

Transition and efficiency: How efficient are Polish local communes in terms of the delivery of local public services?

LEJLA LAZOVIĆ-PITA, TOMASZ SKICA, LAMIJA ŠČETA

Abstract

DOI: 10.23762/FSO_VOL10_N04_5

In recent years, there has been a significant increase in the level of interest in measuring the (in)efficiency of local government (communes). This topic is particularly important due to the growing social needs and limited financial resources of local governments. With the above in mind, this article focuses on the measurement of the technical (in)efficiency of municipalities in Poland. Due to the fact that studies on local government expenditure in terms of the entire population of communes are rarely undertaken, the population of Polish communes (2478 units) was included in the study. The research used a method based on stochastic frontier analysis (SFA). The authors state that urban communes are characterised by greater (in)efficiency than rural communes. The scale of a possible reduction in expenditure without lowering the effects of public task implementation is on average 20.01%, while for rural communes it is 15.94%. Public spending across the categories of communes is also differentiated by the age structure of the population and the homogeneity of political views at the central and local levels. The results obtained indicate that there is space not only for a revision of the current expenditure policy, but also for the development of proposed changes aimed at enhancing the efficiency of public spending.

Key words

efficiency of communes, local public services, expenditure efficiency

Lejla Lazović-Pita

e-mail: lejla.lazovic@efsa.unsa.ba
University of Sarajevo,
Bosnia and Herzegovina

Tomasz Skica¹

e-mail: tskica@wsiz.edu.pl
University of Information Technology
and Management in Rzeszów, Poland

Lamija Ščeta

e-mail: lamija.sceta@efsa.unsa.ba
University of Sarajevo,
Bosnia and Herzegovina

¹Corresponding author

Introduction

The importance and the popularity of measuring the (in)efficiency of local self-government (communes) across countries by

means of the application of several methods have significantly increased in the last three decades. The efficiency of communes in

terms of the provision of local public goods are of crucial importance to all citizens, which has been recognised and acknowledged in the European Charter of Local Self-Government (The Council of Europe, 1985). Furthermore, a theoretical framework for measuring the efficiency of subcentral governments, namely local self-governments, has been grounded in the works of Tiebout (1956), Musgrave (1959) and Oates (1972). Most recently, Milán-García et al., (2022) defined three important theoretical milestones for investigating and measuring local efficiency: the definition of local efficiency as that achieved by local governments in the provision and/or production of public services; types of measuring efficiency, namely technical, allocative or economic; and the significance for policymakers in terms of the identification of the main determinants of local efficiency. One of the most common composite approaches to measuring government performance in terms of the (in)efficiency of communes has been the frontier estimation methodologies, namely stochastic frontier analysis (SFA) together with data envelopment analysis (DEA) and free disposable hull (FDH). In this paper, we focus on measuring the technical (in)efficiency of communes in Poland, the largest post-transition European country in terms of population, for 2017 using the SFA method. Even though research on local efficiency in Poland is increasing (Skica et al., 2019; Jedynak and Wąsowicz, 2021; Grzebyk et al., 2021), no studies of the technical efficiency of Polish communes (by using SFA) have been conducted to date; we wish to contribute towards filling the literature and empirical gap.

Several methods for measuring the (in) efficiency of communes have been used in former communist/socialist countries in Europe. After facing similar transition shocks (Onaran, 2011) and other common transition-related macroeconomic issues such as high unemployment rates,

trade-balance deficits, and delayed or (un) successfully finished privatisation processes, these countries aspired to become European Union (EU) members. However, even after joining the EU and the change in their status to post-transition countries, there are some remaining common grounds between European transition and post-transition countries. Currently, the impact of the COVID-19 pandemic has highlighted the remaining burning issues that (post-) transition countries faced even before the pandemic. These especially relate to the size and the share of the state in the economy in (post-)transition countries (EBRD, 2020), the lack of good governance, and the detrimental consequences poor governance brings, such as the inability of the government to curtail the grey economy, corruption, and (e)migration issues (EBRD, 2019). Faced with these burning issues, very few post-transition European countries focused their local economic policies on efficient local development. European Commission reports (2012) as well as the UN Sustainable Development Goals 2030 focus on, *inter alia*, issues related to migration and providing sustainable cities and communities. Regardless of their size and status (for example, small and rural communes face population decline and rapid aging whereas urban and large communes are faced with greater population inflow), all communes in countries across Europe are under pressure to provide ‘value for money’ at all levels of government, and therefore at the local level as well. Hence, the significance of measuring the (in)efficiency of communes in a large country such as Poland, especially in terms of the urban and rural division of communes. The main purposes of this paper are twofold. Firstly, we wish to contribute to the literature through an overview of methods, variables, and results obtained regarding local efficiency in the European (post-) transition countries. These especially relate to the burning question of the relationship

between local efficiency and the transition process. Unfortunately, for (post-)transition countries, local communes and the efficiency thereof are not at the forefront of the overall transition process. Secondly, we will measure the (in)efficiency of communes in Poland, the largest (post-)transition country, by using the SFA method and identifying the most important variables affecting local (in)efficiency in (post-) transition countries.

In this paper, we begin our analysis with the literature review, where we wish to contribute to the scarce analysis of former communist/socialist countries in Europe that have applied the composite approaches to measuring the (in)efficiency of communes. The following sections deal with the methodology, data, and results of SFA analysis conducted in Poland. We specifically focus on providing a comparative analysis of the applied SFA model in Poland to other (post-)transition countries in the discussion section, before laying out the conclusions reached.

