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Economies of scale in local communal services: a Hungarian case study

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Economies of scale in local communal services: a Hungarian case study

Paper presented to the 53th Congress of the European Regional Science Association,
Palermo, Italy, August 27-31, 2013

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Abstract

Knowledge of whether, and over what range of output, there are economies or diseconomies of scale in providing local communal services is an important question from theoretical, practical and regional political point of view also. The theoretical side of the question is connected to the primordial research concerning to the optimal city size. If optimal city size actually can be established, then a valid policy argument can be made for fostering its approximation. However, theoretical considerations are based sometimes those types of assumptions, which are often not valid in reality. Therefore empirical investigations are essential in this research area.

After a short theoretical overview, our paper firstly gives a general outline about the previous controversial empirical evidences on economies of scale in the community size and providing local communal services. In the second part we present our empirical findings concerning to economies of scale in local communal services based on a large and detailed data base which consist of almost 300 Hungarian settlements. During the examination several methodological questions have occurred. For example, there are several solutions for the organizational structure of providing local services, from the big holding to the smaller individual companies. Considering this and some other issues, the main results suggest that on community level there is a moderated economies of scale in water supply, sewage disposal and district heating and a moderated diseconomies of scale in refuse collection until 5 thousand inhabitants, but above this level there is not connection between the settlement size and the average cost of services. This result is mainly consistent with the previous findings: there are economies of scale under a threshold, but after reaching this, unit cost reduction is not feasible. This threshold can be different in the different types of services.

JEL codes: R5, R38, L97, L23

Keywords: economies of scale, local communal services, Hungary

Introduction

Knowledge of whether, and over what range of output, there are economies or diseconomies of scale in providing local communal services is an important question from theoretical, practical and regional political point of view also. The theoretical side of the question is connected to the primordial research concerning to the optimal city size. If optimal city size actually can be established, then a valid policy argument can be made for fostering its approximation. However, theoretical considerations are based sometimes those types of assumptions, which are often not valid in reality. Therefore empirical investigations are essential in this research area.

This paper will be organized as follows. After a short theoretical overview, it gives a general outline about the previous controversial empirical evidences on economies of scale in the community size and providing local communal services. In the second part we present our empirical findings concerning to economies of scale in local communal services based on a large and detailed data base which consist of almost 300 Hungarian settlements. The main results suggest that on community level there is a moderated economies of scale in water supply, sewage disposal and district heating and a moderated diseconomies of scale in refuse collection until 5 thousand inhabitants, but above this level there is not connection between the settlement size and the average cost of services. This result is mainly consistent with the previous findings: there are economies of scale under a threshold, but after reaching this, unit cost reduction is not feasible. This threshold can be different in the different types of services.

Theoretical background

Classic economies of scale relate to the effect on average costs of production of different rates of output. Economies of scale or scale economies exists if larger output goes hand in hand with lower average cost. The sources of economies of scale can be manifold, most of them can be classified either as technical or organizational reasons: mechanization, specialization, division of labor, vertical and horizontal integration and so on.

Economies of scale is a simple concept on conceptual level but its measurement is very difficult in practice, when the measurement of „output” and „cost” is extraordinarily complicated. The vast majority of the controversial results of the empirical investigations in a wide range of various activities (industrial activities and services) can be traced back to the definitional and measurement problems of output and costs and/or to the treatment of quality

considerations. Measuring the output of a school, a hospital or public administration is extremely difficult. Cost of production can be very different also not only due to problems of non-monetary costs elements, but because of taking into consideration the costs which are arisen on the side of consumers (for example transportation cost, quality considerations) and not only on the side of producer. However, a quantitative analysis must choose some form of measurement.

Theoretically, city size may lead to economies and diseconomies of scales also. Larger city size may enable the spreading of overhead costs over a large number of people, reducing unit costs and thereby achieving economies of scale. Beside this larger cities have more varied public sector, with units of services beyond the optimum scale. Empirical investigations are necessary to discover the real connections between city size and average cost of services.

