

The efficiency of public spending on primary education in the Greater Poland Voivodeship

Aneta Kaczyńska

Poznań University of Economics and Business

Keywords

Public spending efficiency, public primary schools, Poland, Data Envelopment Analysis, DEA.

Abstract

The article aims at evaluating the efficiency of public spending on primary schools in municipalities from the Greater Poland Voivodeship in Poland. This problem features high on the political agenda due to the pressures on public budget balance and the amount of public resources being spend on public education by the local authorities. There are three types of municipalities in Poland that establish and run public primary schools: urban, urban-rural and rural. In order to assess the efficiency of public spending on primary education in each type of municipalities in 2010–2014 a nonparametric method (Data Envelopment Analysis) was applied. The results obtained from the study indicate that urban municipalities achieved higher efficiency than urban-rural and rural municipalities. This finding is important while planning the financial transfers from the central budget to the local budgets where one of the criteria taken into consideration is the type of municipality. Moreover, the article presents a practical implication of the nonparametric approach to measure efficiency in the Polish local public sector.

1. Introduction

The problem of public spending efficiency measurement is continually rising especially in the face of the pressures on public budget balance and the amount of resources allocated for education. There are many studies in the literature that focus on the evaluation of schools performance or units obligated to run them (e.g. school districts, local government). Many of these studies uses the concept of technical efficiency that allow to assess managerial efficiency and scale efficiency and hence find the sources of inefficiency. The main objective of this paper is to extend this literature by focusing on Polish primary schools run by municipalities in the Greater Poland Voivodeship since this tier of Polish local government was obligated to establish and run primary schools as a result of economic transformation that took place in Poland in 90s. Ever since municipalities use public funds coming in the form of the transfers from the central budget and their own resources to cover all expenditures connected with primary education. The law on the education system determines that the effects of schooling can be measured by the national exam results that pupils take obligatorily at the end of the primary school. Since there are differences in the amount of resources used per one pupil in different municipalities and simultaneously the attainment results of children vary there is an economic and social need to assess the public spending on primary schools efficiency.

The study is performed for 2010–2014 and includes three types of municipalities – urban (cities with county rights including), urban-rural and rural. In order to properly asses the technical efficiency of public spending on primary schools of each municipality a nonparametric panel Data Envelopment Analysis was applied using output oriented versions of DEA models: CCR, BCC and scale efficiency. As inputs three different categories of expenditures borne per one pupil by municipalities were used, whereas as output – average result of primary school pupils from the national exam in each municipality.

This article is divided into five main sections concerning primary education in Poland, sources of financing and expenditures borne on primary schools by municipalities, the relevance of measuring the efficiency of public spending on education with a brief literature review, the methodology used and obtained results. After a discussion and conclusion, research limitations and direction for further research was indicated and justified.

2. Primary education as a municipality's own task

Current regulations on education in Poland result from the economic transformation, decentralisation process and the reform of education that took place in 90s. Ever since, Polish local government consists of three local government's levels – voivodeships (16), counties (314) and municipalities (2478). Moreover, there are three types of municipalities – rural, urban-rural and urban (including cities with county rights) (Central Statistical Office, 2015). The Constitution of the Republic of Poland states that municipality is the basic tier of

local government and therefore most of public tasks have been transferred to them from the central level. According to C. Tiebout (1956), a decentralised system of supplying public goods is much more effective than centralised one because it shifts decision power to the local governors. Therefore, they are more responsible for public spending and have better knowledge about local inhabitants' needs and thus public resources are allocated more effectively.

One of the public tasks transferred from the central level to municipalities is public education. These local governments are obliged by the law on the education system to establish and run public kindergartens, primary schools and the lower secondary schools. Polish children from 3 to 6 years old attend kindergarten. 6-year-old children must obligatorily attend kindergarten to undergo the pre-school preparation while younger children can do so if such is the will of their parents. After kindergarten children attend primary school for six years. Then pupils join the lower secondary school (*gimnazjum*) until they are 16. However, the compulsory education lasts until the age of 18 and this educational obligation can be fulfilled by attending upper secondary schools run by counties (Law on the education system, 1991).

Primary education is divided into two 3-years cycles – in the first cycle usually one teacher teaches all subjects while in the second one each subject is run by different teacher. In order to finish primary school, pupils need to take national exam organised externally by Central Examination Board. However, results of this exam do not determine joining the lower secondary school. Nevertheless, they give objective perspective of the education's effects (Law on the education system, 1991; Jeżowski, 2010).

