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The efficiency of social services provided by the municipalities: primary education case study

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Abstract

Motivation: The crucial value guiding local governments is to serve their residents (by carrying out public tasks that satisfy the collective needs of the local community). Although the municipality, as a non-profit organisation, does not have to be profitable, it must apply proper management practices to achieve its goals and attract investors. Local government's efficient and effective functioning is now the basis of modern society. Measuring and analysing results have become an international trend in modernising public administration, and results-based management is seen as a manifestation of public concern for the proper use of taxes. Education is a significant area of local government activity due to its role in every country's development and the fact that it absorbs considerable financial resources. The growing economic crisis and challenges local governments face today mean that efficiency analysis should also be conducted concerning this category of tasks.

Aim: The article aims to assess the efficiency of resources (financial and human) used by municipalities to carry out their task in the field of primary education in the context of the type and wealth of the commune.

Results: The results of this study confirm higher resource efficiency in cities than in rural municipalities. The percentage of cities where the total efficiency coefficient exceeded the level of the third quartile was 84.6% (including 97.3% in large units, 91.9% in medium ones, and 70.8% in small ones). At the same time, it was only 14.9% in rural communes. Medium-sized cities with high levels of own revenue per capita characterised the highest

efficiency of converting input into output. In contrast, rural municipalities with low levels of own revenue had the lowest efficiency.

Keywords: municipal expenditures; primary education; efficiency; DEA; Malmquist index
JEL: C14; H21; H75

1. Introduction

The public (local government) sector's primary task is distributing public goods that satisfy the collective needs of the local community. Education occupies a special place among them due to its role in developing individuals and societies. It determines economic development, promotes scientific discoveries, and is a factor in developing culture and improving quality of life. It is confirmed, among others, by Hanushek and Woessmann (2008, p. 630), who showed that each additional year of schooling increases the long-term GDP growth rate by 0.58 percentage points.

According to the data of Statistics Poland (2023), in 2021, public expenditure on education concerning GDP amounted to 4.71%. This sector is also the most capital-intensive area of local government activity. In 2021, funds allocated by Polish municipalities for education accounted for nearly $_3$ of total budget expenditures on average. On the one hand, based on the correlation between socioeconomic development with the level of human capital, there is a clear incentive to increase investment in education. On the other hand, the prevailing economic crisis and widespread public deficit in almost all countries necessitate optimal outcomes through judicious utilisation of funds (Segovia-Gonzalez et al., 2020, p. 1845).

In light of the above, the article aims to assess the efficiency of resources (financial and human) used by municipalities to carry out their task in primary education in the context of the type of local government and its wealth. The study assumed that this efficiency varies depending on the kind of commune and the level of own income per capita. The DEA (Data Envelopment Analysis) method was used to achieve this goal due to the possibility of simultaneously including multiple inputs and outputs in the analysis and the lack of a requirement to precisely determine their mutual, direct dependencies.

The research is part of the public sector economics trend and pays attention to the diverse efficiency of the task implementation, which is unified in the light of the law. The added value lies in using microeconomic efficiency measurement to evaluate phenomena of a mezzo-economic nature. From the application point of view, the research can be an indication in the search for good practices for less effective local governments.

The structure of the article is subordinated to the research objective. After discussing the research problem in light of the literature review, the methodological assumptions of the study are presented, taking into account the classical DEA CCR model, the Radial Super-efficiency model, and the Malmquist index. Then, the analysis results are discussed, focusing on inputs, outputs, efficiency

indicators, and changes over time. Finally, the findings are compared to those of other authors and summarised.

2. Literature review

The growing economic crisis and the challenges that local government faces make effectiveness and efficiency criteria increasingly crucial in evaluating its actions. Measurement and analysis of results have become an international trend in modernising public administration, and results-based management is seen as a manifestation of concern for the proper use of public funds.