Previous studies

There are few empirical studies about the economies of scale in local communal services and the cost of local administration in Hungary, in spite of the fact, that the question is often mentioned theoretically and in political discussions, both on settlement level and higher level reorganization of spatial structures. On settlement level the fragmented structure with several very small autonomous settlements is criticized as inefficient (Verebélyi, 1993). Empirical investigations on local public services, such as nursery, elementary school, and cost of general administration suggest that there is not any connection between the size of settlement and the average cost. The smallest average cost can be detected in medium-size villages; smallest villages have higher average cost, but the difference is very small (Fekete et al., 2003, p. 59.). There are economies of scale in solid waste and sewage-water management (Hermann et al., 1998; Kerekes, 2002). However, the increasing transportation cost was not taken into consideration in these results.

Bálint Koós and Mihály Lados conducted a research about the size and number of settlements. According to their results the number of settlements is not too large, however, the large number of various tasks of settlement and the lack of joint services of settlements is a real problem (Koós–Lados, 2008). György Budaházy's analysis about the economies of scale in land registry offices was conducted on county level. His results show, that there is linear connection between the size of the county and the cost of land register office: twice as big county has twice as big costs (Budaházy, 2013).

The number of empirical investigations in various other countries is of course enormous and therefore cannot be reviewed in a short paper. General statements without any empirical evidence are quite common in reports of various advisory boards. School district consolidation in USA from the 1930s was motivated by the believing, that economies of scale exists in this services. “Although the validity of this assumption was never tested, ‘Bigger is Cheaper’ became the mantra of the profession as future generations of administrators were taught to believe” (Robertson, 2007, p. 620). However, the growing empirical literature suggests that administrative efficiencies can be increased by merging small districts into larger ones, but only within limits, which lies somewhere between 500 and 1000 students. When this threshold is crossed, it will often result in decreased administrative efficiencies (Hanley, P. F., 2007).

In “Modernizing Local Government” by the Committee for Economic Development in USA these sentences can be read: “The most pressing problem of local government in metropolitan areas may be stated quite simply. The bewildering multiplicity of small, piecemeal, duplicative, overlapping local jurisdictions cannot cope with the staggering difficulties encountered in managing modern urban affairs. The fiscal effects of duplicative suburban separatism create great difficulty in provision of costly central city services benefitting the whole urbanized area. If local governments are to function effectively in metropolitan areas, they must have sufficient size and authority to plan, administer, and provide significant financial support for solutions to areawide problems” (cited by Hutcheson–Prather, 1979, p. 166) According to this statement, increasing the size of jurisdictions would supposedly allow economies of scale to accrue to local governments and enhance the efficiency of service delivery systems. However, empirical evidences show little sign of economies of scale. In a pioneering work by Hirsch, using data on 149 local governments around St. Louis and in Massachusetts, found that growth and consolidation appear to have little, if any, significant effect on per capita expenditures for fire protection, police protection, refuse collection, and other similar services which make up the vast majority (80%-85%) of all city expenditures. Consolidation of water and sewage services, accounting for approximately 10% of total expenditures, leads to a decline in per capita expenditures until a very large scale is reached. After a larger scale there is not economies of scale (Hirsch, 1959).

Gabler’s paper analyzed the connection between settlement size and average cost for several functions, such as highways, police, fire service, sewerage and sanitation, parks and recreation, general expenditures. In most cases the per capita expenditures are larger in larger

towns, that is, diseconomies of scale exists, except the highways (Gabler, 1971). Hutcheson and Prater (1979) shows that 1% increase of population goes hand in hand with 1,2% increase of the size of administration. Andrews and Boyne (2009) have opposite results in their paper about English local authorities: the relationship between population size and back office cost is negative, economies of scale might be achieved by amalgamating smaller councils into larger units. Knapp's paper deals with the economies of scale of crematoriums in England. This analysis is very interesting, because the cost structure and the output also can be measured very well. Economies of scale exist until 3000 cremations, above this level there is diseconomies of scale due to the more complex coordination (Knapp, 1982).

The interpretations and comparisons of results are not easy, because almost every local government service unit has a variety of quality dimensions. "In assessing the influence of population size on urban public sectors, however, it is necessary to note that the concepts of diseconomies and economies of scale assume a constant level of service quality" (Gabler, 1971, p. 131). For example, increasing size of the schools leads to loss of personalization, lower motivation of teachers, parents and students. Growing size of service units means larger distance from the consumers and larger transportation costs also. In residential refuse collection the frequency and the manner of collection, the care and reliability of the removal services, cleanliness, quietness and courtesy of collection crew are important factors. Provision of water and sewer service is influenced by natural conditions.