Regarding municipalities obligations connected with public primary schools, they must provide administrative, organisational and financial services for these units. Ensuring appropriate conditions of functioning (particularly in terms of safety), carrying out repairs and investments, supplying schools with teaching aids and materials or organising a school cafeteria are also the basic tasks within municipalities' competence (Law on the education system, 1991). Moreover, the Constitution of the Republic of Poland gives parents the opportunity to choose whether their child attends public or private primary school which can be run by a natural or legal person other than municipality. Therefore, municipalities are committed to issue permits for establishment and running private primary schools. Furthermore, local governors must determine an appropriate network of primary schools so as to ensure equal opportunities for all children to education. The distance between child's home and primary school should not be bigger than 3 km (in the case of the first cycle of education, grades 1–3) or 4 km (in the case of the second cycle of education, grades 4–6). Otherwise municipalities must organise free transport or reimburse the costs incurred by parents on their child's commute (Law on the education system, 1991). Determining the network of primary schools is also connected with transformation or closing down these units. The latter is frequently used by municipalities particularly in the case of small schools with few pupils. Such a rationalisation is often forced by local governors due to financial problems, raising educational expenditures or demographic changes (Majchrowicz-Jopek, 2012). However, closing down schools should not be the most common solution of the problems faced by particular municipality.

3. Where does the money come from for primary education and what are the expenditures?

Along with conveying tasks connected with primary schools to municipalities the legislator guaranteed revenues that enable them to fulfil all obligations. However, there is no legal act that would directly indicate sources of financing particular educational tasks (Herbst & Herczyński & Levitas, 2009). Therefore, municipalities may use any of their income to finance educational expenditures. These are four basic groups of local government income: municipalities' own resources, unconditional grants, conditional grants and also foreign sources of financing like European Union funds. Municipalities' own income consists of shares in personal income tax (39,34% of total national PIT revenues) and corporate income tax (6,71% of total national CIT revenues), hence municipalities must take into account that revenues from PIT and CIT are unstable and depend on local inhabitants' and entrepreneurs' income and also tax liabilities execution effectiveness (Hybka, 2010). Other own resources include local taxes, local charges and other revenues such as from municipalities' properties, loans, donations or fines. Unconditional grants are the second main source of financing municipalities public tasks, primary education including. They are of two kinds: vertical and horizontal. The purpose of horizontal unconditional grants is to equalize the economic differences among municipalities (Jastrzębska, 2012; Law on income of local governments, 2003), which are significant between urban and rural municipalities (Banaszewska & Bischoff, 2016). The vertical unconditional grants are transferred from the central budget to municipalities generally in the form of the educational part, which is the most important source of financing public expenses connected with education. Municipalities get also conditional grants

(vertical unconditional grants) from the central budget for legally specified purposes (e.g. textbooks for pupils, teaching materials and aids, scholarships, material and social aid) (Law on the education system, 1991). The analysis of the Greater Poland municipalities' income is presented in table 1.

Year	Own resources	Unconditional grants		Conditional grants	Other	Total
		Educational part	Other			
2010	54,9%	23,3%	5,6%	14,3%	2,0%	10 348
2011	54,8%	23,1%	5,2%	13,8%	3,1%	10 987
2012	54,4%	23,1%	5,1%	12,8%	4,6%	11 714
2013	55,1%	23,0%	5,1%	13,5%	3,4%	11 905
2014	56,2%	22,2%	4,6%	14,3%	2,7%	12 454

Table 1: The Greater Poland Voivodeship municipalities' income in 2010–2014 (as a structure in % and in PLN million)

Source: own calculations based on data from Bank Danych Lokalnych.

The structure of municipal income confirms that own resources are the biggest source and the educational part of unconditional grants – the second. In the chosen time span, other revenues provided on average only about 22%. However, using these resources – educational part of unconditional grants especially – municipalities are obliged by law to cover public primary schools' current and investment expenditures and to transfer precisely defined grants to private primary schools. Private primary schools run by a natural or legal person other than municipality can get public resources for current expenses at the request specified in the law on the education system (Law on the education system, 1991). In order to provide an appropriate analysis of municipal educational expenditures they need to be presented per one pupil. Thus it is possible to identify disparities between different (three) types of Polish municipalities. Moreover, according to A. Montén and C. Thum (2010), the analysis should focus only on current expenditures since capital expenditures fluctuate over time among municipalities due to investments. Table 2 presents current expenditures incurred by municipalities from the Greater Poland Voivodships on public and private primary schools per one pupil.

