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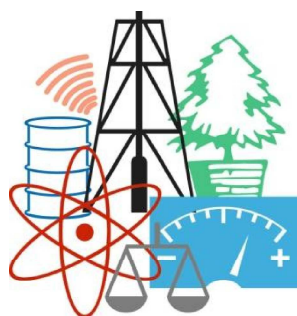
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Intermunicipal Cooperation in Municipal Waste Management and Its Effects on Cost-Effectiveness

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Abstract

This paper focuses on intermunicipal cooperation and provides a new and innovative approach to evaluating the cost effectiveness and cost efficiency of municipal waste management. We examine a sample of 710 municipalities in two regions in the Czech Republic between 2014 and 2016. We investigated two forms of intermunicipal cooperation: joint public procurements and intermunicipal waste collection companies. The results, based on an ordinary least squares regression, show that cost reduction is significantly influenced by both forms of intermunicipal cooperation. The impact is stronger for small municipalities of fewer than 1,000 inhabitants.

Keywords: waste management; intermunicipal cooperation; public procurement; cost effectiveness.

Introduction

Municipalities in the Czech Republic are obliged to provide a large number of public utilities; this obligation is delegated to them as part of their independent and devolved powers. These services include waste management. For the past fifty years, the academic world has been discussing the factors influencing the cost efficiency and cost effectiveness of providing these public utility services[1-4, 6-15]. Most papers have focused particularly on the form of production (public or private) and the form of provision (contracting out and in-house)[1-2, 8-10, 16-18]. Solid new evidence indicates that intermunicipal cooperation is among the most significant factors influencing the efficiency of waste management services[9, 13, 17, 21]. In the area of waste management, intermunicipal cooperation can take the form of intermunicipal contracting out (joined public procurement) or of an intermunicipal waste collection company.

Municipal waste management costs were more than 6 0% of the total current municipal costs for environmental protection and they accounted on average for 4 % to 5 % of the total current costs for municipalities in the Czech Republic in the 2012 – 2016 period. It is thus obvious that waste management is an integral and indispensable part of municipal budgets. Waste management is therefore a suitable target for measures aimed at saving public resources. Within this context, this paper is focused on waste management at the local level in the Czech Republic in general.

The increasing importance of municipal waste management and its efficiency and effectiveness is a broadly discussed topic, both in terms of theory and practical experience[1-21]. Our main intention with our research is to contribute to the ongoing academic debate and to go a bit beyond conventional approaches. Defining and measuring the efficiency, or, in other words, the process of using resources and their transformation into outputs and outcomes, seems to be one of the biggest issues of contemporary research. Over the course of several decades, evaluating efficiency and even evaluation methods have been greatly improved and advanced. However, an accurate evaluation still remains a conceptual challenge in relation to municipal costs. This issue is also complicated by the fact that public sector outcomes used to be off-market, lacking relevant data and thus making it impossible to quantify.

Many relevant factors influence the efficiency of public services. These factors have been widely analysed in the scientific literature worldwide. Although most international studies are strictly focused on

the importance of the form of production (i.e. public, private, or mixed – PPPs), statistically more significant and clearer results are provided by the studies that are focused on the forms of provision (i.e. outsourcing or in-house provision), including contracting out and public procurement issues. In addition, different forms of production and provision lead to different results. Obviously, these issues are closely connected to the problem of suboptimal local government size as well as to the phenomena of economies or diseconomies of scale. More intensive research has recently been focused on intermunicipal cooperation. The authors who study these issues usually point out that intermunicipal cooperation enables the decrease of expenses and the saving of costs for municipalities and the improvement of the quality and accessibility of local services[22-25]. Bel and Costas[18] found intermunicipal cooperation to be an efficient tool for reducing costs, but the cost savings can disappear over time if contracting-out was chosen by the municipality. According to Bel and Mur[26], municipal cooperation can help especially the smallest municipalities to provide higher quality services at stable costs. This result corresponds with that of Steiner[27], who stated that municipal mergers resulted in a higher quality and increased quantity of services. According to Bel et al.[11], the decision of municipalities to cooperate is pragmatic, especially for municipalities of suboptimal size. Some authors[25, 28-29] have pointed out that although most research results show that intermunicipal cooperation has a significant impact on cost savings in waste management, it is important to examine the internal aspects of intermunicipal cooperation (such as management, institutionalization, and share of municipalities in cooperation). However, this research is still in the early stages.