1. Literature review

The possibility of measuring and analysing efficiency and productivity by using frontier estimation methodologies has been recognised across disciplines and economic activities (Daraio et al., 2019). The most commonly used implementation of the frontier estimation method varies across sectors, countries, or groups of countries (Chapelle and Plane, 2005; Hassine-Belghith, 2009). Hence, the academic interest, and therefore literature, which deals with the measurement of (public) performance (in)efficiency of communes have been on the rise in the last 30 years (Jackson, 2011). The works of Narbón-Perpiñá and De Witte (2018a, 2018b) provide an exhaustive and systematic literature review from 1990 until 2016 regarding the efficiency of local governments around the world. The authors provide a clear classification of most applied

methods, followed by a list of input and output variables, determinants, and results obtained in country-level studies of local (in)efficiency. We follow the same procedure, but concentrate solely on the group of European (post-)transition countries, focusing primarily on the methods, most used variables, and results obtained. Most recently, a bibliometric and cluster analysis of local efficiency literature was carried out by Milán-García et al., (2022), which extended the analysis of the main determinants of local efficiency until June 2021.

As early as 1996, De Borger and Kerstens (1996) identified two types of measurement of the efficiency of communes: single local service efficiency measurement (for example street cleaning) (Worthington and Dollery, 2000, 2001; Bosch et al., 2000; Benito-Lopez et al., 2011, 2015) and the measurement of local efficiency from a global perspective, sometimes referred to as composite approaches to measuring efficiency (Kalb et al., 2011). In this paper, we focus on the latter, i.e. composite approaches that identify three methods: DEA, FDH, and SFA. Since composite approaches can be parametric and non-parametric, as well as deterministic and stochastic, a variation of four different approaches can be obtained: 1) parametric deterministic, 2) non-parametric deterministic, 3) parametric stochastic and 4) non-parametric stochastic methods (Radulović and Dragutinović, 2015). DEA and FDH represent non-parametric deterministic methods, whereas in this paper we investigate SFA, which is a parametric stochastic method. Narbón-Perpiñá and De Witte (2018a) also define several additional methods and measurement error corrections for the defined composite approaches, as well as alternative methods of measuring local performance efficiency, e.g. the Malmquist productivity index (Caves et al., 1982), time-variant SFA analysis or an index defined as the ratio of the total aggregate output to local government revenues

(Narbón-Perpiñá and De Witte, 2018a, 438-439) developed by Borge et al. (2008). Lately, the impact of the efficiency of local communes on their financial health has been investigated, concluding that such an impact does exist and is dependent on the type of expenditure (current vs. capital) (Cuadrado-Ballesteros and Bisogno, 2019).

Narbón-Perpiñá and De Witte (2018a, 2018b) identify and classify two groups of variables. In the first paper (2018b), the classification of non-discretionary variables considered in terms of the efficiency of local/regional governments is defined under a general term of 'external or environmental variables', while in the second paper (2018a),

the variables were summarised as input and output variables. Each group of determinants (variables) is again sub-divided into several groups (for example, socio-demographic, economic, political, financial, institutional, etc.).

Similar to the most recent literature systematisations provided in works by Boetti et al. (2012), Nikolov and Hrovatin (2013), Narbón-Perpiñá and De Witte (2018a, 2018b), and Lazović-Pita and Šćeta (2021), Table 1 summarises the most recent relevant research conducted in the European (post-) transition countries, clearly stating the country, authors, method(s), variables and results obtained.

Table 1. Literature review of relevant local/regional efficiency studies in the European (post-) transition countries

Country, authors, method(s) used, level of government	Variables (dependent variables/inputs; independent variables/outputs)	Results /mean efficiency
Bosnia and Herzegovina Lazović-Pita and Šćeta, 2021; Soko, 2018; Soko and Zorič, 2018 DEA and SFA Local communities	(2021 study): SFA: (input) : total local expenditures; (output) : population, population density, education, health services, employment; control: road maintenance, structure of public service provision, mayor's political affiliation; (2018 study): DEA: (input) : total budget expenditure; (output) : population; number of pupils in primary school; length of roads; number of doctors.	(2021): 0.67-0.68; (2018) 0.7115

Country, authors, method(s) used, level of government	Variables (dependent variables/inputs; independent variables/outputs)	Results /mean efficiency
<p>Croatia Slijepčević, 2019; Hodžić and Muharemović, 2019; Rabar, 2013; Hunjet et al., (2012, 2015); Škufljić et al., (2010) DEA Local communities (cities and municipalities), regions/counties</p>	<p>(2019): (input): total expenses of local government units in the county per capita; (outputs): general administrative services - number of inhabitants in 2011, projection of number of inhabitants 2015-2017; education - number of children per kindergarten, average 2015-2017, number of children per school, average 2015-2017; environmental protection - percentage of the population served by waste collection, 2016; infrastructure - road network density, average 2015-2017; culture - number of cinemas per inhabitant in the county, average 2015-2017, number of libraries per inhabitant in the county, average 2015-2017; social services - number of inhabitants in the county aged 65+ years old, 2011;</p> <p>(2019 study): (input): gross earnings of the employed, material expenses and borrowing costs; (outputs): number of businesses in counties, number of primary and secondary schools and population per county;</p> <p>(2015): 12 cities in Croatia over the period 2004-2009; (input): number of workers employed and assets employed (fixed assets—intangible assets, tangible assets, long-term financial assets, accounts receivable, deferred tax assets); (output): total income (income, financial expenses and extraordinary/other income);</p> <p>(2013): (input): registered unemployment rate, support allowance users; (output): share of secondary sector, GDP, graduated students, level of import coverage by export, gross fixed capital formation in fixed assets, share of secondary sector;</p> <p>(2012): 127 decision-making units - local communities for 2007: (input): number of employed workers and employed assets; (output): income;</p> <p>(2010 study): (input): number of graduate students, number of active legal entities, level of foreign direct investment, investment and exports; (outputs): level of the gross domestic product and gross wages.</p>	<p>(2019): 0.65; (2019) 0.88-0.96; (2013): 0.7; (2015): 0.988- 0.712; (2012): 0.540 (average); (2010) 0.85</p>
<p>Serbia Radulović and Dragutinović, 2015 SFA Local communities</p>	<p>(input): current expenditures; (output): population, municipal roads, water supply, kindergartens, primary and secondary education, social services.</p>	<p>(2015) 0.67-0.85</p>
<p>North Macedonia Nikolov and Brosio, 2015; Nikolov and Hrovatin, 2013 DEA and SFA Local communities</p>	<p>(2015): (input): municipal expenditures; (output): age class as a proxy for the competencies of municipalities such as child and elderly care, primary and secondary education, and road maintenance.</p> <p>(2013): (input): current expenditures; (output): population by age categories as a proxy for different services and length of asphalt roads.</p>	<p>(2013): 0.596</p>