The foundations of the theory of economic efficiency were formulated by V. Pareto, who claimed that efficiency conditions are fulfilled only when the utility of one entity (object) cannot be increased without simultaneously decreasing the utility of another (Kucharski, 2014, p. 4). Over the years, Pareto's concept has been further developed by scholars such as T.C. Koopmans and G. Debreu (who brought the analysis of efficiency to the level of mutually interacting production units), M.J. Farrell (who applied Koopmans' and Debreu's methods to analyse the efficiency of individual, independent production units with separately determined inputs and outputs), H. Leibenstein (who developed the concept of X-efficiency, emphasising the need to include additional issues in the analysis, such as the level of rationality and motivation of decision-makers, interpersonal interactions, incomplete contracts, and internal organisation of units) (Rutkowska, 2020, pp. 36–37). Worthington and Dollery (2000, p. 30) classified various approaches to efficiency into three basic types: technical or productive efficiency (refers to achieving the best result from a given set of inputs or, in cost terms, producing a certain amount of output most cost-effectively), allocative efficiency (involves distributing productive resources among alternative uses to achieve an optimal output mix), and dynamic efficiency (takes into account the dimension of time). Technical and allocative efficiency constitute economic efficiency. An organisation can achieve total economic efficiency only when it uses resources entirely and efficiently, both in allocation and technology.

Determining the efficiency of the public sector encounters some barriers, mainly due to the non-market nature of its services. These include difficulties in defining and measuring outputs, the inability to unambiguously determine the extent to which inputs contribute to the production of the final good, incomplete knowledge of production technology (for example, it is difficult to clearly define the "production" process of education and precisely determine the component elements of the "final product"), as well as the lack of a bottom line for this type of services (comparable solutions such as profit and loss statements, which apply to market production, do not use to non-market one) and the absence of a termination mechanism in case the activity results are unsatisfactory (Kozuń-Cieślak, 2011, pp. 88–89; Wolf, 1993, pp. 51–55).

Due to the difficulties involved, the objective measurement of the efficiency in the public sector requires the application of specialised methods, which can be grouped into two sets: parametric and non-parametric. Parametric methods are used when models have a well-defined structure. They require assumptions about the production function, which determines the relationship between inputs and outputs and provides an answer to the maximum output that can be obtained with given inputs. On the other hand, non-parametric methods are used when the functional relationship between inputs and results cannot be unambiguously determined. These methods are applied to models whose structure is not predetermined but adjusted to the data (Ćwiąkała-Małys & Nowak, 2009, p. 6). For evaluating the efficiency of local self-government, data envelopment analysis (DEA) or free disposal hull (FDH) are most commonly chosen from the parametric methods, while stochastic frontier approach (SFA), distribution-free approach (DFA), and thick frontier approach (TFA) are among the non-parametric methods (Czyż-Gwiazda, 2013, p. 105; Milán García et al., 2022, p. 2874).

The difficulties mentioned above do not discourage scientists from conducting research in the field of local government efficiency. Studies of the literature on local governments' efficiency (available in Web of Science, Scopus and Google Scholar) carried out by Narbon-Perpina and De Witte (2018) showed that between 1990 and 2016, over 250 studies were conducted in this area of which 84 met the research criteria and were subjected to an in-depth analysis by the authors. The studies showed that research on the efficiency of local governments focused mainly on European countries (especially Spain, Belgium, and Germany), but none concerned Poland. On the other hand, the bibliometric analysis of 333 articles from Web of Science and 321 from Scopus regarding the determinants of local government efficiency, conducted by Milán García et al. (2022), showed that the United States, Spain, Italy, and the United Kingdom were the most relevant countries, followed by China and Australia. In Poland, research on local governments' efficiency has focused on various areas, including public services (e.g. Kachniarz, 2012), public administration (e.g. Marzec, 2020; Opolski & Modzelewski, 2009; Rutkowska, 2020), public-private partnership (e.g. Brol, 2014), real estate management (e.g. Kokot & Gnat, 2010), local government finances (e.g. Filipiak, 2011; Guziejewska, 2008; Jastrzębska, 2016; Owsiak, 2014), concepts and measurement methods (e.g. Bartoszewicz & Lelusz, 2016; Nowak, 2008; Skica, 2012; Szołno, 2016; Wojciechowski, 2012), projects and investment policy (e.g. Kobiałka & Kubik, 2017; Sierak & Górniak, 2011), the field of education (e.g. Herczyński & Siwińska-Gorzelak, 2016; Jeżowski, 2008; Kaczyńska, 2017; Kołomycew & Kotarba, 2018).