Almost every service is influenced by the population density also. Some writers emphasize the spatially explicit economies of density instead of aspatial economies of scale (Walls et al. 2005; Nauges – van der Berg, 2008). Drew et al. (2012) point out that when areas are decomposed into subgroups (in the Australian research area) on the basis of density, the evidence of scale economies largely disappears. Buettner et al. (2004) show that on regional level there are not connection between population density, the size of population and public expenditures. "Per capita expenditures tend to be almost constant in response to changes in the size of population, indicating that most of the goods provided by the state governments tend to be quasi-private goods" (Buettner et al., 2004, p. 510). According to Holcombe and Williams (2009) municipal government expenditures are characterized by constant returns to scale (examining 487 municipalities above 50 thousand inhabitants in the USA), but population density and various demographic factors have influence on the level of expenditures of local governments. Ladd argues that a U-shaped relationship exists between population density and cost of providing public services: average cost is highest in sparsely

populated areas and at higher density. Ladd's data set consisted of 247 large counties in USA, 59 percent of the population of USA (Ladd, 1992).

The data

For the analysis we wanted to build a temporal database with company-level business data in the following areas of communal services: water supply, sewage disposal, refuse collection, district heating, general communal services, property and real estate management. In building the database we confronted several practical problems: correct identification of activities, frequent temporal changes in organizational structure, mixed and holding structure of companies. Each company was checked singly. Due to the temporal matching problems the database is static. Each year from 2002 to 2011 has its unique classification. Because of abundance of data and the very similarity of the results we show only the results of the latest year, 2011.

The division according to sectors and settlement size can be seen in Table 1 and Table 2. The only city above 250 thousand inhabitants is Budapest, which is an outlier with its 1.7 million inhabitants. Every bigger city (above 50 thousand inhabitants) is represented in the database and majority of medium sized settlements also. In smaller settlements categories the rate of investigated settlements is smaller. Mixed services category means integrated companies with every local public service. There is duplication in the table, because some companies provide more than one service. This is most typical in water supply and sewage disposal.

Table 1 The number of settlements and companies

Size of the settlement (thousand inhabitants)	Number of settlements in the analysis	District heating	Water supply	Sewage disposal	Property and real estate management	Refuse collection	Mixed services (holding structure)	Summary
250-	1	5	2	5	1	1	1	32
100-250	8	10	13	13	3	15	5	84
50-100	12	7	13	13	5	14	3	70
30-50	21	7	20	12	6	13	5	70
20-30	18	6	12	8	1	11	3	47
15-20	24	10	21	14	0	16	8	75
10-15	35	12	20	14	3	15	3	73
7,5-10	27	0	25	16	0	7	3	53
5-7,5	32	3	20	17	1	8	5	60
2,5-5	55	1	34	22	1	10	5	76
-2,5	60	1	24	26	1	10	0	64
Summary	293	62	204	160	22	120	41	704

Table 2 The number of settlements

Size of the settlement (thousand inhabitants)	Number of settlements in Hungary	Number of settlements in the analysis
250-	1	1
100-250	8	8
50-100	12	12
30-50	21	21
20-30	21	18
15-20	29	24
10-15	52	35
7,5-10	46	27
5-7,5	100	32
2,5-5	332	55
-2,5	2535	60
Summary	3157	293

Analysis

Economies of scale could be analyzed in a best manner according to the average cost, namely the ratio of total cost and the output. Yet for the output we do not have data in real terms, but only monetary data. Therefore we use four types of proxys. These can be seen in Table 3. Four of them use the number of inhabitants as denominator. Population is not the best measure for four reasons: settlement borders are sometimes arbitrary, some services (water and sewage) serve several neighbouring settlements, the number of inhabitants and the number of served persons can be different, and the composition of inhabitants (age structure, income level, unemployment rate and other socio-economic factors) can be different. However, we do not have other choice, therefore we used population as the best available solution. Other 10 indicators use only company level data (number of employees and various fiscal indicators). The first indicator can be treated as the primary index of economies of scale: smaller value means more cost efficient activities, but as it was mentioned in general part, quality and other differences are disregarded. Other indicators are supplements only for the broader view.