Intermunicipal cooperation and its influence on increasing the efficiency of municipal expenses are also currently significant research issues in the Czech Republic. Because the expenses expended by municipalities on waste management have grown exponentially in the Czech Republic[30-34], the demand of municipalities for efficient and effective solutions has been increasing. The increasing municipal costs for waste collection and waste disposal, as well as increased wages, require measures that will enable the decrease of total expenses. Thus a space is created for making use of intermunicipal cooperation that will enable the decrease of expenses, for example by utilizing the positive effects of the economies of scale or the economies of density. In addition, municipalities themselves can influence this if they collaborate in the given area. The Czech Republic serves as an excellent data source on this point, contributing to the relevant academic debate with experiences from highly fragmented local government structures.

This paper studies the relation between municipal waste management costs and selected factors affecting cost efficiency. We pay special attention to (1) the form of production (public/private/PPPs), intermunicipal cooperation and its different forms (intermunicipal waste collection company, intermunicipal/joint public procurements), and economies of scale, and (2) the size structure of local governments. The following research questions were set:

RQ1: How is the cost efficiency of local waste collection services affected by selected factors?

RQ2: Is the cost efficiency of local waste collection services affected by intermunicipal cooperation? If so, how?

RQ3: How do the results differ between different population sizes?

The paper is structured to present answers to these three research questions, as follows: the first sub-chapter provides a concise description of the material and the scientific methods used, focusing on data and sources, and the empirical model. The second part of the paper contains the evaluation and exact description of the achieved results and their statistical significance and provides a discussion and comparison of the achieved results and previously published papers, our own opinion of the established differences, and our view of the results. We outline the need for further solutions and the importance of developing the research field, society, and practice. The paper concludes by providing a concise summary of the most important findings in relation to the paper focus.

Materials and Methods

Data and Sources

The research was carried out on data collected from 2014 to 2016. The sample consists of 710 municipalities located in two regions in the Czech Republic: Olomouc Region and Zlín Region. The analysis utilized linked open data on municipal areas and populations from the Czech Statistical Office (CZSO) and linked open data on the costs of the waste collection service for the Czech municipalities from MONITOR, the specialized information portal of the Ministry of Finance of the Czech Republic. The data relating to the forms of intermunicipal cooperation, forms of production, forms of provision, PPPs, and economies of scale were obtained via a questionnaire-based survey. The survey was carried out from September 2016 to the end of December 2017.

For processing the OLS regression, it was necessary to clean the data to achieve a standard data distribution. This was obtained after the data had been cleaned by 5% due to extreme values (18 lowest values and 18 largest values). The data set contained 674 municipalities after the sample was cleaned. In order to perform a statistical data analysis, the municipalities were divided into two population size categories: fewer than 1000 inhabitants and more than 1,000 inhabitants.

The Czech Republic has one of the highest territorial fragmentations of municipalities in Europe. There are many small municipalities with fewer than 1000 inhabitants (more than 82 % of all municipalities) in the Czech Republic. Municipalities with more than 1,000 inhabitants form only 17.3 % of all municipalities (see Table 1). The structure of the research sample corresponds relatively well to the structure of municipalities in the Czech Republic, even though it contains a smaller proportion of municipalities with fewer than 1000 inhabitants (see Table 1).

Table 1: Structure of the research sample

Population	Number of municipalities in the Czech Republic	Percentage of all the municipalities in the Czech Republic	Number of municipalities in the research sample	Percentage of the sample
fewer than 1000	5618	82.69 %	482	67.88 %
more than 1000	1176	17.31 %	228	32.12 %
total	6794	100.00 %	710	100.00 %

Source: The authors, according to CZSO

The Empirical Model

In order to enable the comparison of the results of the research with international parametric (econometric) studies[8, 16, 18-19, 26], an OLS regression model was used, as in those studies. The basic function for total municipal waste management costs per capita (*TMWCpc*) in relation to intermunicipal cooperation, as well as other factors, can be represented as:

$$TMWCpc = f(IWCC, IPP, \ Prod, \ Prov, PPP, Scale) \tag{1}$$

The dependent variable *TMWCpc* represents the total municipal waste costs per capita. It includes collection, transportation, disposal or treatment, and other waste collection services. The total costs incurred by each municipality are determined by the population of the municipality; therefore, we study the costs per capita.

They are mainly determined by the following factors, which were determined as explanatory variables:

- *Intermunicipal waste collection company (IWCC)*: This is a dummy variable expressing *intermunicipal cooperation* and *common municipal waste collection company*. The variable acquires a value of 1 when a municipality is one of the owners of waste collection company; otherwise it acquires a value of 0. The hypothesis for this variable is a negative correlation, which was confirmed by a number of studies [13, 18, 21, 26, 38].