According to De Witte and López-Torres (2017, p. 339), due to its specificity (dominance of non-profit institutions, variety of products, lack of established input and output prices), the education sector creates favourable conditions for efforts to study efficiency. There is extensive literature on efficiency in education and related issues discussed, among others, in Agasisti et al. (2019); Al-

exander et al. (2010); Chiariello et al. (2022); Cordero et al. (2017); De Witte and López-Torres (2017); Dincă et al. (2021); Haddad and Heong (2021); Hu et al. (2009); Huguenin (2015); Johnes (2015); Johnes and Virmani (2020); Johnes et al. (2017); Lauro et al. (2016); Segovia-Gonzalez et al. (2020). The researchers concentrate mainly on school efficiency (e.g. Lauro et al., 2016) or the efficiency of education (e.g. Hu et al., 2009) and analyse the phenomenon through the prism of student characteristics and their environment (family, school, and community) (Chiariello et al., 2022, p. 1730). However, there are significantly fewer studies on the efficiency of primary education as a commune's task.

In Poland, municipalities execute most educational duties, which they perform as obligatory tasks. They are responsible for ensuring education, upbringing, and care, including special education and social prevention in kindergartens and other forms of preschool education, as well as in primary schools, excluding special schools, art schools, schools in correctional facilities, and shelters for minors. Municipalities can close and open educational institutions and determine school budgets. They are also responsible for providing appropriate conditions for educational institutions' functioning, renovations and investments, administrative and financial support, and equipping them with teaching aids and necessary equipment (Lizińska et al., 2020, pp. 5–6).

Comparing the implementation of municipality responsibilities in primary education to resource management, following Wojciechowski (2012, pp. 204–205), it can be considered as a process enclosed in the "black box", characterised by diverse input (resources) and output (material and immaterial goods). It involves transforming public resources (property, financial, and personnel) into results in the form of educational services. Its evaluation is based on a set of multiple indicators. Inputs for producing educational services, as classified by Agasisti et al. (2019, p. 107), encompass three broad groups: financial resources, human resources, and facilities (including consumables and infrastructure). The most commonly used variables are class size measures, student–teacher ratio, and various types of spending per student (Agasisti et al., 2014, p. 123). On the other hand, in the literature, there is consensus regarding the use of standardised test results when assessing process outcomes (Segovia-Gonzalez et al., 2020, p. 1855), such as the OECD Programme for International Student Assessment (PISA) (e.g., Agasisti et al., 2019; Chiariello et al., 2022; Deutsch et al., 2013; Dincă et al., 2021), the Progress in International Reading Literacy Study (PIRLS) (e.g., Cordero et al., 2017), or the Trends in International Mathematics and Science Study (TIMSS) (Giménez et al., 2007). Individual countries also have internal systems for assessing student achievements, the results of which can be used for analysis (e.g., Huguenin, 2015). In Poland, this includes the final exam for primary education (eighth-grade exam) that tests students' knowledge in three areas (Polish language, mathematics, and foreign language) using tasks and evaluation criteria standardised throughout the country.

Based on different theoretical frameworks and methods of estimating efficiency, most articles share the common idea that education can be seen as the output of a production process that uses different variables as production inputs (Chiariello et al., 2022, p. 1730).