Table 3 Proxys for economies of scale

Type of proxy	Short description of indicator
Cost or monetary results	Revenues/production costs (1)
	Production costs/inhabitants (2)
	Production costs/employees (3)
	Revenues/inhabitants (4)
	Revenues/employees (5)
	Employees/inhabitants (6)
Assets (stocks)	Assets/inhabitants (7)
	Assets/employees (8)
Mixed indicators	Asset turnover (ATO) (9)
	Return on assets (ROA) (10)
	Return on equity (ROE) (11)
Indirect measures	Invested assets/Total assets (12)
	Invested assets/Net assets (13)
	Current ratio (14)

The calculations can be seen in Table 4-10 for every services altogether and for each services separately. The general results can be summarized as by and large there is not any systematic connection between settlement size and the average cost of various services. Only the biggest settlement (Budapest with 1.7 million inhabitants) and the settlements under 5 thousand inhabitant shows minor economies or diseconomies of scales, but the various indicators can contradict each other. Budapest has the smallest average cost in water supply and sewage disposal. The smallest settlements have lowest average costs in refuse collection, but highest in district heating. However, between 5 thousand and 250 thousand inhabitants there is not any clear tendency of either economies of scale or diseconomies of scale.

Table 4 Indicators for every services (continued)

Settlement size	Number of indicators (see Table 3)						
	1	2	3	4	5	6	7
250-	0,88	9,06	32,08	10,30	36,47	0,28	19,53
100-250	0,97	21,15	15,80	21,83	16,32	1,34	44,89
50-100	0,96	51,60	18,40	53,80	19,19	2,80	67,28
30-50	0,96	28,58	10,36	29,76	10,78	2,76	69,10
20-30	0,98	53,73	9,92	54,77	10,11	5,41	147,27
15-20	0,99	40,54	12,02	40,85	12,11	3,37	55,48
10-15	0,95	25,00	10,30	26,24	10,81	2,43	28,21
7,5-10	0,96	22,49	7,85	23,49	8,19	2,87	22,61
5-7,5	0,94	32,42	10,50	34,43	11,15	3,09	37,26
2,5-5	0,99	31,36	7,74	31,62	7,81	4,05	32,69
-2,5	0,87	42,59	11,62	49,08	13,39	3,67	238,07
Summary	0,94	17,48	16,62	18,67	17,75	1,05	34,16

Table 4 Indicators for every services (continuation)

Settlement size	Number of indicators (see Table 3)						
	8	9	10	11	12	13	14
250-	69,14	0,53	-0,02	-0,06	0,78	1,26	0,92
100-250	33,55	0,49	0,00	0,15	0,75	1,24	1,38
50-100	24,00	0,80	0,03	0,01	0,68	1,55	1,79
30-50	25,04	0,43	0,02	0,06	0,80	3,07	1,49
20-30	27,20	0,37	0,00	0,00	0,85	4,19	1,48
15-20	16,45	0,74	0,01	0,02	0,71	1,36	1,00
10-15	11,63	0,93	0,05	0,09	0,58	1,56	1,37
7,5-10	7,89	1,04	0,05	0,10	0,60	1,27	1,85
5-7,5	12,07	0,92	0,06	0,12	0,54	1,34	1,51
2,5-5	8,07	0,97	0,04	0,10	0,44	1,00	1,67
-2,5	64,95	0,21	0,03	1,71	0,43	1,69	1,13
Summary	32,47	0,55	0,00	0,04	0,75	1,50	1,23

Table 5 Indicators for district heating (continued)

Settlement size	Number of indicators (see Table 3)						
	1	2	3	4	5	6	7
250-	0,97	13,62	113,02	13,98	115,98	0,12	13,86
100-250	1,05	44,94	30,98	42,95	29,61	1,45	48,10
50-100	0,98	155,09	60,29	158,94	61,79	2,57	108,29
30-50	1,00	30,30	19,52	30,31	19,52	1,55	47,40
20-30	1,07	55,64	18,11	52,07	16,94	3,07	91,45
15-20	1,03	79,81	30,12	77,64	29,30	2,65	108,75
10-15	1,05	27,42	32,17	26,14	30,67	0,85	23,27
5-7,5	0,97	28,60	11,52	29,59	11,92	2,48	40,22
2,5-5	1,24	39,43	14,00	31,71	11,26	2,82	17,85
-2,5	1,36	31,85	9,74	23,44	7,16	3,27	6,19
Summary	1,00	25,27	49,64	25,35	49,79	0,51	25,28