Year	Mean			Mean for all	Standard deviation			Standard deviation for all
	U ¹	U-R ²	R ³		U	U-R	R	
2010	5 383	6 314	7 118	6 652	700	918	1 202	1 191
2011	5 517	6 508	7 442	6 908	710	986	1 223	1 256
2012	5 674	6 689	7 686	7 120	699	1 037	1 231	1 292
2013	5 781	6 740	7 818	7 217	811	1 024	1 238	1 311
2014	5 559	6 367	7 293	6 778	682	1 025	1 152	1 214
2010-2014	5 582	6 523	7 471	6 935	720	998	1 209	1 252

¹ Urban municipalities.

² Urban-rural municipalities.

³ Rural municipalities.

Table 2: Mean and standard deviation of current expenditures for primary schools incurred by the Greater Poland Voivodeship municipalities per one pupil in 2010–2014

Source: own calculations based on data from municipalities' annual budget reports.

Data presented in table 2 indicates that the highest current expenditures per one pupil of primary school were borne by rural municipalities, whereas the lowest – by urban municipalities. However, the biggest fluctuations of these expenses were identified in rural municipalities. Disparities between the three types of municipalities and within each of them are mainly due to the different number of children in classes which are smaller in rural than in urban-rural and urban municipalities. Even though there is a special algorithm that divides the educational part of unconditional grants between different types of municipalities, cost per one primary school's pupil vary among the Greater Poland Voivodeship municipalities. The value of this finding is of great importance due to disposition of public funds by these units.

4. The relevance of public spending efficiency in the field of primary education – a brief literature review

Public spending efficiency measurement is more difficult to conduct than in the case of private sector. This is mainly due to multiple objectives of public sector and that services offered by local government are not sold on the market and thus there is no information about the prices of these services (Dierx & Ilzkovitz & Mandl, 2008). The problem of measuring the efficiency of public spending also results from the difficulty of the appropriate outputs determination and from the fact that it is hard to evaluate tasks aiming at meeting local inhabitants needs (Lubimow-Burzyńska & Sobolewska-Poniedziałek & Tokarski, 2011). Nevertheless, the

analysis of public expenditures efficiency is very important and socially desirable – also in the case of education. According to A. Clementis and J. E. Stone (1998), the education system should not allow to waste pupils' time and public resources, because otherwise it becomes a burden to society. Therefore, many researchers try to evaluate public expenditures efficiency on different levels of education – pre-school, primary, lower secondary, upper secondary or higher education. In such studies generally the technical efficiency is used which is understood as the pure relation between inputs (expenditures borne for education) and outputs (attainment rates, e.g. comparable exam results). Based on these inputs and outputs a production possibility frontier is constructed that is also called “best practice frontier” (Dierx & Ilzkovitz & Mandl, 2008). This method allows to make a benchmark and compare analysed units (schools, municipalities, school districts). Since this article aims at evaluating municipal public spending on primary schools, therefore the most significant studies concerning this topic should be noted.

There are two types of studies in the literature that analyse public spending on primary education using the concept of technical efficiency. Firstly, there are papers examining efficiency of particular schools, for example by M. J. Mancebon and C. Mar Molinero (2000) (public primary schools in the UK), D. Farren, A. Mizala and P. Romaguera (2002) (public and private primary schools in Chile), Y. Hu, Z. Zhang and W. Liang (2009) (public primary schools in China), W. R. J. Alexander, A. A. Haug and M. Jaforullah (2010) (public and private primary schools in New Zealand), T. Agasisti, F. Bonomi and P. Sibiano (2014) (public primary schools in Italy) or J. M. Huguenin (2015) (public primary schools in Switzerland). On the other hand, the efficiency of public spending on primary education made by local government (e.g. municipalities) or school districts was analysed for example by B. Biswas, K. Chakraborty and W. C. Lewis (2001) (public primary schools in the USA) and L. Cherchye, K. De Witte, E. Ooghe and I. Nicaise (2010) (public and private primary schools in Belgium). Inputs and outputs used in these studies vary depending on intended objective. However, there is a consensus resulting from aforementioned and other studies that assessing public spending efficiency requires using expenditures as inputs. Moreover, these expenditures should be expressed per one pupil and – as indicated above – include current expenditures only (Montén & Thum, 2010). Referring to the effects of primary education that can be used in the analysis of public spending efficiency many authors use standardized and international or national exam results that reflects pupils' performance at a specific level (Dierx & Ilzkovitz & Mandl, 2008; Bogetoft & Wittrup, 2011; Agasisti & Bonomi & Sibiano, 2014; Huguenin, 2015). According to the law on the education system in Poland, there are two obligatory national exams that pupils take – at the end of primary school and at the end of the lower secondary school. Both exams are prepared and organised externally by Central Examination Board. The external examination system allows to analyse efficiency of public spending on education. Although it is perceived to be limited, it gives objective possibilities to treat them as outputs of educational process. In particular in the field of financing it from local budgets (Jeżowski, 2010). Average exam results of primary school pupils in each type of municipality presents table 3.