Country, authors, method(s) used, level of government	Variables (dependent variables/inputs; independent variables/outputs)	Results /mean efficiency
Slovenia Pevcin, 2013, 2014 DEA and SFA Local communities	(2014): (input): total expenditures; (output): population, primary and secondary education, elderly care and business development. (2013): (input): total expenditures; (output): population, primary and secondary education, elderly care and business development.	(2014): 0.75-0.88; (2013): 0.75-0.78
Czech Republic Štastná and Gregor, 2011, 2015 DEA and SFA Local communities	(2011): (input): total current spending; (output): administration; cultural facilities; education; environment; housing and industry; public safety; control: population, geography, education, fiscal capacity, politics. (2015): (input): total current spending; (output): administration; cultural facilities; education; environment; housing and industry; public safety; control: population, geography, education, fiscal capacity, politics.	(2011): 0.3-0.79; (2015): 0.62-0.69
Poland Skica et al., (2019) DEA Local communities	(inputs): population at post-working age per 100 persons of working age; density of population per 1 km ² ; number of advices provided in primary healthcare; apartments per 1000 inhabitants; total employment; registered unemployed; water consumption from the water network per inhabitant; total expenditure of municipalities per inhabitant; share of investment expenditures of municipalities in total expenditure; number of advices provided in outpatient health care; outpatient clinics per 10,000 inhabitants; built-up and urbanised land together (in ha); expenditure on agriculture and hunting (in PLN); expenditure on municipal management and environmental protection (in PLN); expenditure on transport and communication (in PLN); expenditure on housing (in PLN); expenditure on public administration (in PLN); expenditure on public safety and fire protection (in PLN); expenditure on public debt service (in PLN); expenditure on education and upbringing (in PLN); expenditure on health care (in PLN); expenditure on social assistance (in PLN); expenditure on educational care (in PLN); expenditure on culture and protection of national heritage (in PLN); expenditure on physical education (in PLN); (outputs): live births per 1000 inhabitants; people below the income criterion using environmental social protection; percentage of people using the water supply network in total population (in %); percentage of people using the sewer-age network in the total population (in %); children per kindergarten; gross enrolment rate - primary schools; gross enrolment rate - secondary schools; readers of public libraries per 1000 inhabitants; newly registered entities per 10,000 working-age population; area of forest land (in ha); mixed waste from households collected during the year per inhabitant (in kg); electoral attendance for municipal councils (% of commune population); foundations, associations and social organisations per 10,000 inhabitants; total income per inhabitant.	(2019) 0.85

Source: own elaboration

From Table 1, we can determine that the most widely used method is DEA, closely followed by SFA. DEA, as the most frequently used method of testing efficiency in both the public and private sectors in the last 40 years, has also been investigated in the works of

Emrouznejad and Yang (2018). The majority of DEA methods were implemented to measure the efficiency of local self-government in the European (post-)transition countries, but overall, very few studies that deal with measuring the efficiency of communities

have been done in this part of Europe. Our results, as well as those of Narbón-Perpiñá and De Witte (2018a, 2018b), suggest that the input variable used most often is current local expenditures, closely followed by total local expenditures. In terms of output variables, total population is the most frequently used in almost all studies, followed by commune roads, waste collection, primary and secondary education, as well as care for the elderly.

2. Methodology

2.1. Research design and data collection

The research design includes the implementation of the SFA model in all local communes in Poland for 2017. The territorial division of Poland is based on three levels and was introduced on 1 January 1999. Accordingly, the country was divided into voivodeships, then into counties (including communes with the status of cities with county rights) and communes. In 2017, the administrative division of Poland included 16 voivodeships, 314 counties, and 66 cities with county status, as well as 2478 communes (including 302 urban communes, 621 urban-rural communes, and 1555 rural communes). Since communes are characterised by the highest level of autonomy in terms of both finances and tasks (Guziejewska, 2013; Kopańska, 2018), the research covered the entire population of the local government units (a total of 2478 communes). We classified Polish communes into two groups. The first group is comprised of rural communes and the second of urban-rural and urban communes which will be classified as communes with urban status (Sobczak, 2014; Swirska and Marciniuk-Kluska, 2015).

We set two research questions:

RQ1: To what extent are Polish communes technically (in)efficient and is there a difference between urban and rural communes?

