320	722	219797	13.61
Industry and infrastructure	27177	0	385696	11.81
Public safety	9719	0	122909	4.22
Social care - discretionary	9860	0	107973	4.29
Total	318291	53245	1784550	138.00
Total adjusted	230163	36451	1498326	100.00

Source: ARIS database, Ministry of Finance; own calculations.
Note: Thousands (Czech koruna), N=1010.

Table 1 provides summary statistics on individual expenditure groups. There are two groups of large mandatory payments: social transfers payments and subsidies on education, which were transferred through municipality budgets directly to primary schools in 2003 and 2004.[6] Hence, we adjust the input only for discretionary spending as is shown in the last row of Table 1. The last column shows the average share of each expenditure group in total adjusted budget, so as to demonstrate budget composition.

3.3 Outputs

A much harder work appears to be with the definition of outputs. In this section, we define relevant output variables. We can use either direct outputs or we can approximate outputs by "consumer" outputs reflecting a demand for a municipality service, where the latter is more feasible in the analysis. We use not only quantitative outputs, but we also consider qualitative outputs for some expenditures. As agriculture and health spending is negligible, we do not include their group-specific outputs.

Most of above mentioned studies perform efficiency analysis for total current expenditures.[7] This is reasonable, as some expenditures can easily overlap. We perform aggregate analysis for total expenditures and individual analyses for selected expenditure groups to see whether effects of local politics differ across different type of spending.

[6] The average of mandatory payments is 57,785 and 76,017 (thousands CZK) for social transfers and for subsidies on education, respectively. Since 2005 state subsidies to primary schools per pupil are directly transferred to schools without affecting municipality budgets.

[7] Table A2 in the Appendix provides a short overview of studies and their inputs and outputs choices.

To find appropriate outputs for each expenditure group we carried out individual pre-analyses. Outputs should reflex real expenditures. To check whether outputs are relevant and whether they have the expected sign, we ran simple pooled OLS and regressed outputs on expenditures. R^2 falls within the range 0.70–0.90 in all but two cases; for housing and social care we could not find better outputs to increase R^2 above 0.45.

Concerning education, municipalities finance mostly primary schools and kindergartens. Grammar schools are generally financed by the regional government. As a quantitative output we include the number of *pupils in primary schools and kindergartens* in a municipality. To evaluate quality of education, we include the *percentage of pupils who enter secondary school* at the age of 11 or 13.[8]

Expenditures on culture and sports comprise subsidies for theaters, municipal museums and galleries, libraries, sport clubs, sport events and costs on monuments preservation. The numbers of theaters, cinemas, children centers and libraries are all highly correlated, thus we simply sum them and obtain variable of *cultural facilities*.[9] Additionally, we include the number of *municipal museums and galleries*, the number of *objects in municipal monuments reserve* and *sporting and recreational area*.

Environment protection expenditures are allocated primarily to waste treatment, air, soil and ground water protection, and nature preservation. *Municipal waste* collected reflects expenditures on waste treatment, *area of pollution* composed by ecologically harming areas such as arable land and built-up area can proxy for the expenditures on air, soil and ground water protection, *nature reserves* can represent spending on nature preservations, and *urban green areas* reflect spending on parks.

For housing and regional development we selected two outputs—*built up area* and the number of *new dwellings* completed. Built-up area corresponds to the demand for services of municipal utilities and new dwellings represent the effect of municipal financial support for housing construction. Industry and infrastructure spending contains support of businesses, costs on municipal roads maintenance, support of public transportation and costs of water resources management. As outputs we use the number of *businesses*, the area of *municipal roads* and the number of *bus stations*.

Administration expenditures are related to *population of districts* administered by a municipality with extended powers as it carries out many administrative services for whole district. Social care expenditures reflect support for retirements homes and homes for disabled, hence we include *old population* (above 65 years old) and number of *homes for disabled* among outputs. Expenditures on public safety involve municipal police and fire brigade ser-

[8] In the Czech Republic, children with higher skills can enter secondary schools with more demanding classwork and attend their 8 or 6 years-of-education programs.

[9] If we employ principal component analysis to see structure of the data, we find that the first component explaining around 60% of the information in the data assigns almost equal weights to all variables, hence aggregation by simple summing up is acceptable.

vices which we proxy by *built-up area* served and *municipal police* dummy. Table 2 lists output variables.[10]

Table 2. Summary statistics: output variables

	Mean	Min	Max	Source
Pupils in primary schools and kindergartens	2,188	282.0	11,944	IIE
Pupils entering secondary schools (%)	11.27	0	33.7	IIE
Cultural facilities	11.43	1	69	CZSO
Municipal museums and galleries	0.41	0	3	MGA
Objects in monuments reserve	25.83	0	254	NIM
Sporting and recreational area (ha)	35.11	2.35	273.6	CZSO
Municipal waste (tons)	14,792	416.2	124,836	ME
Nature reserves	10.64	0	48	ANCLP
Pollute area (ha)	2,287	214.8	8,746	CZSO
Urban green area (ha)	51.17	3.09	351.7	CZSO
Built-up area (ha)	156.9	17.57	726.0	CZSO
New dwellings	37.82	0	600	CZSO
Businesses	4,412	521	33,084	CZSO
Municipal roads (ha)	134.2	26.89	657.8	CZSO
Bus stations	30.71	4	112	IDOS
Population in district	40,595	9,192	160,044	CZSO
Old population	2,709	380	16,715	CZSO
Homes for disabled	0.407	0	4	CZSO
Municipal police	0.874	0	1	CZSO

Sources: ANCLP = Agency for Nature Conservation and Landscape Protection, MGA = Museums and Galleries Association, CZSO = Czech Statistical Office, IDOS = Transportation timetables, IIE = Institute for Information on Education, ME = Ministry of Environment, NIM= National Institute of Monuments.
Note: $N = 202$.

To control for cost conditions, we include gross wage in production process (cost function) directly. [11]

3.4 Determinants

In addition to efficiency scores, we aim to estimate determinants of inefficiency and focus mainly on political effects. However, we include also demographic and economic variables.

Municipality size matters. Economies of scale typically make the larger municipalities more efficient, hence we include *population*, or dummies for different municipality size (up

[10] Sources are in a greater detail listed in Table A3 in Appendix.

[11] Data on gross wages are, however, not available on municipal level. Hence, wages for higher level of territorial districts (74 districts) are collected until 2005 and since that growth of district wages accommodates for growth in regional wages (14 regions).

to 10,000 people, 10–20,000, and above 50,000). *Population density* approximates urban character of municipalities, which can be also regarded as a proxy for the heterogeneity of property prices differing between rural and urban areas. More urbanized municipalities have cost advantages due to concentration of services, however higher property prices may increase their production costs.

Municipalities with a higher *share of university-educated population* may be more efficient either directly (qualified labor), or through voters' higher participation (De Borger and Kerstens 1996). On the other hand, university-educated people do have higher wages which may make a municipality less efficient. Municipalities with less favorable economic situation where *unemployment* is large, may need to finance more services for residents who cannot afford them. These services may not translate in higher output.

By including *subsidies from upper levels of government* among determinants, we can answer the question whether these grants fully translate into a larger provision of public goods or if municipalities receiving higher grants tend to be less efficient (Hines and Thaler 1995). So far, empirical evidence supports that the "flypaper effect" is rather significant (e.g. Kalb 2008; De Borger et al. 1994; De Borger and Kerstens 1996; Loikkanen and Susiluoto 2005). We will also study whether the past *government debt* serves as an incentive for increase in efficiency. Or on the other hand, as shown by Geys and Moesen (2009), high debt repayments in contrast impinge on municipal efficiency. The extent how municipality is dependent on its own revenues may also influence its economic decisions, hence we include variable illustrating share of its *own revenues*. All nominal variables are adjusted for inflation.