Year	Mean			Mean for all	Standard deviation			Standard deviation for all
	U ¹	U-R ²	R ³		U	U-R	R	
2010	60,5	57,3	57,1	57,5	3,7	3,5	4,2	4,0
2011	62,8	59,9	60,0	60,2	2,7	2,9	4,2	3,7
2012	56,0	52,9	52,7	53,1	3,1	2,8	3,7	3,4
2013	59,4	56,2	55,9	56,3	5,1	4,2	4,7	4,6
2014	64,2	60,9	60,7	61,1	3,6	3,4	4,7	4,2
2010–2014	60,6	57,4	57,3	57,6	3,6	3,4	4,3	4,0

¹ Urban municipalities.

² Urban-rural municipalities.

³ Rural municipalities.

Table 3: Mean and standard deviation of primary school pupils exam results in the Greater Poland Voivodeship municipalities in 2010–2014 (%)

Source: own calculations based on data from Regional Examination Board.

Average primary school pupils exam results in municipalities from the Greater Poland Voivodeship are diversified depending on the type of municipality. The highest results were achieved by pupils from urban municipalities and the lowest in rural ones in which deviations were the biggest. However, the difference between urban-rural and rural municipalities was very small. It must be noted that the best results were achieved in urban municipalities in which, according to table 2, current expenditures for primary schools incurred per one pupil were the lowest on average. The inverse relationship can be observed also in the case of rural municipalities. This finding is crucial and justifies the necessity of public spending efficiency evaluation

since the big part of expenditures is made from conditional and unconditional grants defined by the law (Jakubowski, 2007).

5. Data and methodology

The analysis of efficiency of public spending on primary schools in the Greater Poland Voivodeship is conducted for 2010–2014 taking into consideration three types of municipalities: urban (including cities with county rights), urban-rural and rural. These municipalities account for 9,11% of total number of Polish municipalities (as of January 1 2014). In order to assess technical efficiency scores a nonparametric method was chosen – Data Envelopment Analysis (DEA). This method is most often used in the studies concerning public spending technical efficiency (Agasisti & Bonomi & Sibiano, 2014) since there are many of reasons why DEA should be implemented in the analysis of public sector. First of all, DEA eliminates the problem of nonexistence of theoretical model of supplying public goods that could be considered as fully efficient with given inputs (Mante & O'Brien, 2002; Kozuń-Cieślak, 2011). Therefore, this method does not require defining a function like in parametric approach (e.g. OLS or SFA) because it uses mathematical algorithm to define the production frontier. In turn, this frontier is constructed on the basis of fully technically efficient units and hence it is called best practice frontier. Entities' efficiency scores are calculated basing on the relative technical efficiency (Huguenin, 2015). Moreover, DEA allows to handle multiple inputs and multiple outputs simultaneously and they can be expressed in different units. This is the particular advantage of using DEA in public spending analysis when there is no outputs prices (Mante & O'Brien, 2002).

The basic DEA model is called CCR – from the first letters of DEA creators' names – Charnes, Cooper and Rhodes. In its standard envelopment version, output oriented CCR model is solved using equations as follows (Cooper & Seiford & Zhu, 2011):

$$\begin{aligned} & \max \theta_o \\ \text{subject to:} \\ & x_{io} \geq \sum_{j=1}^n x_{ij} \lambda_{jo}, i = 1, \dots, m \\ & \theta_o y_{ro} \leq \sum_{j=1}^n y_{rj} \lambda_{jo}, r = 1, \dots, s \\ & \theta_o \geq 1 \\ & \lambda_{jo} \geq 0, j = 1, \dots, n \end{aligned}$$

Assuming there are n decision making units (DMUs) each of them consumes different quantities of m different inputs and produces s varying number of outputs. Therefore, DMU _{j} uses x_{ij} amount ($x_{ij} \geq 0$) of input i to make y_{rj} amount ($y_{rj} \geq 0$) of output r . λ_{jo} represents the weight associated to inputs and outputs of DMU _{j} and θ_o is the efficiency score of the entity under analysis (in output-oriented model $\theta_o \geq 1$ in the case of Farrell output efficiency measure which is the reciprocal of Shephard input distance function, therefore in the case of Shephard output distance function it is $0 \leq \theta_o \leq 1$). Hence, if the efficiency score is $\theta_o \leq 1$ the entity can produce more outputs ($1 - \theta_o$) given its inputs (Cooper & Seiford & Zhu, 2011).