RQ2: What factors affect the technical (in) efficiency of Polish communes?

The variables required for econometric estimation are described in Table 2. The data set for Polish communes was collected for the year 2017 and includes one input, four output, and three control variables.

From the category of financial expenditures, we selected total local expenditures as the input variable. This approach was applied because we were to analyse the overall (in)efficiency of communes, not the efficiency of selected areas of commune activities. An approach based on the analysis of selected expenditure categories (e.g. in accordance with the COFOG classification) or groups thereof (i.e. current, investment) would thus be methodologically incorrect. In the available literature, this variable is often used as a proxy for the total cost of service provision (De Borger and Kerstens, 1996; Pevcin, 2014; Lazović-Pita and Šćeta, 2021).

We selected four output variables: population, population density, number of pupils in elementary school, and number of people employed. The most frequently used output indicator for efficiency estimation is total population, classified as a social and demographic variable. It was first used in the work of Eeckant et al., (1993) as a proxy indicator for public services. It is becoming an almost indispensable indicator in assessing the efficiency of communes (see e.g. De Borger, 1996; Pevcin, 2014; Radulović and Dragutinović, 2015). From a group of environmental variables, we selected population density as an indicator that explains demographic characteristics. The population density is measured as a ratio of the total local population and the corresponding area (measured in square kilometres) of each commune. The most commonly used indicator for the provision of primary education services is the number of pupils in elementary schools (e.g. Geys et al., 2010; Pevcin, 2014; Štastná and Gregor, 2015; Lazović-Pita and Šćeta, 2021). In the case of

Polish communes, we use the education output variable of the number of pupils in public elementary schools. Even though the most commonly used economic output variable is the rate of unemployment, some studies use the number of people employed (e.g. Kalb, 2010; Geys et al., 2010; Pevcin, 2014) instead of the unemployment rate. Studies conducted across different countries have shown the

economic output variable of unemployment and/or the business development variable regarding employment levels could have both positive and negative impacts on local government efficiency (Nikolov, 2013). In a group of explanatory variables, we employed three control variables: aging index, the length of local roads, and the mayor's political affiliation.

Table 2. Indicators of selected variables for local communes in Poland

	Variable	Explanation of variable
Input	Total local expenditures	Total annual expenditures of a commune, given in PLN
	Population	Total resident population in a commune
Output	Population density	Resident population in a commune per km ²
	Education	Number of pupils in public elementary schools
	Employment	Total number of people employed in a commune (total employment in a local commune)
Control	Aging index	The aging index is given as a ratio between the number of residents above 65 and number of residents under 15 in a commune. It represents the structure of public service provision.
	Local roads	The length of local roads maintained by communes (bituminous (asphalt), concrete, paved roads). It represents road maintenance.
	Mayor	The mayor's political affiliation in relation to central government coalition (0 - the same, 1 otherwise). It is a dummy variable.

Source: own elaboration

2.2. Sample and data analysis

In Table 3 we provide summary statistics of input, output, and control variables collected from 2478 communes (1555 urban and 923 rural) in Poland. Our results reveal that the average number of residents in the group of urban communes is 29,773, while in the case of rural communes the average is more than four times smaller. As expected, the average population density in urban communes is significantly higher than in rural communes (Table 3). Urban communes are not only more densely populated, but also have better transport infrastructure than their rural counterparts. The local road network in urban areas is on average 1.5 times longer than in

rural communes. The average aging index in urban communes is 1.34 and in rural communes 1.21. In both cases, the aging index is greater than 1, which suggests that Poland, similar to other European (post-) transition countries, also faces issues associated with its aging population. Similar results in the average differences between urban and rural communes are shown in Table 3. However, there are particularly large discrepancies between the categories of the analysed communes in the case of two other variables, i.e. education and employment. While the education variable in urban communes was nearly four times higher than in rural communes, the employment variable was over 10 times higher.

Table 3. Descriptive statistics of the selected indicators for all communes, for urban and for rural communes in Poland

		Observations	Total local expenditures	Population	Population density	Education	Employment	Aging index	Local roads
Mean	All	2478	76,871,872.21	15,510	220.40	997	3823	1.27	47.44
	Urban	923	1,553,355,924	29,773	470.62	1881	8795	1.34	60.05
	Rural	1555	314,733,00	7044	71.88	472	872	1.21	39.95
Std. Dev.	All	2478	376,564,593.6	50,875	463.47	2942	23,616	0.36	54.08
	Urban	923	608,987,131.1	81,241	685.39	4669	38,149	0.33	78.42
	Rural	1555	21,204,177.25	4137	66.46	336	1,453	0.35	29.37
Minimum	All	2478	6,130,939.14	1302	4.36	55	55	0.47	0
	Urban	923	8,350,648	1302	8.30	55	115	0.56	0
	Rural	1555	6,130,939	1567	4.36	61	55	0.47	0
Maximum	All	2478	15,271,678,033.46	1,764,615	3875.77	104,576	934,342	4.62	1391.3
	Urban	923	15,271,678,033.46	1,764,615	3875.77	104,576	934,342	3.02	1391.3
	Rural	1555	266,097,219.29	30,706	593.96	3324	27,216	4.62	256.3

Source: own elaboration

Narbón-Perpiñá and De Witte (2018a, 2018b) suggest that a set of political determinants play a significant role in explaining local government (in)efficiency. Even though a variety of political factors can be used in the estimation of the significance of political variables for local (in)efficiency, we use

the mayor's political affiliation in relation to the central government coalition as a control variable. Previous research has indicated that this variable can affect local (in)efficiency primarily through the 'bailing out' principle of central government towards local self-government.