Political characteristics of a municipality can also influence its efficiency. High *political concentration*, or low political competition, arguably reduces efficiency. Single-party municipal governments are found to be particularly inefficient (Geys et al. 2008; Borge et al. 2007). For political competition, we compute indices of party fragmentation within the local council (e.g., Laakso-Taagepera index, a version of the classic Herfindahl concentration index).

Additionally, we consider political ideology. *Left-wing* parties are often assumed to prefer larger government. However, larger spending does not necessarily mean less efficient governments. Geys et al. (2008), nevertheless, found that the low share of left-wing parties is associated with lower efficiency. The extent to which people are involved in local politics should also influence performance of the government. We measure voters' involvement by *turnout* in municipal elections (see Geys et al. 2008; Borge et al. 2007). Finally, we study whether effects upon inefficiency are different in *electoral year*, *pre-electoral year*, and *post-electoral* which may detect the political budget cycle.[12]

The geographical distance between the municipality and its capital of district can influence pressure on the municipality and consequently its efficiency (Loikkanen and Susiluoto 2005), hence we include the *proximity* of a municipality to its regional center.

[12] In 2003–2008 there were however only one electoral year in 2006, one pre-electoral year in 2005 and two post-electoral years in 2003 and 2007. We plan to extend the analysis for new elections in 2010.

Table 3 presents overview of potential determinants. Additional information about the data can be found in Table A4.

Table 3. Summary statistics - determinants

	Mean	Min	Max
Population	19496	2892	10268
Population < 10,000	0.397	0	1
Population 10,000–20,000	0.315	0	1
Population 20,000–50,000	0.201	0	1
Population > 50,000	0.086	0	1
Population density (per km^2)	496.0	67.55	2647
University-educated people (%)	6.15	2.54	12.20
Unemployment	8.718	1.5	24.23
Subsidies per capita	4224	76.5	25511
Own revenues (%)	18.06	6.39	43.77
Lagged debt dummy	0.447	0	1
Proximity	35.36	0	84
Political concentration	0.218	0.107	0.539
Left-wing parties (%)	32.42	0	82.61
Right-wing parties (%)	30.64	0	73.91
Left-wing winner	0.146	0	1
Right-wing winner	0.487	0	1
Voters' turnout	42.38	21.69	60.55
Electoral year	0.167	0	1
Pre-electoral year	0.167	0	1
Post-electoral year	0.333	0	1

Source: Czech Statistical Office, Ministry of Finance.
Note: $N = 1212$.

4 Empirical analysis

We start our analysis with outputs determination. In the previous section, we defined relevant output variables. However, if we include all these variables as outputs in aggregate analysis, the model will have 1+16 dimensions. This dimensionality is not appropriate and even unnecessary, as many variables are related to the municipality size, hence contain similar information and will be correlated. Table A4 shows the correlation matrix of output variables. Population of a municipality is very highly correlated with the number of pupils (0.993), the number of old people (0.988), the number of businesses (0.967), built-up area (0.935), the length of municipal roads (0.916), population of a district (0.898), municipal waste (0.846), cultural facilities (0.831) and urban green area (0.827). Hence, efficiency analysis with such a large number of variables should not be carried out, as our model would

Table 4. Principal component analysis

	PC1	PC2	PC3	PC4	PC5	PC6
Eigenvalue	9.799	1.385	1.280	1.089	0.906	0.795
Proportion	0.516	0.073	0.067	0.057	0.048	0.042
Cumulative	0.516	0.589	0.656	0.713	0.761	0.803
Pupils in primary schools and kindergartens	0.308	-0.126	-0.040	0.041	-0.004	0.021
Pupils entering secondary schools	-0.041	0.292	0.149	0.615	-0.559	-0.297
Cultural facilities	0.272	0.076	-0.130	0.033	-0.034	0.093
Municipal museums and galleries	-0.070	0.339	-0.471	0.332	0.227	0.579
Objects in monuments reserve	0.132	0.546	0.253	-0.076	-0.028	0.135
Sport in and recreational area	0.203	0.283	-0.024	-0.133	0.210	-0.407
Municipal waste	0.269	-0.171	-0.045	0.088	-0.100	0.084
Nature reserves	0.079	0.141	0.648	-0.212	0.166	0.292
Pollute area	0.219	0.361	-0.237	-0.184	0.097	-0.158
Urban green area	0.256	-0.169	-0.111	0.012	0.077	-0.232
Built-up area	0.305	0.002	-0.036	0.014	-0.042	0.041
New dwellings	0.217	0.139	0.140	-0.052	-0.346	0.179
Businesses	0.308	-0.064	0.015	0.037	-0.083	0.047
Municipal roads	0.251	0.218	-0.209	-0.110	0.111	-0.219
Bus stations	0.241	-0.151	-0.025	0.159	-0.071	0.296
Population in district	0.288	-0.107	0.171	0.002	0.007	0.125
Old population	0.311	-0.079	-0.024	0.029	-0.072	0.021
Homes for disabled	0.179	-0.286	0.015	0.136	0.061	-0.015
Municipal police	0.079	0.003	0.296	0.581	0.619	-0.158

suffer from multicollinearity.

A potential remedy is to aggregate outputs by principal component analysis (PCA) as suggested by Adler and Golany (2001). PCA allows us to decrease the dimension of our model without significant loss of the information in the original data. Table 4 shows, how the data are aggregated to principal components. We decide to keep 6 components, together explaining 80.28% of the variance in the original outputs. Adler and Yazhemsky (2010) suggest the rule-of-thumb of at least 80 % of the variance of the original data in non-parametric estimation.

Table 4 shows how the variables are aggregated in to principal components. The first component explains more than 50% of the variance and represents the size effect of a municipality, as it mainly contains information of variables which are highly correlated with population. The interpretation of other components is not as straightforward. For some observations, the values of components can be negative. To get positive output data we can apply an affine transformation which should not change results.

Hence, for each municipality i we transform the original value of a component k, Y_{ki}^{PC}, $\forall k \in \{1, \ldots, 5\}$. We get the transformed value $Y_{ki}^{PC'}$ such that $Y_{ki}^{PC'} = Y_{ki}^{PC} + b$, where

$b = |\min \{Y_{ki}^{PC}\}_{i=1}^{N}| + 1$ which will ensure strictly positive output data.

In the subsequent analysis, we aim to apply a parametric approach to estimate efficiency scores and find determinants of inefficiency.

4.1 Aggregate analysis

Firstly, we perform the aggregate analysis and aim to find determinants of inefficiency as a whole. Input is represented by total current expenditures of a municipality adjusted for inflation and outputs are principal components computed above. We consider both specifications of a production process: Cobb-Douglas production (cost) function versus more flexible Translog function.

Table 5 shows estimation results when determinants are included in the model as is shown in (5). For each cost function (Cobb-Douglas and Translog) we present various model specifications.[13] In the upper part of the table we can see coefficients of principal components. All significant coefficients are positive as expected, wage has positive significant effect on costs.