3. Methods

The implementation of the research objective was based on verifying the hypothesis that the efficiency of resources engaged by municipalities to carry out their task in primary education varies depending on the type of commune and level of own revenue per capita. The subject of the study was technical efficiency, interpreted as obtaining the best outcome from utilising the lowest level of resources (Haddad & Heong, 2021, p. 4210). To determine it, the non-parametric Data Envelopment Analysis was used. It is a widely employed mathematical programming technique for evaluating the relative efficiency of a collection of homogeneous Decision-Making Units (DMUs) (in this research, represented by municipalities) consuming different quantities of the same inputs to produce different quantities of the same outputs (Benítez et al., 2021, p. 1).

DEA finds its origin in Charnes et al. (1978) and is first applied to the education sector by Bessent and Bessent (1980) (Huguenin, 2015, p. 541). Since then, the method has undergone many modifications (cf.: Cook & Seiford, 2009; Zhu, 2014) and areas of application (cf.: Emrouznejad & Yang, 2018; Izadikhah, 2022). In the field of primary education, it was utilised by, among others, Chiariello et al. (2022) to evaluate the Italian education system; Lauro et al. (2016) to analyse the efficiency of 465 elementary schools run by the city of Rio de Janeiro; Hu et al. (2009) to evaluate a sample of 58 primary schools in six districts in Beijing; Segovia-Gonzalez et al. (2020) to explore the efficiency of Spanish schools; Cordero et al. (2017) to assess the performance of primary schools in 16 European countries; Dincă et al. (2021) to evaluate education sector's efficiency by comparing 28 European Union states; Dutta (2012) to assess the technical efficiency and efficiency differences in the elementary education system across Indian states.

In the model developed by Charnes et al. (1978) (CCR model), the efficiency score of each unit can be represented as a ratio of the total weighted outputs to the total weighted inputs (Pedraja-Chaparro et al., 2005), according to the formula below (Mardani et al., 2017, p. 1301):

$$Eff = \frac{\sum_r u_r y_{rj}}{\sum_r v_i x_{ij}}, \tag{1}$$

where:

y_{rj} — the amount of the rth output from DMU_j;
u_r — the weight given to the rth output;

x_{ij} — the amount of the ith input used by DMU_j;
v_i — the weight given to the ith input.

DEA allows the calculation of technical efficiency measures that can be either input or output-oriented (Afonso & Fernandes, 2006, p. 42). In this study, the first approach was applied.

When using this technique, it should be borne in mind the relative character of the results as the efficiency of a selected object is measured to the group of objects covered by the study. Therefore, an inefficient DMU may be considered efficient because the others are worse.

In the CCR model, all DMUs that score one are considered efficient relative to the other observations (Charnes et al., 1978, p. 442). Therefore, it makes it impossible to indicate a leader and create a ranking in a sample where several units have the highest score. In such a situation, a helpful solution is to use the modified version of DEA based upon comparing efficient DMUs relative to a reference technology spanned by all other units developed (Andersen & Petersen, 1993, p. 1261). Determined in this way, the coefficients $\Theta<1$ inform about the lack of efficiency (i.e. a situation where other municipalities perform the task using fewer inputs). In turn, coefficients $\Theta \geq 1$ appear in efficient DMUs, with $\Theta=1$ indicating that the commune is not worse than others and $\Theta>1$ when other local governments would need more inputs to achieve the outputs than the examined commune incurred.

This study also applied the Malmquist index (MI) to measure municipal productivity changes over time. It is calculated by multiplying two components: the technical change index and the efficiency change index. The first measures the change in technology between the two time periods, while the second measures the change in the efficiency of the DMUs over the same period. Productivity declines if $MI<1$; remains unchanged if $MI=1$ and improves if $MI>1$ (Rayeni et al., 2010, pp. 2876–2877).