Table 4. Mayor's political affiliation in relation to the central government coalition

Mayor	All communes	Rural communes	Urban communes
Number of observations	2478	1,555	923
Same party (0)	13.36%	15.37%	9.97%
Not the same party (1)	86.64%	84.63%	90.03%

Source: own elaboration

In Table 4 we may note that in 84.63% of rural communes the mayor is not from the same party as the central government coalition, while the corresponding percentage is slightly higher for urban communes, amounting to 90.03%.

2.3. Methodology and model specification

As per the available literature on local efficiency (Milán-García et al., 2022), we may differentiate two sources of inefficiencies in production that increase cost, while the goal

is to minimise cost for a given level of output. If there is a place for improving efficiency by achieving the same level of output using less input, then it refers to technical inefficiency. Allocative inefficiency refers to different combinations of inputs, by which we mean that the same level of output could be produced using different combinations of inputs and there is a place for improving the combination of inputs such that the production cost could be reduced. In this paper, our focus is on examining technical inefficiency, as we assume full efficiency of the communes in terms of allocative efficiency.

SFA, developed independently by Aigner et al. (1977) and Meeusen and van den Broeck (1977), is a method based on the idea of establishing the best practice frontier in

a specific functional form which describes the relationship between input variable and output variables. SFA allows for the decomposition of deviation from the best practice frontier into two components: one which gives us the effects of measurement error and the other which represents inefficiency.

We follow the approach proposed by Battese and Coelli (1995) to estimate technical inefficiency using the stochastic frontier model with the Cobb-Douglas functional form. The applied approach has been exhaustively implemented, for example by Kalb et al. (2011) or Radulović and Dragutinović (2015), where the stochastic frontier model, as a linearised version of the logarithm of the Cobb-Douglas function, is specified by

$$\ln C_i = \beta_0 + \sum_{r=1}^k \beta_r \ln X_{ir} + V_i + U_i \quad (1)$$

$\beta = (\beta_1, \beta_2, \dots, \beta_k)$ is a vector of unknown parameters to be estimated, and the error term consists of V_i , which is a noise error term representing independent random variables, and U_i , which captures the effect of the economic inefficiency. In our case,

U_i is referred to as the measure of technical inefficiency.

The technical inefficiency effects U_i among the local communities are expressed as a linear function of a vector of local communities' control variables and random error by

$$U_i = \delta_0 + \sum_{t=1}^s \delta_t z_t + W_i \quad (2)$$

where $\delta = (\delta_0, \delta_1, \dots, \delta_s)^T$ is a vector of unknown parameters to be estimated, $z = (z_1, z_2, \dots, z_s)$ is a vector of a control variables, and W_i are random variables.

The stochastic frontier model defined for the cross-sectional data on Polish communities is specified as:

$$\ln(\text{Total expenditures}_i) = \beta_0 + \beta_1 \ln(\text{Population}_i) + \beta_2 \ln(\text{Population density}_i) + \beta_3 \ln(\text{Education}_i) + \beta_4 \ln(\text{Employment}_i) + V_i + U_i \quad (3)$$

V_i represents unsystematic deviations from the frontier, and is usually attached to the equation to capture modelling errors and is normally distributed. The one-sided non-negative inefficiency component U_i is assumed to follow half-normal distribution. Using the conditional distribution approach suggested by

Jondrow et al., (1982), we can obtain a point estimate of U_i from the expected value of U_i conditional on the composed error $V_i + U_i$, which tells us the percentage increase in cost due to input overuse (Kumbhakar et al., 2015).

Apart from measuring the level of inefficiency of each commune i , it is interesting

to observe factors that may explain inefficiency. That is the reason why the (technical) inefficiency effects U_i are assumed to be

$$U_i = \delta_0 + \delta_1 \text{Aging index}_i + \delta_2 \text{Local roads}_i + \delta_3 \text{Mayor}_i + W_i \quad (4)$$

where $\delta = (\delta_0, \delta_1, \delta_2, \delta_3)$ is an unknown coefficient vector to be estimated and W_i are random variables. The control variables aging index, local roads, and mayor's political affiliation represent exogenous determinants of inefficiency. We can view them as factors by which differences in the effects of inefficiency among the communes may be explained. As proposed by Kumbhakar et al. (1991), we simultaneously estimate the parameters of equation (3) and (4) following the maximum likelihood single-stage estimation procedure. We have distinguished

represented as a linear function of the control variables aging index, local roads, and mayor's political affiliation by:

two different groups of models of the stochastic parametric estimation of the total local expenditures – with output variables only and with output variables and control variables. Each set of models is done in three cases: for all communes, for urban and for rural communes. In our analysis, we estimate the efficiency index of local communes, the stochastic frontier model and the technical inefficiency model. The relationship between technical efficiency and inefficiency for the i -th community, when the model (1) - (2) is assumed, can be evaluated by:

$$TE_i = \exp(-U_i) \quad (5)$$

The results are obtained using Stata/SE 12.0 software and commands developed and explained by Kumbhakar et al. (2015).

3. Results and Discussion

Table 5 provides the main results of the efficiency index for Polish communes grouped as urban, rural, and total. We have distinguished two different groups of models of the stochastic parametric estimation of the total local expenditures. The first group of models (Model 1, Model 1a, and Model 1b) includes only the effect of four output variables (population, population density, education, and employment). These models represent basic Cobb-Douglas models: for all communes (Model 1), for urban communes (Model 1a), and for rural communes (Model 1b). Our results show that, on average, minimum

total local expenditures are approximately 84.8% (for Model 1) of actual total local expenditures. We could interpret this as stating that on average, the actual total local expenditures could be reduced by approximately 17.86% ($=1/0.848 - 1$) without reducing outputs.