The CCR model is known as the CRS model because it assumes constant returns to scale (CRS). However, adding an additional constraint $\sum_{j=1}^n \lambda_j = 1$ results in changing the model into BCC model which makes it possible to assume variable returns to scale (VRS) (increasing, constant or decreasing). This extra constraint allows to decompose technical efficiency (TE) measured by the CCR model into pure technical efficiency (PTE) calculated by the BCC model and scale efficiency (SE) in the following way (Cooper & Seiford & Zhu, 2011):

$$CCR = TE = PTE \times SE = BCC \times SE$$

The CCR model simultaneously measures pure and scale efficiency whereas the BCC model allows to separate out the scale efficiency by assessing only pure technical efficiency. Pure technical efficiency reflects the usage of maximum technology possibilities and whether there is any wastage of resources. Therefore, it reflects the managerial efficiency of the evaluated entity. In contrast, scale efficiency indicates if entity operates in the optimal scale size (Cooper & Seiford & Zhu, 2011).

In the article an output-oriented version of the CCR and BCC model were chosen because municipalities that run schools must operate with given inputs (public funds) in a way that maximizes pupils attainment results (Mancebon & Mar Molinero, 2000). Moreover, the analysis is conducted using panel Data Envelopment Analysis for 226 municipalities in 2010–2014 which results in 1130 entities that need to be evaluated. Inputs and outputs were carefully chosen on the basis of the literature review and the specificity of

Polish education system. As inputs three categories of current expenditures were used: current expenditures incurred for public primary schools, earmarked subsidies for private primary schools' current expenditures and funds transferred in the form of, among others, benefits in kind, social benefits, awards for teachers, scholarships for pupils and other forms of allowances for them. Whereas pupils results from the national and external test taken at the end of primary school were chosen as outputs. Data connected with inputs were collected from municipalities' budgetary statements and outputs – from Regional Examination Board of Poznań (the Greater Poland Voivodeship capital).

6. Results

Average results of efficiency of public spending on primary education in municipalities from the Greater Poland Voivodeship including their type (urban, rural and urban-rural) presents figure 1. Moreover, figure 1 takes into consideration three different measures of efficiency: technical efficiency (CCR model), pure technical efficiency (BCC model) and scale efficiency. The study uses Shephard output distance function, therefore efficiency score is $0 \leq \theta_o \leq 1$.

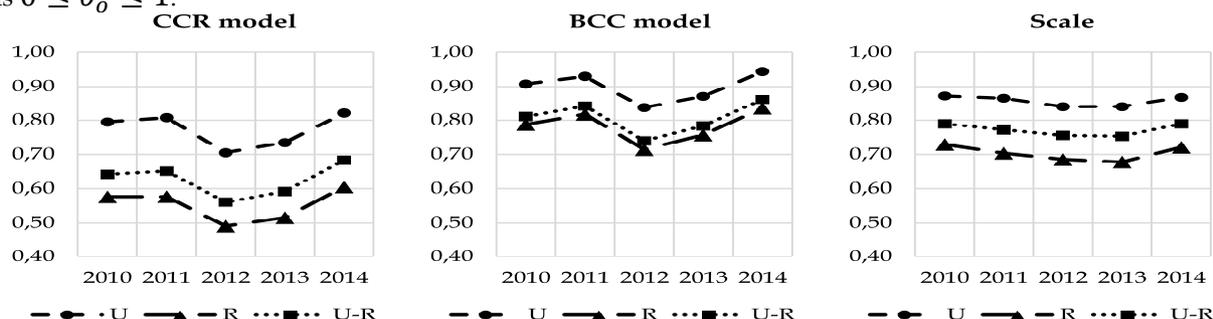


Figure 1: Average efficiency scores measured by CCR, BCC and scale efficiency in urban (U), rural (R) and urban-rural (U-R) municipalities from the Greater Poland Voivodeship in particular year of 2010–2014

Source: own calculations.