- *Intermunicipal/joint public procurement (IPP)*: This is a dummy variable expressing *intermunicipal cooperation in public procurement* for municipal waste management. This variable acquires a value of 1 when a municipality submits a joint public procurement contract for waste management and a value of 0 otherwise.

- *Form of production (Prod):* This variable captures the influence of either *public or private delivery* of waste collection and services on costs. It is constructed as a dummy variable and takes a value of 1 if the service is produced by a public company and a value of 0 for cases of private delivery. A public company is defined as a company which is more than 50% under public ownership. The expected effect is ambiguous. According to Ohlsson[7], public delivery is more cost efficient than private delivery. In contrast, other authors[6, 9,13, 18,20-21, 26, 38-40] have concluded that there are no significant differences between public and private delivery.

- *Form of provision (Prov)*: This is a dummy variable for the *form of delivery* of waste collection services. It acquires a value of 1 for cases of contracting out and a value of 0 for cases of internal delivery. The results of empirical studies conducted in various European countries and in the US are ambiguous as regards this variable. According to Bel and Costas (2006) and Bel and Mur (2009), the form of delivery (internal/contracting out) does not have a significant impact on municipal waste collection costs. Dijkgraaf and Gradus (2013) and Gradus, et al. (2016) indicate that contracting out reduces municipal costs. For this reason, the hypothesis for this variable is ambiguous.

- *Public-private partnership (PPP)*: The impact of *the mixed (PPP) form* of waste collection companies is examined in a number of empirical studies[13, 15, 39]. In order to assess the influence of the PPP form of enterprise on waste collection costs, we use the PPP variable as a dummy variable that takes a value of 1 if waste collection services are provided by a mixed form of enterprise (PPP), and a value of 0 otherwise. The hypothesis for this variable is a positive correlation. In mixed ownership, the co-owner is a private company, which is expected to exert pressure on the waste collection company to achieve a higher profit.

- *Multinational waste collection corporation (MNC)*: This is a dummy variable that acquires a value of 1 in cases in which a municipality is served by a waste *multinational corporation* (MNC) and a value of 0 if it is not. The hypothesis for this variable is a positive correlation. The globalization of the world economy has resulted in the rapid growth of MNCs; regions forge increasing numbers of links with other locations within and across national boundaries through the local technological development efforts of MNCs. This kind of ownership leads the owner or/and co-owner of the MNC to exert pressure on the waste collection company to achieve an increasingly higher profit. Subsequently, the MNCs are allowed to return the achieved profit to the municipality only in a minor degree; hence, the costs are increasing.

- *Economies of scale (Scale)*: This dummy variable acquires a value of 1 where economies of scale have been achieved in a waste collection area with more than 30,000 inhabitants and a value of 0 in the opposite situation. The hypothesis for this variable is a negative correlation, as was proved in a number of studies[1, 40].

The analysis, consisting of both exploratory data analysis and multiple OLS regression analysis, was conducted at the municipality level; the data used stemmed from 2016. We used the software packages Microsoft Excel 2011 and STATISTICA. Tables 2 – 5 shows descriptive statistics for the individual variables.

Table 2: Descriptive statistics for variables used in the OLS model (whole sample; N=710; 2016)

Variable	Mean	Min	Max	St. dev.
MWMCpc [CZK/capita]	533.53	283.79	1,406.30	152.46
IWCC	0.29	0.00	1.00	0.45
IPP	0.17	0.00	1.00	0.37
Prod	0.58	0.00	1.00	0.49
Prov	0.61	0.00	1.00	0.49
PPP	0.13	0.00	1.00	0.33
MNC	0.49	0.00	1.00	0.50
Scale	0.72	0.00	1.00	0.45

Table 3: Descriptive statistics of variables used in the OLS model (sample of Municipalities with fewer than 1000 inhabitants; N = 482; 2016)

Variable	Mean	Min	Max	St. dev.
MWMCpc	556.69	283.79	1,477.86	188.37
IWCC	0.35	0.00	1.00	0.48
IPP	0.17	0.00	1.00	0.38
Prod	0.68	0.00	1.00	0.47
Prov	0.57	0.00	1.00	0.50
PPP	0.07	0.00	1.00	0.25
MNC	0.57	0.00	1.00	0.50
Scale	0.69	0.00	1.00	0.46

Source: The authors

Table 4: Descriptive statistics of variables used in the OLS model (sample of Municipalities with more than 1000 inhabitants; N = 228; 2016)

Variable	Mean	Min	Max	St. dev.
MWMCpc	615.31	290.259	1,465.868	197.23
IWCC	0.15	0.00	1.00	0.36
IPP	0.15	0.00	1.00	0.36
Prod	0.38	0.00	1.00	0.48
Prov	0.71	0.00	1.00	0.46
PPP	0.25	0.00	1.00	0.43
MNC	0.33	0.00	1.00	0.47
Scale	0.78	0.00	1.00	0.41

Source: The authors

Results and discussion

Table 5 shows the results obtained for the whole sample and for two different population size subgroups. The results for all samples indicate that the explanatory power of the model is not very high, but in relation to the sample size the results are significant.