The DEA method requires specifying a set of variables representing inputs and outputs. Considering the conclusions from the literature review, eight indicators were used to assess the efficiency of resources in carrying out the commune's task in primary education. The set of inputs included three indicators relating to financial resources (x_1, x_2, x_3) and two to human resources (teachers engaged in the education process) (x_4, x_5):

- x_1 — expenditure from the municipal budget for primary schools (chapter 80101 in budget classification) per pupil — it informs about the unit cost of educating a student in a given municipality. It is one of the most popular indicators used to characterise the functioning of education;
- x_2 — expenditure from the municipal budget for primary schools (chapter 80101 in budget classification) per full-time equivalent of employed teachers — it reflects the financial commitment of the municipality in implementing educational tasks. The indicator considers expenditures on teacher salaries, investment expenses, and other costs associated with carrying out educational tasks (in primary education). It informs about the proactive

approach of the municipality, which acquires funds from various sources to improve the conditions and quality of education;

- x_3 — share of expenditure from the municipal budget for primary schools (chapter 80101 in budget classification) in total expenditure of gminas budgets — it ranks the expenditures on primary education with other municipality tasks. A high amount allocated to primary education can also indicate that the municipality is investing in the development of its schools (such as infrastructure modernisation and equipment), which can improve the quality of education and attract new students to the municipality;
- x_4 — number of sections in schools per 16 students — the indicator is an inverse of the "number of students per class". It informs about the relationship between class sizes and the average determined for the population (16 students per class). If $x_4<1$, the classes are larger than the average from 2019–2021, while if $x_4>1$, the classes are smaller. It indirectly refers to human resources as the number of classes depends on the number of teachers. Human resources are crucial because in smaller classes, individual approaches to students can be applied, making the work more effective, which should result in better outcomes;
- x_5 — number of full-time equivalent teachers per 10 students — it directly describes the human resources. Many teachers per student can indicate that the school or educational system invests in the quality of education and strives to provide appropriate support for each student. As a result, teachers can focus on individual work with students and better address their educational needs, which can translate into better learning results.

Conversely, the output set includes the results of the eighth-grade exam, i.e.:

- y_1 — a result of the Polish language eighth-grader exam;
- y_2 — a result of the Mathematics eighth-grader exam;
- y_3 — a result of the modern foreign language eighth-grader exam.

Descriptive statistics of the distribution of the indicators within the research sample are presented in Table 1 (inputs) and Table 2 (outputs).

Selected variables meet the requirements pointed out by Młynarski et al. (2021, p. 2), i.e. they are expressed in positive values, measured in the same units for each DMU, and each input is positively correlated with at least one output as an increase in inputs should lead to an increase in outputs.

The information used in the analysis came from the resources of public statistics, x_1–x_5 from the Local Data Bank (Statistics Poland, 2023), whereas y_1–y_3 from the Central Examination Board (2023). The time range of the study covers the years between the first edition of the eighth-grade exam (2019) and the availability of the most up-to-date statistical data (2021). The study included all 2,477 local governments in Poland (302 urban municipalities, 1,523 rural municipalities, and 652 urban-rural municipalities). However, due to data gaps, 21 communes were excluded from the study, including three towns, 16 rural communes and two urban-rural ones. These were units that either failed to fulfil the statistical reporting obligation (one commune) or were covered by

statistical secrecy because of too few pupils (fewer than 10) taking the exam in a given subject (20 local governments).

All the necessary calculations were made in deaR-Shiny, credited by Benítez et al. (2021).

Considering the purpose of the study, the sample of 2,456 Polish municipalities was divided into separate groups using two criteria, i.e. the type of commune (large cities with over 100,000 inhabitants; medium-sized cities with a population between 20,000 and 100,000; small towns inhabited by fewer than 20,000 people; urban-rural communes; rural communes) and the level of own revenues per capita (very high, high, medium, low and very low). The basis for the grouping was averaged data from 2019–2021 and the current administrative division of the country. The values of own revenues per capita were assigned into classes based on the quartiles (Q), the range (R) and the division parameter k ($k=R/3$) (Kukuła, 2015, pp. 176–177). First, two extreme classes were distinguished, i.e. communes with:

1. very high revenue: $DMU_i \in <\max_{2,456}; Q_3+1.5(Q_3-Q_1)>$ (111 municipalities);
2. very low revenue: $DMU_i \in <\min_{2,456}; Q_1-1.5(Q_3-Q_1)>$ (0 municipalities).