Table 5 Indicators for district heating (continuation)

Settlement size	Number of indicators (see Table 3)						
	8	9	10	11	12	13	14
250-	114,96	1,01	-0,16	-0,57	0,64	1,70	0,59
100-250	33,16	0,89	-0,10	-0,24	0,59	1,27	0,95
50-100	42,10	1,47	0,02	0,02	0,48	0,85	1,92
30-50	30,53	0,64	0,04	0,01	0,70	1,84	1,29
20-30	29,76	0,57	-0,06	-0,26	0,74	2,69	0,92
15-20	41,04	0,71	-0,01	0,00	0,76	1,76	0,54
10-15	27,30	1,12	-0,03	-0,05	0,52	1,48	0,95
5-7,5	16,20	0,74	0,01	0,02	0,57	0,71	2,39
2,5-5	6,34	1,78	-0,29	1,33	0,10	-1,05	0,71
-2,5	1,89	3,79	-0,52	2,30	0,00	0,00	0,51
Summary	49,64	1,00	-0,09	-0,28	0,62	1,43	0,83

Table 6 Indicators for water supply (continued)

Settlement size	Number of indicators (see Table 3)						
	1	2	3	4	5	6	7
250-	0,85	6,93	18,58	8,17	21,89	0,37	30,60
100-250	0,93	22,61	11,46	24,26	12,30	1,97	64,95
50-100	0,97	57,34	11,23	59,36	11,62	5,11	115,63
30-50	0,96	39,68	9,48	41,36	9,88	4,19	123,93
20-30	0,98	86,49	9,90	88,17	10,09	8,73	315,03
15-20	0,96	42,29	9,24	43,85	9,58	4,58	69,37
10-15	0,92	26,57	8,56	28,93	9,32	3,11	36,38
7,5-10	0,95	24,00	7,04	25,23	7,40	3,41	25,24
5-7,5	0,96	27,48	7,98	28,51	8,28	3,44	40,02
2,5-5	0,99	25,10	6,09	25,27	6,13	4,12	25,54
-2,5	1,09	29,16	8,48	26,73	7,77	3,44	74,30
Summary	0,94	24,43	10,66	25,91	11,31	2,29	66 893

Table 6 Indicators for water supply (continuation)

Settlement size	Number of indicators (see Table 3)						
	8	9	10	11	12	13	14
250-	82,04	0,27	0,01	0,02	0,90	1,26	1,05
100-250	32,94	0,37	0,02	0,03	0,80	1,26	1,79
50-100	22,64	0,51	0,01	0,03	0,77	1,97	2,00
30-50	29,61	0,33	0,01	0,04	0,86	4,38	1,45
20-30	36,07	0,28	0,00	0,02	0,89	5,99	1,72
15-20	15,16	0,63	0,02	0,02	0,75	1,21	1,81
10-15	11,71	0,80	0,06	0,12	0,65	1,65	1,75
7,5-10	7,40	1,00	0,06	0,10	0,59	1,12	1,89
5-7,5	11,63	0,71	0,01	0,03	0,65	1,63	1,54
2,5-5	6,20	0,99	0,06	0,10	0,57	1,14	1,53
-2,5	21,61	0,36	0,00	-0,08	0,79	2,70	2,06
Summary	29,20	0,39	0,01	0,03	0,83	1,83	1,67

Table 7 Indicators for sewage disposal (continued)

Settlement size	Number of indicators (see Table 3)						
	1	2	3	4	5	6	7
250-	0,70	3,30	23,52	4,72	33,67	0,14	15,74
100-250	0,93	18,12	10,67	19,51	11,49	1,70	54,16
50-100	0,95	50,15	11,55	52,71	12,14	4,34	104,23
30-50	0,95	52,75	9,75	55,47	10,26	5,41	191,06
20-30	0,98	107,31	10,73	109,11	10,91	10,00	420,26
15-20	0,98	41,39	7,43	42,08	7,56	5,57	64,69
10-15	0,93	31,22	8,67	33,60	9,34	3,60	27,42
7,5-10	0,92	28,84	9,47	31,29	10,28	3,05	31,50
5-7,5	0,98	36,54	14,79	37,39	15,13	2,47	50,27
2,5-5	1,03	19,41	8,22	18,78	7,95	2,36	34,46
-2,5	1,05	29,96	9,66	28,52	9,19	3,10	47,31
Summary	0,90	13,95	11,32	15,47	12,56	1,23	41,66