In the second group of models (Model 2, Model 2a, and Model 2b) we observe a Cobb-Douglas model with included control variables (aging index, local roads, and mayor's political affiliation) for three sets of analysed communes. In Model 2, on average, the actual total local expenditures could be reduced by approximately 17.39% without reducing the outputs, which is an improvement when compared to Model 1. A similar situation occurs if we compare the results of models with and without control variables for urban communes and for rural communes in Poland.

Table 5. Summary statistic of the efficiency index for all, urban and rural communes in Poland in 2017

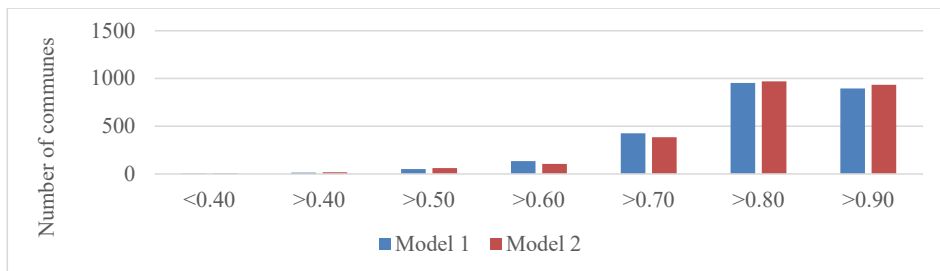
Characteristics	Observations	Mean	Std. Dev.	Min	Max	
No control variables	Model 1	2476	0.8484844	0.1002422	0.1194566	0.9826335
	Model 1a	923	0.8332913	0.1116769	0.1952245	0.9836508
	Model 1b	1553	0.8624893	0.0885566	0.132929	0.981987
With control variables	Model 2	2476	0.851847	0.1012125	0.1208531	0.9818373
	Model 2a	923	0.8408461	0.1146687	0.2035621	0.980919
	Model 2b	1553	0.8684391	0.0854847	0.125549	0.979913

Source: own elaboration

The higher values of the efficiency index for each commune indicate a higher level of efficiency. Our results show that Polish communes are relatively efficient. The efficiency index is high in almost all communes in Poland (Figure 1). The group of

those communes where the efficiency index (Model 2) is greater than 0.9 includes 933 communes (i.e. 37.68% of the sample). There are only 75 communes where the efficiency index (Model 2) is lower than 0.6 (i.e. 3.03% of the sample).

Figure 1. Distribution of the technical efficiency index for Model 1 and Model 2 for all Polish communes



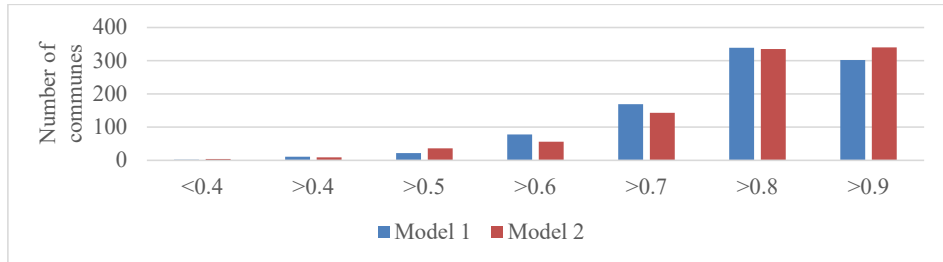
No. of observations: 2476

Source: own elaboration

According to the results of Models 2a and 2b, if we observe the efficiency of rural communes compared to the average efficiency of rural communes in Poland, 40.18% of the rural communes are below the average

level of rural technical efficiency. The same indicator for urban communes amounts to 38.90% of the average level of urban technical efficiency (Figures 2 and 3).

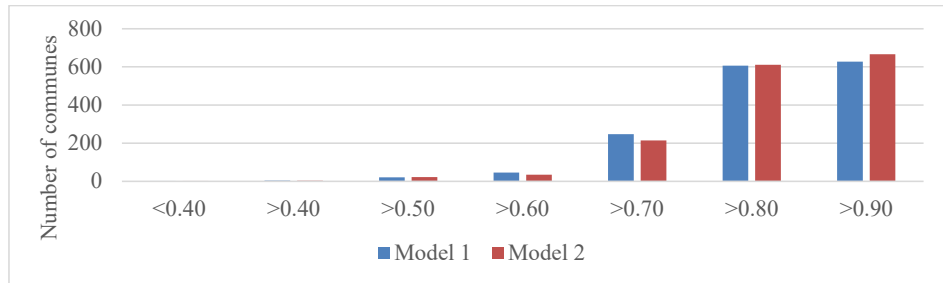
Figure 2. Distribution of the technical efficiency index for Model 1a and Model 2a for urban communes



No. of observations: 923

Source: own elaboration

Figure 3. Distribution of the technical efficiency index for Model 1 and Model 2 for rural communes