Then, the remaining part (2,345 units) was divided into three subgroups as follows:

– $DMU_i \in <\min_{2,345}-\max_{2,345}-2k)$ (low-revenue class) (874 municipalities);
– $DMU_i \in <\max_{2,345}-2k; \max_{2,345}-k)$ (medium-revenue class) (1,180 municipalities);
– $DMU_i \in <\max_{2,345}-k; \max_{2,345}>$ (high-revenue class) (291 municipalities).

The result of clustering with the number of municipalities in each group is presented in Table 3.

4. Results

Between 2019 and 2021, Polish municipalities allocated an average of 18.3% of their total budget expenditures to implementing primary education tasks, with an upward trend over the analysed years (the average change was 1.2 percentage points). An increase in the share of expenditure on primary education was recorded by 70% of communes, and the most extensive changes (by approx. 17 percentage points) were caused by the investment activity of local governments (construction, extension or renovation of schools).

The percentage of funds allocated by municipalities to primary education decreased with the increase of own revenues per capita. It also varied with the size and type of municipality. As a result, rural municipalities with the lowest level of own revenues per capita held the highest share of expenditures on implementing the discussed task in the overall budget expenditures. Throughout the analysed period, it averaged 20.4% and was 11.3 percentage points higher than that achieved by large cities with a very high level of revenues.

In order to obtain a complete picture of financial engagement in implementing the task in primary education, the expenses incurred by municipalities

were relativised concerning two main groups of stakeholders, namely students and teachers.

In 2019–2021, the average amount per student was 13,249.86 PLN and 144,494.47 PLN per teacher. In this approach, rural municipalities with a very high level of own revenues were characterised by the highest unit costs. The indicators achieved in this group amounted to an average of 15,391.00 PLN per student and 174,724.80 PLN per teacher's position. On the other hand, the lowest values were recorded in large cities with a medium level of own revenues per capita. The indicators determined for them were 8,952.90 PLN (expenditure per student) and 115,548.90 PLN (expenditure per teacher's position).

Efficient implementation of primary education requires municipalities to engage financial and personnel resources optimally. The study described the second aspect indirectly using the number of sections in schools per 16 students and directly by the number of full-time equivalent teachers per 10 students.

In this area, rural municipalities with a low level of own revenues per capita performed the best. The number of students in a class averaged 14 people, and the teacher position index was 1.03. On the other hand, large and small cities with an average level of own revenues per capita performed the least favourably. The former stood out with the most numerous classes (average of 21 pupils), while the latter with the smallest number of teacher positions per 10 students (0.74).

Small classes and many teachers facilitate an individual approach to students and create conditions for achieving better results, but they do not guarantee the quality of education. The analysis shows that the highest outputs (expressed by the results of the eighth-grade exam) were achieved by pupils in communes with the highest value of their own revenue per capita. In this group, large and medium-sized cities took the lead — the first in terms of Polish language (with an average score of 64.6%) and mathematics (52.8%) and the second regarding foreign language (67.7%). On the other hand, the lowest results were most common in communes from the lowest income group. In the case of mathematics, these were urban-rural communes (40.9%), the Polish language — small towns (56.0%), and foreign language — rural municipalities (48.8%).

Submitting the input and output indicators to the DEA procedure enabled determining the efficiency of the commune's own task in the field of primary education. The study shows that the group of local governments considered efficient included 38 units. In this set, only 10 achieved an efficiency coefficient (Θ) equal to 1 in each analysed year. Half of them were from the Mazowieckie Voivodeship (including the Capital City of Warsaw and neighbouring municipalities: Milanówek, Podkowa Leśna, Sulejówek, and Michałowice), and also the city of Świdnik (Lubelskie Voivodeship), the city of Kraków (Małopolskie Voivodeship), the city of Krosno (Podkarpackie Voivodeship), the city of Sopot (Pomorskie Voivodeship), and the rural municipality of Koszarawa (Śląskie Voivodeship). The efficiency of other communes was highly diverse and, af-

ter averaging the results from the three analysed years, ranged from 0.3916 (the rural municipality of Platerówka, Dolnośląskie Voivodeship) to 0.9994 (the city of Kielce, Świętokrzyskie Voivodeship). Above means that these local governments demonstrated efficiency ranging from 39.2% to 99.9% of the leader's efficiency, which was (after averaging the results) the rural municipality of Koszarawa.