Table 7 Indicators for sewage disposal (continuation)

Settlement size	Number of indicators (see Table 3)						
	8	9	10	11	12	13	14
250-	112,31	0,30	0,04	0,05	0,85	1,12	2,37
100-250	31,89	0,36	0,02	0,03	0,82	1,30	1,88
50-100	24,01	0,51	0,02	0,05	0,77	2,04	1,51
30-50	35,33	0,29	0,01	0,06	0,87	5,50	1,52
20-30	42,01	0,26	0,01	0,04	0,90	7,15	1,72
15-20	11,61	0,65	0,02	0,03	0,75	1,33	2,02
10-15	7,62	1,23	0,07	0,11	0,47	1,00	1,61
7,5-10	10,35	0,99	0,05	0,09	0,60	1,23	1,75
5-7,5	20,35	0,74	0,04	0,09	0,64	1,70	1,44
2,5-5	14,59	0,55	0,04	0,08	0,62	1,14	2,10
-2,5	15,25	0,60	0,02	0,00	0,66	1,50	1,67
Summary	33,82	0,37	0,02	0,05	0,83	1,80	1,78

Table 8 Indicators for property and real estate management (continued)

Settlement size	Number of indicators (see Table 3)						
	1	2	3	4	5	6	7
250-	0,83	19,19	11,72	23,13	14,13	1,64	34,25
100-250	0,95	33,25	12,34	35,04	13,00	2,69	40,12
50-100	0,87	30,41	11,09	34,84	12,71	2,74	64,43
30-50	1,01	25,58	10,01	25,27	9,89	2,56	37,85
20-30	0,88	43,07	6,19	48,89	7,03	6,96	78,95
15-20	1,08	28,55	7,06	26,42	6,53	4,05	16,73
10-15	1,08	51,40	8,61	47,55	7,97	5,97	67,33
7,5-10	1,43	19,05	4,29	13,30	2,99	4,44	65,33
5-7,5	1,02	28,30	5,61	27,86	5,52	5,04	32,88
2,5-5	0,95	20,52	7,72	21,64	8,14	2,66	27,23
Summary	0,90	25,19	10,64	27,96	11,81	2,37	38,72

Table 8 Indicators for property and real estate management (continuation)

Settlement size	Number of indicators (see Table 3)						
	8	9	10	11	12	13	14
250-	20,93	0,68	0,04	0,07	0,61	1,04	1,77
100-250	14,89	0,87	0,05	0,07	0,60	1,05	1,69
50-100	23,50	0,54	0,10	-0,89	0,76	4,55	1,67
30-50	14,81	0,67	0,03	0,05	0,61	0,95	2,04
20-30	11,34	0,62	0,06	0,07	0,74	1,25	1,58
15-20	4,14	1,58	0,04	0,08	0,36	0,66	2,45
10-15	11,28	0,71	0,02	-0,03	0,72	2,38	0,80
7,5-10	14,70	0,20	-0,01	0,04	0,94	1,99	0,57
5-7,5	6,52	0,85	0,01	0,00	0,73	2,64	1,07
2,5-5	10,24	0,79	0,04	0,13	0,70	0,98	1,61
Summary	16,35	0,72	0,05	0,04	0,63	1,19	1,71

Table 9 Indicators for refuse collection (continued)

Settlement size	Number of indicators (see Table 3)						
	1	2	3	4	5	6	7
250-	0,83	19,19	11,72	23,13	14,13	1,64	34,25
100-250	0,92	16,66	11,74	18,16	12,80	1,42	23,32
50-100	0,90	18,40	12,67	20,52	14,13	1,45	16,72
30-50	0,84	19,36	8,48	23,00	10,08	2,28	24,21
20-30	0,91	30,11	7,80	33,13	8,58	3,86	28,02
15-20	0,93	26,53	9,20	28,57	9,91	2,88	33,84
10-15	0,93	27,77	8,46	29,71	9,06	3,28	31,13
7,5-10	0,97	25,67	9,75	26,45	10,05	2,63	26,56
5-7,5	0,84	42,84	12,44	51,05	14,83	3,44	49,72
2,5-5	0,94	76,39	9,97	80,87	10,56	7,66	70,77
-2,5	0,70	119,69	16,22	171,71	23,27	7,38	413,40
Summary	0,88	20,12	10,81	22,85	12,28	1,86	27,94