Concerning determinants of inefficiency, differences among Cobb-Douglas and Translog results are minor. For the Cobb-Douglas production function, we include dummies for population groups as the fit of the model improves. On the other hand, for Translog specification, population itself is more appropriate, inclusion of population groups causes rapid decrease of Log likelihood function and many coefficients loose their significance. Conclusions are, however, similar: population increases inefficiency. Hence, we cannot say that economies of scale make large municipalities more efficient. Rather, small municipalities operate with very limited budget and are pushed to economize.

Urbanization measured by population density also increases inefficiency; higher property prices and rents outweigh savings of concentration of services. Concerning university-educated population, we found positive effect on inefficiency (on the contrary to Afonso and Fernandes 2008, De Borger and Kerstens 1996). These people are paid higher wages which increases costs of a municipality, and despite controlling for wages, this effect remain significant.[14]

Concerning economic variables, positive effect of unemployment is significant. In municipalities where unemployment is high, inefficiency is more severe. This effect can have several reasons: as wages are mostly low in these municipalities, costs are relatively higher than in a municipality with high wages, which translates into positive effect of unemployment; additionally, unemployed people are poorer, hence a municipal council has to provide more public services for them which may be hardly measurable and not taken into account among outputs.

[13] Full results for Translog specification are available in Table A5.

[14] This may be caused by the lack of data on wages, we include gross wages in districts instead of municipality, as is mentioned above.

Table 5. Aggregate analysis: Cost function and determinants of inefficiency

	Cobb-Douglas			Translog		
β_0	7.77005 ***	7.74815 ***	7.81854 ***	8.38331 †	8.43070	8.37871 †
PC1	0.66250 ***	0.66269 ***	0.66263 ***	0.54645 ***	0.54606 ***	0.55214 ***
PC2	0.00606	0.00512	0.00841	0.44531	0.45858	0.44692
PC3	0.02972	0.02965	0.02918 †	−0.06618	−0.06628	−0.08028
PC4	0.01811	0.01825	0.01808	1.01161 ***	1.01702 ***	1.02805 ***
PC5	0.02424	0.02429	0.02361	−0.57083	−0.56018	−0.55528
PC6	0.07359 **	0.07368 **	0.07276 **	1.00148 *	1.01111 *	1.03114 *
Wage	0.17966 **	0.18132 **	0.17391 **	0.39354 ***	0.39160 ***	0.39631 ***
Constant	1.36533	1.37626	1.36038	0.92190	0.87038	0.90185
Population				0.00002 ***	0.00002 ***	0.00002 ***
Pop < 10,000	−0.46479 ***	−0.46465 ***	−0.46498 ***			
Pop 10,000–20,000	−0.23461 ***	−0.23463 ***	−0.23450 ***			
Pop > 50,000	0.25038 ***	0.25093 ***	0.24840 ***			
Population density	0.00018 ***	0.00018 ***	0.00018 ***	0.00013 ***	0.00013 ***	0.00013 ***
Unemployment	0.00670 ***	0.00668 ***	0.00669 ***	0.00611 ***	0.00610 ***	0.00607 ***
University-ed. pop.	0.04720 ***	0.04711 ***	0.04738 ***	0.02831 ***	0.02838 ***	0.02853 ***
Subsidies per capita	0.00001 ***	0.00001 ***	0.00001 ***	0.00001 ***	0.00001 ***	0.00001 ***
Own revenues	0.01104 ***	0.01107 ***	0.01084 ***	0.01366 ***	0.01364 ***	0.01337 ***
Lagged debt dummy	0.01291	0.01295 †	0.01224	0.00576		
Proximity	0.00071 **	0.00071 *	0.00072 *	0.00115 ***	0.00115 ***	0.00116 ***
Political concent.	−0.05134	−0.07324		−0.05953	−0.05752	
Voters' turnout	−0.01067 ***	−0.01066 ***	−0.01070 ***	−0.01050 ***	−0.01052 ***	−0.01054 ***
Left-wing winner	0.03169 *	0.03179 *	0.03096 *	0.04988 ***	0.05187 ***	0.05091 ***
Right-wing winner	0.02977 **	0.03064 **	0.03047 **	0.03370 ***	0.03299 ***	0.03288 ***
Electoral year	0.03548 †	0.03733 *	0.04146 ***	0.04077 *	0.04133 ***	0.04876 ***
Post-electoral year	−0.00109	−0.00104		−0.00719	−0.00625	
Pre-electoral year	−0.00980	−0.01000		−0.01699	−0.01628	
El_year × left winner	−0.00037			0.00965		
El_year × right winner	0.00499			−0.00284		
σ^2	0.02836 ***	0.02836 ***	0.02838 ***	0.02561 ***	0.02562 ***	0.02566 ***
γ	0.96067	0.95511	0.95598	0.80688 ***	0.68434	0.79011 †
Log likelihood	439.223	439.204	438.895	501.015	500.781	500.035
LR one-sided error	705.336 ***	705.298 ***	704.681 ***	534.538 ***	534.069 ***	532.578 ***

Note: ***, **, * denote statistical significance at 1%, 5% and 10% level, respectively. † denotes statistical significance at 10% level on one-tail.

The effect of subsidies per capita is positive in all cases. This result validates the fly-paper hypothesis that municipalities do not fully translate grants into larger provision of outputs (this effect was found also by Kalb 2008; De Borger et al. 1994; De Borger and Kerstens 1996; Loikkanen and Susiluoto 2005). Interestingly, share of own revenues increase inefficiency. It seems that a municipality which is more capable to raise own revenues may afford to spend/waste more than a municipality more dependent on state revenues. Lagged debt is mostly not significant, hence it does not serve as an incentive for increasing efficiency.

We also study the effect of proximity from the regional center. The further the municipality lies, the less likely it is controlled from its regional government residing in regional center. Additionally, a municipality can less likely free ride on goods and services provided in the regional center and needs to provide full service for their residents. Loikkanen and Susiluoto (2005) also found that peripheral location of a municipality increases inefficiency.

Political variables seem to also significantly influence inefficiency. Voters' involvement in terms of voters' turnout in local elections influences the way a local government spends its resources. In municipalities, where people are involved more in politics, politicians behave more economically. Similarly, Geys et al. (2008) found that voters' involvement increase efficiency in German municipalities.

We also study effect of ideology and include dummies of left-wing (right-wing) winner being equal to 1 when major left-wing parties—Communist and Social Democratic Party—(right-wing parties—Civic Democratic Party, Freedom Union-Democratic Union, Association of Independents-European Democrats, Civic Democratic Alliance) obtain more seats in a municipality council than the major right-wing (left-wing) parties. The effects of dummies are very similar, with slightly higher effect of left-wing parties upon inefficiency. Negative effect of left-wing parties upon efficiency was found also in Kalb (2008). Concerning political concentration, we have not found any effect on inefficiency.

If we look at political cycle, we can see that inefficiency is higher in the year when elections take place. This inefficiency is driven by higher spending which does not correspond to higher output. Politicians tend to spend more which make them less efficient. Effect is not significant in pre-electoral year, hence spending is on its common level and politicians attract voters only in electoral year (elections take place always in autumn). No effect was found for post-electoral year. Concerning political cycle, we may explore whether ideology influences increase in expenditures during electoral year, hence we include interaction terms of left-wing (right-wing) winner and electoral year. However, we have not found any additional effects.

Figure 3 illustrates distributions of efficiency scores under Cobb-Douglas and Translog model for case with the least determinants which are almost all significant (third and sixth columns in Table 5), the scores are averaged over 2003–2008 period. Differences among Cobb-Douglas and Translog case are apparent; distribution under Translog is more symmetric with the highest density around 0.3 than those under Cobb-Douglas with very high density for whole lower part of the distribution. Still, if we compute Spearman correlation coefficient, we find out that differences in rankings are very small as correlation is around 0.985. Hence, regardless of the specification, rankings of municipalities according to their efficiency scores will be very similar.[15]

[15] Individual scores of municipalities are available in Table A6.