The results for the whole sample show that PPPs increase total municipal waste management costs per capita and show a significant relation to costs per capita (above 99 % of the confidence level). MNCs

have a significant and positive relation to costs (above 95 % of the confidence level). In contrast, intermunicipal cooperation in both forms has a **cost-reducing effect**: for the *intermunicipal waste collection company* variable, the significance reaches above 95 % of the confidence level; for the *intermunicipal public procurements* variable, the significance reaches above 99 % confidence level. Finally, form of provision and economies of scale achieved from waste collection areas larger than 1000 inhabitants did not show a significant relation to costs; however, the result is not significant, and international studies indicate that, economies of scale have a positive relation with costs for municipalities with over 10,000 inhabitants.

Table 5: Empirical results of the regression analysis (OLS model) for the dependent variable of total costs of waste collection service per capita

Variable	Whole sample	Municipalities with fewer than 1000 inhabitants	Municipalities with over 1000 inhabitants
Const	874.378*** (25.643)	846.588*** (42.658).	920.881*** (45.251)
IWCC	**-31.704** (8.865)**	**-34.453*** (4.111)**	**-20.516** (5.339)**
IPP	**-53,381*** (12.146)**	**-64.907*** (17.492)**	**-34.453*** (20.811)**
Prod	-35.808* (1.999)	21.370 (20.617)	-38,298 (34.509)
Prov	-89,381 (59.146)	-112.471 (78.220)	-112.579 (50.576)
PPP	**49.404*** (14.039)**	**65.703*** (4.516)**	10.748 (29.833)
MNC	**30.691** (15.467)**	31.367 (33.939)	36.149 (23.845)
Scale	-13.366 (14.246)	-4.648 (25.023)	8.008 (44.849)
N	710	482	228
R^2	0.3419	0.3467	0.3432
adj. R^2	0.3001	0.2517	0.2472

Note : The values in brackets are the standard errors for individual variables. The results of the variables with a significance level higher than 95 % are marked in bold.
The numbers* stand for the p-value of the significance of a variable: *** the significance level of 99 %, ** the significance level of 95 %, * the significance level of 90 %.

Source: The authors

Table 5 also shows different results for different population size subgroups: municipalities with fewer than 1000 inhabitants and municipalities with over 1000 inhabitants. In the municipalities with fewer than 1000 inhabitants, the results for the variables *IPP* and *PPP* are quite similar to the total sample estimation. In both cases, **intermunicipal cooperation reduces waste collection costs** and is significant, but the confidence level differs. In the municipalities with fewer than 1000 inhabitants

intermunicipal public procurement has a stronger effect; it is above 99 %. **Intermunicipal waste collection companies** have a significant effect in municipalities with over 1000 inhabitants.

The results indicate that intermunicipal cooperation shows a significant cost-reducing effect; however, this effect is relatively small when compared to the opposite effects of PPPs and MNC. Concerning the importance of intermunicipal cooperation and our RQ2, as shown by other studies focused on highly fragmented countries[19], it can produce positive effects especially for local governments with insufficient capacities, i.e. for small local governments, as is shown by our results for the intermunicipal public procurements variable. According to Bel and Warner[25], economies of scale exist especially for small local governments. Small local governments could benefit more from cooperation than larger ones, as the smaller ones are more likely to achieve a reduced average cost of service delivery[25]. The same point was made by Koprić[5], who stresses that intermunicipal cooperation can serve as a surrogate or functional substitute for territorial consolidation under the conditions of small units and fragmented local structure in particular. Larger local governments do not need intermunicipal cooperation in order to properly perform their own tasks. Our results correlate with these findings[5, 9-11, 25, 31-34].