Table 9 Indicators for refuse collection (continuation)

Settlement size	Number of indicators (see Table 3)						
	8	9	10	11	12	13	14
250-	20,93	0,68	0,04	0,07	0,61	1,04	1,77
100-250	16,44	0,78	0,05	0,09	0,60	1,27	2,07
50-100	11,51	1,23	0,10	0,26	0,45	1,35	1,15
30-50	10,61	0,95	0,14	0,24	0,48	1,21	1,86
20-30	7,26	1,18	0,09	0,13	0,61	1,12	1,38
15-20	11,74	0,84	0,03	0,04	0,67	1,20	2,49
10-15	9,49	0,95	0,08	0,11	0,52	1,52	1,26
7,5-10	10,09	1,00	0,02	0,12	0,69	1,81	2,86
5-7,5	14,44	1,03	0,10	0,21	0,39	0,96	1,55
2,5-5	9,24	1,14	0,05	0,13	0,25	0,71	1,84
-2,5	56,03	0,42	0,12	0,26	0,64	2,51	1,59
Summary	15,01	0,82	0,06	0,10	0,58	1,19	1,71

Table 10 Indicators for mixed services (holding structure) (continued)

Settlement size	Number of indicators (see Table 3)						
	1	2	3	4	5	6	7
250-	0,83	19,19	11,72	23,13	14,13	1,64	34,25
100-250	0,95	33,25	12,34	35,04	13,00	2,69	40,12
50-100	0,87	30,41	11,09	34,84	12,71	2,74	64,43
30-50	1,01	25,58	10,01	25,27	9,89	2,56	37,85
20-30	0,88	43,07	6,19	48,89	7,03	6,96	78,95
15-20	1,08	28,55	7,06	26,42	6,53	4,05	16,73
10-15	1,08	51,40	8,61	47,55	7,97	5,97	67,33
7,5-10	1,43	19,05	4,29	13,30	2,99	4,44	65,33
5-7,5	1,02	28,30	5,61	27,86	5,52	5,04	32,88
2,5-5	0,95	20,52	7,72	21,64	8,14	2,66	27,23
Summary	0,90	25,19	10,64	27,96	11,81	2,37	38,72

Table 10 Indicators for mixed services (holding structure) (continuation)

Settlement size	Number of indicators (see Table 3)						
	8	9	10	11	12	13	14
250-	20,93	0,68	0,04	0,07	0,61	1,04	1,77
100-250	14,89	0,87	0,05	0,07	0,60	1,05	1,69
50-100	23,50	0,54	0,10	-0,89	0,76	4,55	1,67
30-50	14,81	0,67	0,03	0,05	0,61	0,95	2,04
20-30	11,34	0,62	0,06	0,07	0,74	1,25	1,58
15-20	4,14	1,58	0,04	0,08	0,36	0,66	2,45
10-15	11,28	0,71	0,02	-0,03	0,72	2,38	0,80
7,5-10	14,70	0,20	-0,01	0,04	0,94	1,99	0,57
5-7,5	6,52	0,85	0,01	0,00	0,73	2,64	1,07
2,5-5	10,24	0,79	0,04	0,13	0,70	0,98	1,61
Summary	16,35	0,72	0,05	0,04	0,63	1,19	1,71

Summary and further research

The results suggest that there is no optimal settlement size from the point of view of communal services. Only the small settlements (under approximately 5 thousand inhabitants) have some minor cost disadvantages in activities requiring big fixed capital (water supply, sewage disposal, central heating). In the next stage of the research we will include some of those factors which were mentioned in general part: the cost structure, the effect of settlement

structure and population density, the number of served people and furthermore some demographic and socio-economic factors, which has potential influence on economic status of communal service companies. The explanation of huge differences in secondary indicators (such as assets/inhabitants, assets/employees) can be also interesting.

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