In order to verify the research hypothesis, the averaged 2019–2021 results obtained by the Radial Super-efficiency technique were analysed in groups of municipalities distinguished by their type and level of wealth (Table 4). The inquiry showed that the results decreased with the level of own revenues and with the change of municipality type. The highest level of resource efficiency was observed in medium-sized cities with high per capita own revenue levels. These units obtained a Θ index above the third quartile each year of the analysis, and their average position was the highest, at 59. On the other hand, the lowest efficiency was observed in rural municipalities with a low level of own revenues, although it should be noted that this group was highly diverse. It comprised the ranking leader and municipalities with a total efficiency index below the first quartile. Their share in the group's structure accounted for 36% and was the highest percentage of all the clusters included in the study. The average of places occupied by local governments in this group was also the lowest and amounted to 1522.

The study also focused on the changes in efficiency, using the averaged Malmquist indices calculated for two periods, i.e. 2019–2020 and 2020–2021. The analysis shows that over three-quarters of municipalities (83.2%) experienced decreased efficiency. The average for the entire dataset was 5.2%, with a standard deviation of 6.0 and a coefficient of variation of 116.8%.

The analysis of groups of municipalities distinguished by type and level of wealth has shown that only local governments with the highest efficiency (medium-sized cities with very high levels of own revenues per capita) improved their efficiency (on average by 1.32%). In the other groups, changes were in the opposite direction, with the highest decrease in efficiency (by 6.6%) experienced by urban-rural municipalities with a low level of own revenues per capita. In these municipalities, the worsening in spending on primary education (on average by 22.8%) was accompanied by a decrease in the number of students (on average by 1.1%) and teaching positions (on average of 3.1%). At the same time, in terms of outputs, these local governments recorded a deterioration in results in the Polish language exam, comparable to the national average, and improvement in the other two subjects was below the national average.

Nevertheless, it should be noted that in some municipalities, the decrease in efficiency resulted from the overlap of two factors, i.e., an increase in expenditures due to investments and a deterioration of results due to the sudden transition to distance learning (caused by the outbreak of the Covid-19 pandemic). Both of these factors were temporary, and the inefficiency of this group of municipalities should be perceived accordingly. However, more detailed data

and a longer time frame of analysis are needed to determine the scale of this phenomenon.

5. Discussion and Conclusions

Studies taking into account the context of the location provide ambiguous conclusions regarding its impact on the effectiveness of education. For example, Cordero et al. (2017, p. 372) detected a negative influence of being placed in a rural area and indicated a lack of competition as the main reason. Similarly, De Witte and López-Torres (2017, p. 350) indicated 17 papers showing that urban educational institutions achieve better results and can reduce costs. In turn, research by Soteriou et al. (1998, p. 65) on secondary schools showed no difference in performance between schools operating in rural areas compared to schools operating in urban areas. In contrast, Johnes and Virmani (2020, p. 1879) evaluated the efficiency of education systems in four low and middle-income countries and noticed that rural schools convert their inputs into outputs more efficiently. Although the results obtained in cities were usually better than in rural areas, at the same time, they had a higher level of input due to the greater wealth of these areas. Students from rural areas often achieved good results accompanied by significantly lower inputs. Similar conclusions were reached by Alexander et al. (2010, p. 109), who observed the advantage of the effectiveness of schools in rural and smaller city areas compared to their counterparts in major urban areas.