All three models indicate that in all municipalities after two first years of relative stability of public spending on primary school efficiency, it fell in 2012. Then it began to rise to achieve slightly bigger level in 2014 in the case of the CCR and BCC models and similar or a little smaller in the case of scale efficiency. The highest efficiency of public spending on primary education was achieved by urban municipalities and the lowest by rural municipalities – regardless of the efficiency model. However, the biggest difference between these two types of municipalities was identified in the CCR model (0,15 on average) and the smallest in scale efficiency (0,08 on average) which presents table 4.

Type of municipalities	Average efficiency scores depending on the efficiency model type		
	CCR	BCC	Scale
Urban	0,77	0,90	0,86
Rural	0,55	0,78	0,70
Urban-rural	0,63	0,81	0,77
Average for all types	0,65	0,83	0,78

Table 4: Average efficiency scores measured by CCR, BCC and scale efficiency in urban (U), rural (R) and urban-rural (U-R) municipalities from the Greater Poland Voivodeship in 2010–2014

Source: own calculations.

Considering sources of technical inefficiency of each type of municipalities it should be stated that these inefficiencies were mainly caused by operating in the suboptimal scale size. However, waste of public funds so managerial problems were also of importance. In the case of urban municipalities scale inefficiency accounted for 55,2% overall technical inefficiency and the rest 44,8% of inefficiency was due to pure inefficiency. Rural municipalities' inefficiency was also mostly brought about by scale inefficiency (51,3%). However, in the case of urban-rural municipalities pure inefficiency (51,5%) was slightly bigger source of technical inefficiency than scale inefficiency (48,5%).

Summing up, out of 1130 entities (panel DEA: 226 municipalities X 5 years) in the CCR model there were 6 fully efficient municipalities (3 urban and 3 rural), whereas in the BCC model 16 urban and 6 rural municipalities' efficiency scores amounted to 1 (full pure technical efficiency).

Discussions and conclusions

The main aim of this article was to evaluate the technical efficiency of public spending on primary schools in municipalities from the Greater Poland Voivodeship in Poland in 2010–2014. The efficiency assessment was preceded by analysis of Polish municipalities' educational tasks, sources of financing them, expenditures borne on primary schools by these local governments and the importance of public spending which included also a brief literature review. In order to evaluate technical efficiency of public spending on primary schools taking into consideration three different types of municipalities a nonparametric panel Data Envelopment Analysis was applied. The study focused on technical efficiency (CCR model), pure technical efficiency (BCC model) and scale efficiency. The main results indicate higher efficiency of public spending on primary schools in urban than in urban-rural municipalities and the lowest in rural municipalities from this voivodeship (regardless of the model type). The average total inefficiency of urban municipalities amounted to 23%, whereas in urban-rural – 37% and in rural – 45%. In order to eliminate these inefficiencies all municipalities should reconsider their educational policy in the field of public funds management and the scale efficiency. However, it should be noted that deterministic version of DEA applied in the study does not take into account other sources of inefficiency like stochastic fluctuations and measurement errors (Agasisti & Bonomi & Sibiano, 2014).

The results obtained from the study indicate that there is a need that central and local governors should take actions in order to decrease the difference between urban and urban-rural and rural municipalities' primary school pupils' final exam results. In particular, efforts should be focused on increasing educational opportunities for children from rural and urban-rural municipalities. Therefore, along with improving public funds management and scale efficiency, local governors should also seek for the determinants of lower attainment result of these pupils. Eliminating or decreasing negative factors or increasing the impact of the positive ones could enhance children achievements and result in the whole education system efficiency improvement. Moreover, governors should always remember that cutting educational expenditures or shutting down small schools is not the best solution to improve efficiency of public spending on primary schools since the allocation of public resources for education is incontestable.

Research limitations and direction for further research

Fluctuations of public spending on primary schools efficiency in the Greater Poland Voivodeship municipalities identified in 2010–2014 could be partly attributed to the differences in difficulty of national exam at the end of primary schools in each year. It is also due to the differences in the amount of budget expenditures incurred per one pupil depending on municipality, problems with public funds management and scale efficiency. However, it should be noted that municipalities do not have full impact on their pupils' exam results since children are influenced by other environmental factors being mostly out of control of local governors. Therefore, a further research focusing on public spending on primary education efficiency in Polish municipalities should also take into account the second stage of analysis – the measurement and assessment of the impact of socio-economic variables on public spending efficiency which are considered to have an impact on pupils' abilities to learn and their attainment results.

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