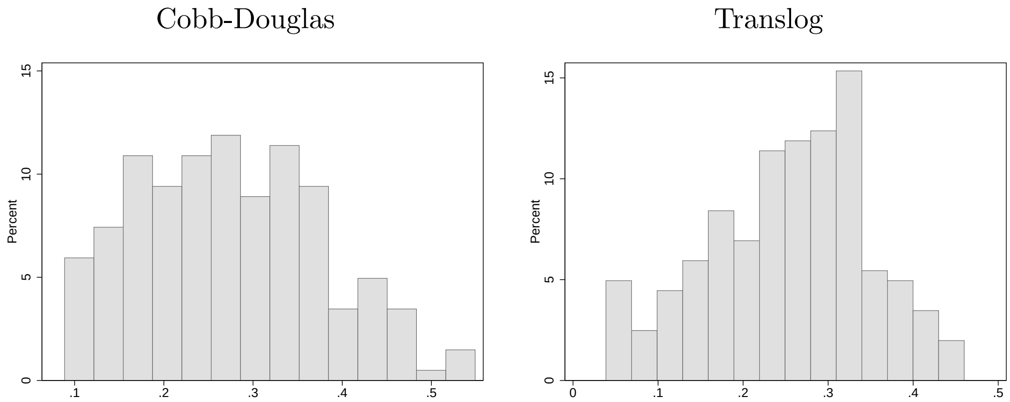

Figure 3. Distribution of efficiency scores: 2003–2008 average

4.2 Spending-specific analysis

In this section, we aim to find determinants of inefficiency in five major local public services (groups of spending): education, culture and sports, environmental protection, industry and infrastructure, and housing. Most of effects of determinants are driven by effects upon spending than upon outputs.

Table 6 presents results and Table 7 supplements with outputs description. For all expenditure groups, we select Translog specification, because most of cross-product terms are significant. Determinants with very low p-value were omitted in the estimation. Concerning population size, small municipalities tend to be more efficient in expenditures on culture and environmental protection. These municipalities are more likely to free-ride upon bigger neighboring municipalities and spend only a little. On the other hand, large municipalities benefit from scale economics in the provision of education. Capacity of schools is much larger in big cities, hence operating costs of schools are lower compared to the situation with several small schools. Small municipalities are also relatively efficient in housing services, however, large housing construction in the biggest municipalities make them also more efficient.

Population density increases efficiency in environmental spending and spending on industry and infrastructure (scale savings], but opposite effect is found for culture and housing (high property prices). Positive effect of unemployment upon inefficiency was found only for environment and industry and infrastructure, however university-educated population increases inefficiency for all groups but housing.

Table 6. Spending-specific analysis: Cost function and determinants of inefficiency

	Education	Culture	Environment	Ind. & infrast.	Housing
β_0	3.98710 ***	8.21261	−6.99932 ***	−2.24646 **	15.38548 ***
A	0.98923 ***	1.53808 ***	3.45697 ***	13.14690 ***	0.14772
B	9.60239 ***	2.32180 ***	0.41905 †	1.99288 ***	4.41531 ***
C		1.16504 ***	−1.49353 ***	2.67949 ***	
D		0.96506 ***	2.81158 ***		
A × B	1.60162 *	−5.22198 **	−3.58411 ***	0.21791	−2.99201
A × C		−7.83678 ***	2.89698 †	7.63608 ***	
A × D		−2.29129 **	10.86946 ***		
B × C		−6.38010 ***	−1.66086 †	1.83047 *	
B × D		0.54045	−0.93345		
C × D		0.46622	−9.09455 ***		
A^2	−3.26136 ***	3.60314 ***	−12.96462 ***	−28.16529 ***	1.96856
B^2	−15.53020 ***	−3.14378 **	3.59902 ***	−7.60744 ***	−4.79120 **
C^2		0.31106	7.61656 ***	−8.25352 ***	
D^2		−1.58425 †	−3.10168 *		
Wage	0.43808 ***	−0.10644	1.64827 ***	1.01361 ***	−0.82128
Constant	0.14544	2.84833	−0.78345 ***	−0.26607	2.37942 *
Pop < 10,000	0.18198 **	−1.07080 ***	−0.96599 ***	0.10196	−0.58700 ***
Pop 10,000–20,000	0.27398 ***	−0.47454 ***	−0.36621 ***	0.17448 ***	−0.26890 ***
Pop > 50,000	−0.52958 ***	0.40765 ***	0.27824 *	0.06666	−0.15801 *
Population density	0.00003	0.00031 ***	−0.00030 ***	−0.00018 **	0.00027 ***
Unemployment	−0.00469	−0.00330	0.02049 ***	0.02536 ***	
University-educated pop	0.02621 **	0.02197 **	0.12981 ***	0.06081 ***	
Subsidies per capita	0.00001 **	0.00001 ***	−0.00003 ***	0.00004 ***	0.00002 ***
Own revenues	0.00604 **	0.01151 ***	−0.01150 ***	0.02010 ***	0.06292 ***
Proximity	0.00152 *	0.00247 ***		0.00165	−0.00274 ***
Political concentration	−0.12648	−0.50613 **	0.42931 ***	−0.48821 †	−0.25262
Voters' turnout	−0.00961 ***	−0.01644 ***	0.00669 ***	−0.01910 ***	−0.03594 ***
Left-wing winner	0.01979	−0.02097		0.07725 †	0.08170 *
Right-wing winner	0.07789 **	0.06623 **		0.09805 **	0.04701 †
Left-wing share			0.00504 ***		
Electoral year	0.07339 *	0.03084	0.04781 ***	0.03985	−0.07925 *
Post-electoral year	−0.01494	−0.05236 **	−0.01591 ***	−0.01762	−0.06202 *
Pre-electoral year	0.00368	−0.04966 †	−0.00459	0.06407	−0.16232 ***
El_year × left winner				0.00082	
El_year × right winner				0.00595 *	
σ^2	0.05199 ***	0.13556 ***	0.64766 ***	0.39212 ***	0.27346 ***
γ	0.07658	0.34899 †	0.00002 ***	0.00003 **	0.16830
Log likelihood	63.73	−508.76	−1456.38	−1191.89	−933.90
LR one-sided error	227.11 ***	987.29 ***	189.01 ***	88.59 ***	636.76 ***

Note: ***, **, * denote statistical significance at 1%, 5% and 10% level, respectively. † denotes statistical significance at 10% level on one-tail.

Table 7. Spending-specific analysis: outputs for each group

	A	B	C	D
Education	Pupils	Students enter. sec. school		
Culture	Cultural facilities	Sport and recr. area	Municipal mus., gal.	Obj. in mon. reserves
Environment	Municipal waste	Nature reserves	Pollute area	Urban green area
Ind. and infr.	Businesses	Municipal roads	Bus stations	
Housing	New dwellings	Built-up area		

Municipality with high subsidies per capita tend to spend more on industry and infrastructure (highest coefficient), however this spending does not translate to our outputs ("fly paper effect"). Similarly, inefficiency is increased in housing, education and culture provision. The opposite effect is find for environmental policy, so it seems that higher subsidies make environmental budget harder due to outflow of resources allocated to other policies (in case where co-financing of projects is necessary). If a municipality has bigger own-revenues-raising capacity, it can afford to spend/waste more. The most of these resources are given to housing services. On the other hand, efficiency in environmental protection increases with higher share of own revenues. This indicates that municipality uses more state revenues to cover environmental spending.