No. of observations: 1553

Source: own elaboration

Table 6 provides the estimation of the stochastic frontier model and technical inefficiency model. These results could be used in a discussion on corrective measures of the (in)efficiency of communes' total expenditures. We can notice the difference in the sign of the coefficient of the variable aging index in Model 2a and Model 2b. In Model 2a (urban communes) this coefficient is positive and significant, suggesting that in urban communes the relatively older population implies that urban communes are more inefficient. By contrast, in Model 2b (rural communes) a negative and significant coefficient indicates that rural communes with a higher ratio of older inhabitants are less inefficient. The result obtained may indicate the diversity of needs

of the population of rural and urban communes respectively. Most of the elderly population in Poland in 2017 lived in cities/urban communes (Demographic Yearbook of Poland, 2018, p. 134). The dynamics of the relatively older population in cities is also greater than in rural communes. As a result, the ratio of people aged 65 and more per 1000 children in cities is much higher than in rural areas (Sobczak, 2014). The result will be the targeting of larger financial flows in urban communes towards policies that correspond to the older age structure of society. These expenses will be concentrated around the broadly understood social sphere. The progressive aging of the population will mean stronger competition between public tasks for communes' own

funds, as well as funds from the central budget (intended for tasks commissioned in the field of government administration). The orientation of budget expenditure to the needs of the population of the commune will obviously not halt investment activities completely, nor will it hinder the development of urban and urban-rural self-governments. Nevertheless, it will likely translate into the dynamics and scale of this development. Consequently, the relatively higher share of the older population will be accompanied by a higher level of inefficiency of urban communes. This can be compared to the convergence effect, according to which units with a higher level of development develop slower than units with a lower level of development aspiring to the level of development of urban communes. Similarly, much lower saturation (both in nominal and relative terms) of the population structure with elderly people means that in the case of the observed indicator, neither its level nor growth dynamics negatively affect the efficiency of rural communes. Despite its growth, Model 2b did not show (as in the case of urban communes) any higher inefficiency.

The positive and significant coefficient next to the variable length of local roads for

all three cases (i.e. for all communes, rural and urban communes) indicates that communes with more local roads under their supervision are more inefficient. At the same time, those coefficients are relatively small, so this relationship between local roads and inefficiency is very weak.

The political variable of the mayor's affiliation to central government is positive and statistically significant in cases of all communes in Poland and for urban communes in Poland. At the same time, it is not statistically significant in the case of rural communes. The estimated coefficients suggest that, on average, communes are more inefficient if the mayor's political affiliation is contrary to the central government's coalition. The observed regularity indicates that the distribution of various types of public funds to local governments considers the political affiliation of commune governments. Financial support is more readily available for communes whose mayor or head of the commune belongs to (or at least identifies with) the ruling party than for communes with mayors who hold different political views. As a result, communes with mayors of a different political orientation will be more inefficient compared to those with ties to the central government.

Table 6. Results of Cobb-Douglas type SFA estimation for Poland

Variable	Model 1	Model 1a	Model 1b	Model 2	Model 2a	Model 2b
Stochastic frontier						
Constant (β_0)	9.242222*** (155.72)	8.773183*** (86.25)	9.514181*** (121.63)	9.466385*** (153.30)	9.260153*** (86.14)	9.534916*** (120.60)
In Population	0.67318*** (42.80)	0.7546053*** (26.78)	0.6250369*** (33.54)	0.6374757*** (39.73)	0.6433874*** (22.03)	0.65182349*** (34.06)
In Population density	-0.03621*** (-10.82)	-0.022646*** (-5.27)	-0.064304*** (-10.91)	-0.0370408*** (-10.93)	-0.027614*** (-6.56)	-0.0637788*** (-10.73)
In Pupils	0.28688*** (20.09)	0.2354116*** (8.70)	0.3210629*** (19.94)	0.3011055*** (20.39)	0.3288271*** (11.59)	0.2805128*** (15.74)
In Employed	0.04049*** (7.62)	0.0338427** (3.01)	0.0524686*** (8.50)	0.0429845*** (8.31)	0.0306688** (2.96)	0.0513259*** (8.29)
Inefficiency model						
Aging index				0.1013226 (1.35)	1.052486*** (6.66)	-0.6639471*** (-5.30)
Local roads				0.005947*** (8.05)	0.0036686*** (4.27)	0.0054907*** (3.75)
Mayor				0.3263371*** (3.57)	0.5992069*** (3.51)	0.1718994 (1.53)
N	2476	923	1553	2476	923	1553
σ^2	0.0026	0.0021	0.0027	0.0028	0.00244	0.00323
LL	1424.2894	470.24143	1022.8319	1240.763	519.69309	1053.6892
LR test of the one-sided error	570.5009***	229.78355***	312.92506***	700.96111***	328.68687***	374.63963***

Note: Significance: *** 1% level, ** 5% level, * 10% level.

Source: own elaboration

Comparing the results of the likelihood ratio statistic (LR) for models without control variables (Model 1, Model 1a, and Model 1b), and models with control variables (Model 2, Model 2a, and Model 2b) with the critical values of the mixed distribution for hypothesis testing that can be found in the work of Kodde and Palm (1986) (at the 0.001% significance level of the test, this is 3.841 for the degree of freedom 1 and

17.612 for the degree of freedom 4), it is obvious that the null hypothesis of no technical inefficiency can be rejected.

The results obtained in the case of local Polish communes show that the achievement of a level of efficiency that is currently characterised by urban communes is possible at a level of public expenditure one-fifth lower than the current one. Since local government authorities should constantly

aspire to improve the efficiency of the services provided, the result obtained determines the identified financial potential for the introduction of such desired changes. Moreover, this potential is only slightly weaker after adjusting the control variables. Their specificity, therefore, has only a minor impact on the overall level of efficiency of public spending.