The results of this study confirm higher resource efficiency in cities than in rural municipalities. The percentage of cities where the total efficiency coefficient exceeded the level of the third quartile was 84.6% (including 97.3% in large units, 91.9% in medium ones, and 70.8% in small ones). At the same time, it was only 14.9% in rural municipalities.

The analysis showed that local governments differed in partial indicators (input and output) and final results (total technical efficiency).

When interpreting results in distinguished groups of municipalities, one should take into account the varying size of individual sets and the fact that the criteria for their identification were unable to capture the complete specificity of local governments, especially those that are rural and urban-rural (e.g., distance from a large city or post-state farm legacy). A limitation was also the short period of analysis (since the first edition of the eighth-grade exam took place in the 2018/2019 school year) and the aggregated way of providing data by Statistics Poland (2023) (i.e., a lack of information from lower levels of budget classification). The above made it impossible to unambiguously identify the determinants of the obtained result while at the same time providing a premise for deepening the analysis using primary data. Nevertheless, the research may guide good practices in constructing an optimal "technology" for implementing the municipality's task in primary education, which is particularly important in the context of the deepening crisis of local government finances.

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Appendix

Table 1.
Descriptive statistics of the distribution of the input indicators within the research sample (N=2,456)

Input	Mean	Min	Max	SD	V	S
x_1	13,249.86	6,623.21	34,614.58	2,700.55	20.38	0.95
x_2	144,494.47	77,509.26	360,972.07	21,002.07	14.53	1.75
x_3	18.27	4.34	34.74	3.68	20.16	0.01
x_4	1.04	0.62	2.63	0.24	23.00	1.22
x_5	0.92	0.40	1.72	0.17	18.21	0.84

Note:

x_1 — expenditure in chapter 80101 (primary schools) per pupil (2019–2021 average); x_2 — expenditure in chapter 80101 (primary schools) per full-time equivalent of employed teachers (average 2019–2021); x_3 — share of expenditure in chapter 80101 (primary schools) in total expenditure of gminas budgets (average 2019–2021); x_4 — number of sections in schools per 16 students (2019–2021 average); x_5 — number of full-time equivalent teachers per 10 students (2019–2021 average).

min — minimum value; max — maximum value; SD — standard deviation; V — variability coefficient; S — skewness coefficient.

Source: Own preparation based on Statistics Poland (2023).

Table 2.
Descriptive statistics of the distribution of the output indicators within the research sample (N=2,456)

Output	Mean	Min	Max	SD	V	S
y_1	58.28	41.42	73.09	4.64	7.96	–0.15
y_2	42.43	23.01	72.30	5.67	13.36	0.36
y_3	51.85	32.12	83.85	7.58	14.62	0.48

Note:

y_1 — average result of the Polish language eighth-grader exam; y_2 — average result of the Mathematics eighth-grader exam; y_3 — average result of the modern foreign language eighth-grader exam.

min — minimum value; max — maximum value; SD — standard deviation; V — variability coefficient; S — skewness coefficient.

Source: Own preparation based on the Central Examination Board (2023).

Table 3.
Groups of municipalities distinguished by type and level of own revenue per capita

Own revenue per capita	Cities			Gminas		Total
	large	medium	small	urban-rural	rural	
very high	14	4	10	27	56	111
high	21	64	27	70	109	291
medium	2	81	74	366	657	1,180
low	0	0	2	187	685	874
very low	0	0	0	0	0	0
total	37	149	113	650	1,507	

Source: Own preparation.

Table 4.
The efficiency of the own task in primary education in groups of municipalities distinguished by type and level of own revenue per capita

Own revenue per capita	Cities			Gminas	
	large	medium	small	urban-rural	rural
very high	0.9307	1.0574	0.8143	0.7485	0.7531
high	0.8847	0.8726	0.8258	0.7295	0.7177
medium	0.8883	0.8320	0.8091	0.7075	0.6785
low	–	–	0.7505	0.6747	0.6637
very low	–	–	–	–	–

Source: Own preparation based on calculations using deaR-Shiny (Benítez et al., 2021).