Concerning proximity, municipality lying far from its regional capital has to devote more resources to provision of education and culture. It has to operate schools even it is not as efficient, because children cannot commute to schools long away; it has to organize cultural activities due to the worse possibility to free ride on services in its regional capital. On the contrary, lower proximity (higher geographical distance) make municipality more efficient in housing services. This effect may be explained by development of housing construction in these municipalities.

Finally, we study political effects. Higher political concentration increases inefficiency in environmental protection, hence more concentrated municipal councils are less controlled and devote more resources without an increase in environmental output (similar effect is found in Geys et al. 2008 and Borge et al. 2007). On the other hand, more fragmented councils are more inefficient in cultural spending and weaker effect is found also for spending on industry and infrastructure. Each local party aims to pursue its own interests (attract voters through cultural activities or businesses through better infrastructure) which brings about higher spending and higher inefficiency.

Voters' turnout generally puts pressure on politicians to increase efficiency. The only exception was found for environmental protection. Municipalities, where people are more involved in local politics and may be more conscious of bad environment, tend to spend more on environmental protection, as this effect is mostly driven by higher spending on nonmeasurable output than inefficiency itself.

Political ideology has various effects on inefficiency. If major left-wing parties prevail major right-wing parties in municipal council, provision of housing services tend to be less efficient. Share of left-wing parties also increases inefficiency in terms of environmental spending.[16] On the contrary, right-wing parties tend to be less efficient in education, cultural provision and industry and infrastructure. According to Stastna (2009), left-wing parties in Czech municipalities tend to increase spending on culture and decrease spending on industry and infrastructure, hence lower efficiency of right-wing parties will be the most probably explained by lower amount of cultural services and higher expenditures on industry and infrastructure.

Political cycle also influences inefficiency of local government. Most of these effects will be driven by an increase in spending before elections. In the electoral year, municipality's efficiency worsens in provision of education the most and also in environmental protection. On the other hand, municipalities significantly lower their spending on culture and environmental protection in the year after elections. Results also suggest that local politicians do not start to attract their voters in the year preceding electoral year. Concerning housing, we found negative effects upon inefficiency in electoral, pre-electoral and post-electoral year. Here, increase in efficiency in electoral year may be explained by larger housing construction, where local politicians may have interest to finish building new dwellings just before elections which may increase their political support. Inefficiency rapidly decreases in post-electoral year, when financial support of housing tends to decrease. If we look at industry and infrastructure, we can see that only right-wing parties tend to be significantly less efficient in electoral year and hence tend to increase this type of spending to attract more votes.

5 Conclusion

In the paper, we assess efficiency of Czech local governments. We target the 202 Czech municipalities with extended powers in 2003–2008 period. The main aim of the paper is to uncover drivers of inefficiency with the main focus on political effects. We carry out two types of analyses: the aggregate analysis where we evaluate efficiency of a municipality as a whole; and individual spending-specific analyses which allows us to find determinants of inefficiency in different policies. We employ parametric approach of the stochastic frontier analysis and apply the method developed by Battese and Coelli (1995) where efficiency scores and its determinants are estimated in one-stage.

Efficiency analysis is based on evaluation how inputs are transformed into outputs. Input is represented by current spending (total or group-specific) adjusted for inflation. For each type of policy, we define various public outputs (from 2 to 4). In aggregate analysis, we had to aggregate output variables to avoid multicollinearity problem. We apply principal

[16] Model specification including the share of left-wing parties proved to have a better fit than that one including left- and right-wing winner.

components analysis and aggregate 19 variables into 6 components.

Concerning aggregate analysis, we compare results when Cobb-Douglas and more flexible Translog function are applied. Effects of determinants are similar for both specifications. We find that population, population density, and the share of university-educated people increases inefficiency. Concerning economic variables, we show that municipalities with higher unemployment also tend to increase inefficiency. Additionally, results suggest that the "fly-paper" effect is present as the effect of subsidies per capita upon inefficiency is positive. Interestingly, a higher share of own revenues (fiscal independence) makes municipalities less limited in its spending and consequently less efficient. We estimate the effect of proximity from the regional center and found that more distant municipalities tend to be less efficient. The effects of political variables are also interesting: local legislatures where major left-wing parties prevail tend to be less efficient; districts where voters are more involved in local politics are more efficient, probably given improved accountability and transparency; and local politicians tend to be less efficient in the year of elections, which is driven by an increase in expenditures.

In spending-specific analysis, we explore provision of education, cultural services, environmental protection, industry and infrastructure, and housing services. Focusing on political variables, we find that political concentration may have different effects when spending groups are analyzed separately. This explains the reason, why we do not find any significant effect on aggregate level. Higher political concentration increase inefficiency in environmental protection, but decrease inefficiency in provision of cultural services. Specific effect in case of environment was also found for voters' turnout. Although voters' involvement generally increases efficiency, it has opposite effect in case of environmental protection. One explanation may be that voters more involved in local politics are also those voters who care about environment. On the contrary to aggregate analysis, we find that right-wing parties tend to increase inefficiency more for the most types of spending. The aggregate effect is probably driven by a different type of spending which we do not analyze separately (i.e. administration spending consuming the largest share of a municipal budget). Local political cycle is detected for all expenditure groups. The weakest effect was found for industry and infrastructure, where results suggest that only right-wing parties tend to increase expenditures in electoral year. Positive effect upon efficiency of electoral year was found for housing, which can be explained by increase in new dwellings which are finished just before elections.

Although this paper aims to find determinants of inefficiency of Czech municipalities, many effects are mainly driven by spending, as for large part of spending we cannot find better outputs. From the political perspective, this analysis is just an illustration of potential effects of political variables on local spending. More rigorous analysis exploring longer dataset with more electoral years is necessary. In terms of inefficiency, however, longer dataset would not be as useful, as municipalities with extended powers emerged in 2003 and their competencies and responsibilities were not comparable before 2003. In further research, we plan to focus on spending of municipalities and analyze local political cycle in a greater detail. Especially, we plan to focus on capital expenditures on disaggregated level.

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Appendix

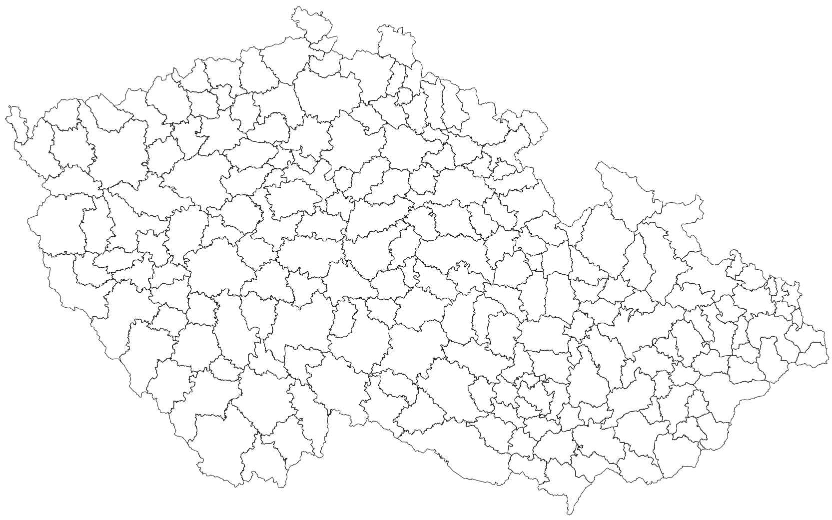

Figure A1. Districts of municipalities with extended powers in the Czech Republic