On the other hand, the PPPs have a significant positive relation to the costs in both cases in relation to increasing costs, but in the smallest municipalities with fewer than 1000 inhabitants, the effect is stronger. The results of the OLS model show a significant positive relation between the PPPs and cost increase in the total sample and for municipalities with population sizes of fewer than 1000 inhabitants. Chong, et al.[20] obtained similar results based on the data from 5000 local French authorities. The choice made by local authorities to engage in a PPP is not random; further, conditional on the choice of the PPP, consumer prices are significantly higher on average. Considering these results, it is possible to ask: *Do the PPPs lead to failure in terms of efficiency?* The results obtained in the estimation indicate that the form of provision (especially contracting out) has no significant effects on municipal waste collection costs for either sample. It seems surprising in contrast that the results for intermunicipal public procurement (contracting out in the form of intermunicipal cooperation) have a significant cost-reducing effect. The result for the form of production variable shows a small cost-reducing effect for the service produced by a public waste collection company. This effect is not so strong; the significance level is above 90 % and cost reduction is only 35.8 CZK for the whole sample. In the economies of scale achieved from a waste collection area larger than 30,000 inhabitants, the results for municipalities with fewer than 1000 inhabitants have a positive effect and for municipalities with over 1000 inhabitants a negative effect (increasing costs). These results were not significant. The achieved results enable us to provide a contrast with previously published papers, to present an opinion of established differences, and to express a view of the results with a relevant explanation. This enables us to open a space in which to outline the need for further possible solutions and for the development of science, society, and practices in the area of local waste management, even beyond the borders of conventional ways of thinking in regards to different factors and variables.

Conclusions

The paper is focused on the relation between local waste collection costs and selected factors affecting cost efficiency. We paid special attention to the forms of production and provision, to intermunicipal cooperation in two forms (intermunicipal waste collection company and intermunicipal public procurements), to economies of scale, and to PPPs. Based on the data set, the paper provides clear answers to the established research questions and contributes to ongoing academic debates while going beyond conventional approaches.

The empirical analysis of factors influencing waste collection costs returned interesting findings. In addressing RQ1, the obtained results show a significant positive relation between intermunicipal cooperation and cost savings in the total sample and for all population size subgroups. Concurrently we found that the cost efficiency of local waste collection services is negatively affected by PPPs but only for smaller municipalities with populations of fewer than 1000 inhabitants.

RQ2 and RQ3 help us to understand this issue in a deeper way. In addressing RQ2, we found that the cost efficiency of local waste collection services is more strongly affected by intermunicipal waste

collection companies, but the significance is higher for intermunicipal public procurements. In addressing RQ3, we found that intermunicipal cooperation more reduces waste collection costs in the smaller municipalities with fewer than 1000 inhabitants.

The paper provides clear answers to the research questions and contributes broadly to the field of cost effectiveness in waste management studies. The policy implications could involve pointing out the importance of intermunicipal cooperation in cost savings and offering a new and innovative solution to the decision-making processes of municipal representatives. It is clear from numerous studies that local governments prefer to collaborate with other local governments. From this perspective, it is no surprise that intermunicipal cooperation is considered a sufficient measure of cost reduction for the municipality. In addition, our results allow us to support the assertion that intermunicipal cooperation is often accompanied with decreases in costs per capita. However, as was stressed by Lackowska[42], intermunicipal cooperation is not a panacea. When policy makers seek to identify an "optimal" population size for delivering services, even the high diversity of local services can lead to different recommendations. Taking this fact into account, it is impossible to state the sizes and the number of local governments that must cooperate in order to achieve cost efficiency and cost effectiveness in all cases of delivering the local services for which they are responsible. More precisely, while collaborating local governments can be very efficient in delivering one service, at the same time they may fail to achieve efficiency in the delivery of another service.

Acknowledgment

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Meziobecní spolupráce obcí v odpadovém hospodářství a její efekty na nákladovou efektivnost

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Souhrn

Článek se zaměřuje na meziobecní spolupráci a její efekty v oblasti nákladové efektivnosti odpadového hospodářství obcí ČR a poskytuje nový a inovativní přístup k nákladové efektivnosti služeb nakládání s komunálním odpadem. Byl zkoumán vzorek 710 obcí ze dvou regionů v České republice (Olomoucký a Zlínský kraj) pro data výdajů na odpadové hospodářství za období 2014 až 2016. Byly zkoumány dvě formy meziobecní spolupráce: svozové společnosti ve společném vlastnictví obcí a veřejné zakázky zadávané společně obcemi. Výsledky analýzy zpracované pomocí obecné lineární regrese metodou nejmenších čtverců ukazují, že meziobecní spolupráce má výrazný vliv na snižování výdajů na odpadové hospodářství obcí, a to zvláště u malých obcí do 1 000 obyvatel.

Klíčová slova: odpadové hospodářství, meziobecní spolupráce, veřejné zakázky a nákladová efektivnost