Table A1. List of municipalities

1	Benešov	69	Litoměřice	137	Boskovice
2	Beroun	70	Litvínov	138	Břeclav
3	Brandýs nad Labem-Stará Boleslav	71	Louny	139	Bučovice
4	Čáslav	72	Lovosice	140	Hodonín
5	Černošice	73	Most	141	Hustopeče
6	Český Brod	74	Podbořany	142	Ivančice
7	Dobříš	75	Roudnice nad Labem	143	Kuřim
8	Hořovice	76	Rumburk	144	Kyjov
9	Kladno	77	Teplice	145	Mikulov
10	Kolín	78	Ústí nad Labem	146	Moravský Krumlov
11	Kralupy nad Vltavou	79	Varnsdorf	147	Pohořelice
12	Kutná Hora	80	Žatec	148	Rosice
13	Lysá nad Labem	81	Česká Lípa	149	Slavkov u Brna
14	Mělník	82	Frýdlant	150	Šlapanice
15	Mladá Boleslav	83	Jablonec nad Nisou	151	Tišnov
16	Mnichovo Hradiště	84	Jilemnice	152	Veselí nad Moravou
17	Neratovice	85	Liberec	153	Vyškov
18	Nymburk	86	Nový Bor	154	Znojmo
19	Poděbrady	87	Semily	155	Židlochovice
20	Příbram	88	Tanvald	156	Hranice
21	Rakovník	89	Turnov	157	Jeseník
22	Říčany	90	Železný Brod	158	Konice
23	Sedlčany	91	Broumov	159	Lipník nad Bečvou
24	Slaný	92	Dobruška	160	Litovel
25	Vlašim	93	Dvůr Králové nad Labem	161	Mohelnice
26	Votice	94	Hořice	162	Olomouc
27	Blatná	95	Hradec Králové	163	Prostějov
28	České Budějovice	96	Jaroměř	164	Přerov
29	Český Krumlov	97	Jičín	165	Šternberk
30	Dačice	98	Kostelec nad Orlicí	166	Šumperk
31	Jindřichův Hradec	99	Náchod	167	Uničov
32	Kaplice	100	Nová Paka	168	Zábřeh
33	Milevsko	101	Nové Město nad Metují	169	Bystřice pod Hostýnem
34	Písek	102	Nový Bydžov	170	Holešov
35	Prachatice	103	Rychnov nad Kněznou	171	Kroměříž
36	Soběslav	104	Trutnov	172	Luhačovice
37	Strakonice	105	Vrchlabí	173	Otrokovice
38	Tábor	106	Česká Třebová	174	Rožnov pod Radhoštěm
39	Trhové Sviny	107	Hlinsko	175	Uherské Hradiště
40	Třeboň	108	Holice	176	Uherský Brod
41	Týn nad Vltavou	109	Chrudim	177	Valašské Klobouky
42	Vimperk	110	Králíky	178	Valašské Meziříčí
43	Vodňany	111	Lanškroun	179	Vizovice
44	Blovice	112	Litomyšl	180	Vsetín
45	Domažlice	113	Moravská Třebová	181	Zlín
46	Horažďovice	114	Pardubice	182	Bílovec
47	Horšovský Týn	115	Polička	183	Bohumín
48	Klatovy	116	Přelouč	184	Bruntál
49	Kralovice	117	Svitavy	185	Český Těšín
50	Nepomuk	1185	Ústí nad Orlicí	186	Frenštát pod Radhoštěm
51	Nýřany	119	Vysoké Mýto	187	Frýdek-Místek
52	Přeštice	120	Žamberk	188	Frýdlant nad Ostravicí
53	Rokycany	121	Bystřice nad Pernštejnem	189	Havířov
54	Stod	122	Havlíčkův Brod	190	Hlučín
55	Stříbro	123	Humpolec	191	Jablunkov
56	Sušice	124	Chotěboř	192	Karviná
57	Tachov	125	Jihlava	193	Kopřivnice
58	Aš	126	Moravské Budějovice	194	Kravaře
59	Cheb	127	Náměšť nad Oslavou	195	Krnov
60	Karlovy Vary	128	Nové Město na Moravě	196	Nový Jičín
61	Kraslice	129	Pacov	197	Odry
62	Mariánské Lázně	130	Pelhřimov	198	Opava
63	Ostrov	131	Světlá nad Sázavou	199	Orlová
64	Sokolov	132	Telč	200	Rýmařov
65	Bílina	133	Třebíč	201	Třinec
66	Děčín	134	Velké Meziříčí	202	Vítkov
67	Chomutov	135	Žďár nad Sázavou		
68	Kadaň	136	Blansko		

Table A2. List of selected studies

Authors	**Country**	N	**Period**	**Methods**	**Inputs**	**Outputs**
Afonso and Fernandes (2008)	Portugal	278	2001	DEA	Total per capita expenditures	Old people, no. of schools, school enrolment, share of library users in population, water supply, solid waste, licenses for building construction, length of roads per population
Arcelus et al. (2007)	Spain: Navarre region	263	1998–2001	SFA (BC)	Total current expenditures	Area, total population, share of old people, dwellings, index measuring the scarcity in the provision of municipal services, time trend
Balaguer-Coll et al. (2007)	Spain: Valencian region	414	1995	DEA, FDH	Wages and salaries, expenditure on goods and services, current transfers, capital transfers, capital expenditures	Population, no. of lighting points, tons of waste, street infrastructure area, public parks area, quality services (good, average, bad)
De Borger and Kerstens (1996)	Belgium	589	1985	DEA, FDH, SFA, COLS	Total current expenditures	No. of beneficiaries of minimal subsistence grants, students in local primary schools, surface of public recreational facilities, population, share of old people
Geys et al. (2008)	Germany: Baden-Wurtenberg	1021	2001	SFA (BC)	Total current expenditures	Students in local public schools, kindergartens, surface of public recreational facilities, population, old people, no. of employees paying social security contributions
Geys and Moesen (2009)	Belgium: Flanders	300	2000	SFA (BC)	Current expenditures on those issues for which we observe government outputs	Number of subsistence grant beneficiaries, number of students in local primary schools, size of public recreational facilities, length of municipal roads, share of municipal waste collected through door-to-door collections
Kalb (2010)	Germany: Baden-Wurtenberg	245	1990–2004	SFA (BC)	Total current expenditures	Students in public schools, population, share of old people, number of employees covered by social security, surface of public recovery areas
Vanden Eeckaut et al. (1993)	Belgium: Wallone region	235	1986	DEA, FDH	Total current expenditures	Population, length of roads, old people, no. of beneficiaries of minimal subsistence grants, no. of crimes

Note: We denote the method developed by Battese and Coelli (1995) as SFA (BC), corrected ordinary least squares (COLS).

Table A3. Output variables: overview

	Source	Database	Web page	Available	Note
Pupils in primary schools and kindergartens	IIE	Aggregated data	http://stistko.uiv.cz/vo/	2003–2008	
Pupils entering secondary schools (%)	IIE	Aggregated data	http://stistko.uiv.cz/vo/	2005–2008	2005–2008 average for 2003–2004
Cultural facilities	CZSO	City and municipal statistics (MOS)		2003–2006	2006 data for 2007–2008
Municipal museums and galleries	MGA, municipal websites	Catalog of museums and galleries	http://www.cz-museums.cz/amg/faces/adresar/	Retrieved in 2009	Same for 2003–2008
Objects in monuments reserve	NIM	Monumnet	http://monumnet.npu.cz/monumnet.php	2003–2008	Objects in municipal monuments reserves and zones
Sporting and recreational area (ha)	CZSO	MOS		2006–2008	2006 data for 2003–2005
Municipal waste (tons)	ME	ISOH	http://isoh.cenia.cz/groupisoh	2003–2008	Data for ORP districts adjusted for population share of a municipality in whole district population
Nature reserves	ANCLP	USOP	http://drusop.nature.cz/	2003–2008	Sum of national nature reserves, nature reserves, national nature monuments and nature monuments
Pollute area (ha)	CZSO	MOS		2003–2008	Sum of arable land, built-up and other area
Urban green area (ha)	CZSO	MOS		2006–2008	2006 data for 2003–2005
Built-up area (ha)	CZSO	MOS		2003–2008	
New dwellings	CZSO	MOS		2003–2008	
Businesses	CZSO	MOS		2003–2008	
Municipal roads (ha)	CZSO	MOS		2006–2008	2006 data for 2003–2005
Bus stations	IDOS		http://jizdnirady.idnes.cz/	Retrieved in 2009	Same for 2003–2008
Population in district	CZSO	Regional Yearbooks	http://www.czso.cz/csu/redakce.nsf/i/krajske_rocenky	2003–2008	
Old population	CZSO	MOS		2003–2008	
Homes for disabled	CZSO	MOS		2003–2006	2006 data for 2007–2008
Municipal police	MOS, municipal websites		2003–2008		

Sources: ANCLP = Agency for Nature Conservation and Landscape Protection, MGA = Museums and Galleries Association, CZSO = Czech Statistical Office, IDOS = Transportation timetables, IIE = Institute for Information on Education, ME = Ministry of Environment, NIM= National Institute of Monuments.

Table A4. Determinants: overview

	Source	Database	Web page	Available	Note
Population	CZSO	Regional Yearbooks	http://www.czso.cz/csu/redakce.nsf/i/krajske_rocenky	2003–2008	
Population density	CZSO	Regional Yearbooks	http://www.czso.cz/csu/redakce.nsf/i/krajske_rocenky	2003–2008	
University-educated people	CZSO	Census		2001	Same for 2003–2008
Unemployment	CZSO	Regional Yearbooks	http://www.czso.cz/csu/redakce.nsf/i/krajske_rocenky	2003–2008	Unemployment in ORP districts
Subsidies	MF	ARIS	http://wwwinfo.mfcr.cz/aris/	2003–2008	Total state subsidies
Own revenues	MF	ARIS	http://wwwinfo.mfcr.cz/aris/	2003–2008	Charges and fees, real estate tax and non-tax revenues / Total revenues (own transfers excluded)
Lagged debt dummy	MF	ARIS	http://wwwinfo.mfcr.cz/aris/	2003–2008	Deficit after consolidation
Proximity	Map server		http://www.mapy.cz	Retrieved in 2010	The shortest distance
Political concentration	CZSO	Election server	http://volby.cz/	2002, 2006	Data same for 2003–2006, 2007–2008, Herfindahl index
Left-wing parties	CZSO	Election server	http://volby.cz/	2002, 2006	Data same for 2003–2006, 2007–2008, share of seats of KSČM and ČSSD
Right-wing partis	CZSO	Election server	http://volby.cz/	2002, 2006	Data same for 2003–2006, 2007–2008, share of seats of ODS, US-DEU, SNK-ED, ODA
Left-wing winner	CZSO	Election server	http://volby.cz/	2002, 2006	Data same for 2003–2006, 2007–2008, equals 1 if KSČM and ČSSD get more seats than ODS, US-DEU, SNK-ED, ODA altogether
Right-wing winner	CZSO	Election server	http://volby.cz/	2002, 2006	Data same for 2003–2006, 2007–2008, equals 1 if ODS, US-DEU, SNK-ED, ODA get more seats than KSČM and ČSSD altogether
Voters' turnout	CZSO	Election server	http://volby.cz/	2002, 2006	Data same for 2003–2006, 2007–2008
Wage	CZSO	KROK		2003–2005	Data for districts (okresy), 2006–2008 data based on 2005 but adjusted for growth of regional gross wages (13 regions)
Inflation	CZSO		http://www.czso.cz/	2003–2008	CPI, 2003 base year

Sources: CZSO = Czech Statistical Office, MF = Ministry of Finance of the Czech Republic.

Table A5. Aggregate analysis: Translog specification

β_0	8.38331	†	8.43070		8.37871	†
PC1	0.54645	***	0.54606	***	0.55214	***
PC2	0.44531		0.45858		0.44692	
PC3	−0.06618		−0.06628		−0.08028	
PC4	1.01161	***	1.01702	***	1.02805	***
PC5	−0.57083		−0.56018		−0.55528	
PC6	1.00148	*	1.01111	*	1.03114	*
Wage	0.39354	***	0.39160	***	0.39631	***
PC11	0.54029	***	0.54081	***	0.53819	***
PC12	−0.23388	**	−0.23485	**	−0.23233	**
PC13	0.07094		0.07120		0.07103	
PC14	0.63604	***	0.63781	***	0.63966	***
PC15	−0.22205	†	−0.22449	*	−0.22705	*
PC16	−0.48129	***	−0.48353	***	−0.48600	***
PC22	−0.25396	†	−0.24753	†	−0.24172	†
PC23	−0.28252	†	−0.28691	†	−0.29108	†
PC24	0.32493	†	0.31855	†	0.33021	†
PC25	−0.14110		−0.15015		−0.13796	
PC26	−0.01645		−0.01675		−0.01625	
PC33	0.21456		0.21226		0.21594	
PC34	0.47325	*	0.47295	*	0.47982	**
PC35	0.09721		0.09502		0.09360	
PC36	−0.07838		−0.07802		−0.07863	
PC44	0.37853	†	0.37377	†	0.37744	†
PC45	−1.21502	***	−1.21117	***	−1.22546	***
PC46	−0.07661		−0.07789		−0.08051	
PC55	−0.65739	*	−0.66066	*	−0.68369	
PC56	0.57516	***	0.57746	***	0.57776	***
PC66	−0.04670		−0.04991		−0.05077	
Constant	0.92190		0.87038		0.90185	
Population	0.00002	***	0.00002	***	0.00002	***
Population density	0.00013	***	0.00013	***	0.00013	***
Unemployment	0.00611	***	0.00610	***	0.00607	***
University-educated population	0.02831	***	0.02838	***	0.02853	***
Subsidies per capita	0.00001	***	0.00001	***	0.00001	***
Own revenues	0.01366	***	0.01364	***	0.01337	***
Lagged debt dummy	0.00576					
Proximity	0.00115	***	0.00115	***	0.00116	***
Political concentration	−0.05953		−0.05752			
Voters' turnout	−0.01050	***	−0.01052	***	−0.01054	***
Left-wing winner	0.04988	***	0.05187	***	0.05091	***
Right-wing winner	0.03370	***	0.03299	***	0.03288	***
Electoral year	0.04077	*	0.04133	***	0.04876	***
Post-electoral year	−0.00719		−0.00625			
Pre-electoral year	−0.01699		−0.01628			
El_year × left winner	0.00965					
El_year × right winner	−0.00284					
σ^2	0.02561		0.02562	***	0.02566	***
γ	0.80688		0.68434		0.79011	†
Log likelihood	501.02		500.781		500.035	
LR one-sided error	534.54	***	534.069	***	532.578	***

Note: ***, **, * denote statistical significance at 1%, 5% and 10% level, respectively. † denotes statistical significance at 10% level on one-tail.

Table A6. Efficiency scores: 2003–2008 average

Rank	Mun.	Translog	Cobb-Doug.	Rank	Mun.	Translog	Cobb-Doug.	Rank	Mun.	Translog	Cobb-Doug.
1	46	0.4600	0.5409	69	182	0.2954	0.3210	137	63	0.2132	0.2263
2	49	0.4576	0.5193	70	55	0.2952	0.3661	138	156	0.2089	0.2243
3	158	0.4381	0.5081	71	161	0.2941	0.3333	139	75	0.2079	0.2073
4	147	0.4359	0.5490	72	137	0.2932	0.2677	140	173	0.2039	0.2142
5	110	0.4193	0.4799	73	152	0.2915	0.3013	141	11	0.2007	0.1958
6	131	0.4131	0.4535	74	167	0.2900	0.3276	142	14	0.1992	0.1904
7	39	0.4079	0.4766	75	58	0.2899	0.2959	143	117	0.1977	0.1939
8	30	0.4078	0.4678	76	143	0.2891	0.2883	144	193	0.1972	0.1915
9	54	0.4045	0.4575	77	84	0.2885	0.3003	145	62	0.1952	0.1892
10	146	0.4044	0.4719	78	120	0.2879	0.2946	146	2	0.1949	0.1847
11	121	0.4023	0.4199	79	159	0.2876	0.3364	147	153	0.1947	0.1890
12	139	0.3987	0.4344	80	52	0.2870	0.3075	148	1	0.1945	0.2144
13	6	0.3986	0.4453	81	145	0.2868	0.3334	149	184	0.1918	0.1835
14	44	0.3929	0.4466	82	33	0.2867	0.2936	150	180	0.1874	0.1730
15	124	0.3896	0.4119	83	141	0.2848	0.3023	151	68	0.1849	0.2006
16	16	0.3855	0.4652	84	123	0.2816	0.2937	152	195	0.1834	0.2017
17	27	0.3827	0.4286	85	168	0.2813	0.2864	153	178	0.1828	0.2000
18	26	0.3730	0.4270	86	119	0.2809	0.2906	154	12	0.1816	0.1908
19	177	0.3712	0.3981	87	19	0.2803	0.2944	155	122	0.1799	0.1949
20	202	0.3712	0.4418	88	188	0.2795	0.2693	156	175	0.1796	0.1853
21	142	0.3707	0.4099	89	47	0.2788	0.3448	157	166	0.1762	0.1699
22	179	0.3692	0.4226	90	86	0.2775	0.2781	158	69	0.1751	0.1687
23	116	0.3628	0.3895	91	7	0.2754	0.2885	159	196	0.1747	0.1818
24	42	0.3571	0.3834	92	111	0.2746	0.2900	160	140	0.1721	0.1899
25	134	0.3559	0.3671	93	176	0.2698	0.2649	161	65	0.1718	0.1787
26	155	0.3543	0.3808	94	25	0.2693	0.2987	162	138	0.1714	0.1763
27	194	0.3504	0.3934	95	190	0.2677	0.2599	163	135	0.1688	0.1566
28	128	0.3461	0.3744	96	35	0.2667	0.2523	164	81	0.1655	0.1798
29	132	0.3454	0.3984	97	96	0.2649	0.2820	165	104	0.1645	0.1814
30	32	0.3451	0.3724	98	56	0.2648	0.2669	166	37	0.1620	0.1580
31	150	0.3442	0.3274	99	103	0.2646	0.2543	167	64	0.1579	0.1628
32	41	0.3442	0.3867	100	53	0.2645	0.2571	168	185	0.1564	0.1612
33	100	0.3392	0.3695	101	107	0.2637	0.2552	169	133	0.1536	0.1711
34	90	0.3392	0.3771	102	170	0.2607	0.2795	170	70	0.1499	0.1691
35	126	0.3383	0.3755	103	76	0.2595	0.2617	171	171	0.1489	0.1649
36	172	0.3376	0.3611	104	4	0.2591	0.2758	172	201	0.1473	0.1718
37	98	0.3371	0.3602	105	165	0.2590	0.2678	173	34	0.1459	0.1499
38	92	0.3358	0.3600	106	21	0.2586	0.2643	174	183	0.1421	0.1451
39	87	0.3355	0.3252	107	91	0.2580	0.2761	175	154	0.1382	0.1624
40	82	0.3354	0.3552	108	113	0.2571	0.2845	176	20	0.1338	0.1401
41	197	0.3353	0.4270	109	157	0.2555	0.2455	177	163	0.1307	0.1580
42	51	0.3347	0.3502	110	45	0.2546	0.2569	178	10	0.1295	0.1383
43	129	0.3345	0.3744	111	24	0.2534	0.2725	179	38	0.1275	0.1503
44	74	0.3344	0.4452	112	89	0.2515	0.2392	180	15	0.1269	0.1513
45	108	0.3299	0.3406	113	57	0.2487	0.2585	181	59	0.1241	0.1481
46	43	0.3278	0.3683	114	72	0.2466	0.2333	182	77	0.1150	0.1552
47	50	0.3270	0.3604	115	22	0.2443	0.2506	183	199	0.1134	0.1205
48	151	0.3252	0.2974	116	5	0.2433	0.2215	184	83	0.1107	0.1323
49	160	0.3247	0.3413	117	18	0.2414	0.2447	185	164	0.1071	0.1267
50	13	0.3228	0.3617	118	106	0.2394	0.2315	186	66	0.1030	0.1171
51	169	0.3225	0.3333	119	80	0.2373	0.2732	187	60	0.1007	0.1311
52	149	0.3214	0.3421	120	130	0.2368	0.2316	188	125	0.0989	0.1361
53	101	0.3190	0.3324	121	97	0.2366	0.2434	189	67	0.0973	0.1231
54	127	0.3178	0.3372	122	136	0.2353	0.2279	190	198	0.0910	0.1307
55	102	0.3155	0.3716	123	109	0.2324	0.2340	191	187	0.0852	0.1226
56	94	0.3154	0.3333	124	17	0.2317	0.2258	192	73	0.0775	0.1050
57	115	0.3138	0.3409	125	174	0.2315	0.2287	193	181	0.0663	0.1149
58	191	0.3138	0.3299	126	3	0.2288	0.2407	194	192	0.0654	0.1077
59	8	0.3123	0.3140	127	31	0.2284	0.2424	195	114	0.0652	0.1208
60	40	0.3114	0.3347	128	99	0.2272	0.2134	196	9	0.0589	0.1140
61	36	0.3104	0.3410	129	186	0.2266	0.2179	197	189	0.0560	0.1373
62	148	0.3104	0.3371	130	118	0.2258	0.2149	198	95	0.0499	0.1036
63	61	0.3098	0.3548	131	79	0.2240	0.2240	199	78	0.0465	0.0887
64	200	0.3054	0.3314	132	93	0.2235	0.2289	200	28	0.0430	0.0987
65	88	0.3049	0.3088	133	29	0.2224	0.2296	201	162	0.0405	0.0975
66	23	0.2990	0.3287	134	112	0.2216	0.2316	202	85	0.0387	0.1047
67	105	0.2977	0.2777	135	48	0.2206	0.2537				
68	144	0.2963	0.2778	136	71	0.2171	0.2116				