Also not without significance for the efficiency of local public spending are the management of communal services and the local economy (Grzebyk et al., 2021; Jedynak and Wąsowicz, 2021), the lack of measurement of the implementation of public tasks (Swirska, 2014), as well as the unsatisfactory scope of complementation of methods and instruments for managing local government finances (Swirska and Marciniuk-Kluska, 2015). All these factors combined mean that even with the current system of financing local government structures (which is also inconsistent with the current reality) there is space for increasing the efficiency of public spending, and local governments, due to decentralisation, have the potential needed to reduce the scale of the identified inefficiency.

If we compare the previous results on Polish communes to previous research on the efficiency of local governments, we can determine that several authors used similar variables and obtained complementary results. Papers by Radulović and Dragutinović (2015) based on data from Serbia in 2012, and Lazović-Pita and Šćeta (2021) for BiH for 2017, which both make use of the SFA method, can be compared to the Polish results albeit with a degree of caution due to differences in input, output, and control variables. We have to bear in mind that these three countries are not comparable population-wise, but as (post-)transition countries they are facing similar economic and development issues. Poland is currently a full EU member; Serbia is a candidate for membership of the EU and BiH aspires to become

an EU candidate. Also, issues regarding the efficiency of communities in all three countries are quite similar, which could be justified by the similar output and/or control variables used in the country models. For example, all three papers use population, population density, education, aging index, and local roads as either output and/or control variables. In that sense, if we compare the results of the efficiency index for communes in Poland, Serbia, and BiH, we can conclude that the communes could have improved their local efficiency by 15.7% in Serbia for 2012, by 17.9% in Poland and 46.84% in BiH for 2017. Also, in all three models, the aging index has been used as a control variable indicating that all three countries are aware of the impact that an aging population might have on the efficiency of local governments. Other papers in several (post-)transition countries (for example, Štastná and Gregor (2011) for the Czech Republic, Pevcin (2013) for Slovenia, or Nikolov and Hrovatin (2013) for North Macedonia) also recognise the significance that the aging population has on local efficiency by using similar variables (the share of the population aged over 65 to the total population or the number of elderly care centres per community, etc.).

In relation to the limitations of this research, as previously noted, the analysis and therefore the conclusions regarding Polish local (in)efficiency were done for one year only. More data availability and panel SFA would perhaps provide more salient results, especially for policymakers regarding the improvements in technical efficiency of Polish local communes. Furthermore, as per the available literature (Milán-García et al., 2022), testing more variables, especially environmental variables and new forms of local management as determinants of technical (in)efficiency, might provide insightful results. Another important research limitation of our work relates to the fact that allocative inefficiency was not measured as well as the corresponding economic efficiency.

Conclusions

The results of the SFA model applied to local Polish communes for 2017 reveal insightful results. The developed models are stable, both in relation to the basic models (without control variables) analysed jointly for all communes and separately for urban and rural ones, and also in relation to the models that include three control variables. The results are therefore reliable and can form the basis for inference.

In both groups of models urban communes are characterised by higher inefficiency. The indications of Model 1a, which do not consider the control variables, prove that in the case of urban communes it would be possible to reduce expenditure by an average of 20.01% without lowering the effectiveness of public task implementation. After including the control variables (e.g. Model 2a), the scale of possible expenditure reduction decreases only slightly, to the level of 18.93%. In turn, with regard to rural communes, the scale of possible savings in both models (e.g. 1b and 2b) is comparable and amounts to 15.94% and 15.15% respectively. An equally small difference in the scale of possible savings is characteristic of the results of the models describing the entire population of communes (e.g. Models 1 and 2). In the model excluding the control variables, it amounts to 17.86%, and after taking them into account, it drops to 17.39%.

The picture that emerges from the research is one with several negative characteristics. Although self-government is a synonym of autonomy, the structure of the current system of local government finance in Poland and the associated structures of the division of public tasks are not coherent with each other. Moreover, the results of the research undermine the thesis that the main problem of communal self-governments in Poland is the under-financing thereof. The research has shown space for savings while maintaining the current scope and the accompanying quality of public task implementation. Thus,

the observed fact proves to a greater extent the inefficiency of managing public funds at the level of communes, rather than the lack thereof. The reason for this state of affairs is certainly the relatively limited nature of control over the financial management of local government units in Poland, not in terms of the efficiency of public spending, but only in compliance with the law.

The research is a valuable source of guidance for local policymakers. The results obtained indicate that there is space not only for a revision of the current expenditure policy, but also for the development of proposed changes aimed at enhancing the efficiency of public spending. The research shows that the current approach to the implementation of public tasks has exhausted its formula, and the greater scale of public expenditure cannot guarantee the greater efficiency of public policies.

References

- Benito-Lopez, B., del Rocio Moreno-Enguix, M., Solana-Ibañez, J. (2011), Determinants of efficiency in the provision of municipal street-cleaning and refuse collection services, *Waste Management*, 31(6), 1099-1108. <https://doi.org/10.1016/j.wasman.2011.01.019>.
- Boetti, L., Piacenza, M., Turati, G. (2012), Decentralization and local governments' performance: How does fiscal autonomy affect spending efficiency?, *FinanzArchiv / Public Finance Analysis*, 68(3), 269-302. DOI: 10.1628/001522112X653840.
- Borge, L. E., Falch, T., Tovmo, P. (2008), Public sector efficiency: The roles of political and budgetary institutions, fiscal capacity, and democratic participation, *Public Choice*, 136(3-4), 475-495. <https://doi.org/10.1007/s11127-008-9309-7>.
- Bosch, N., Pedraja, F., Suárez-Pandiello, J. (2000), Measuring the efficiency of Spanish municipal refuse collection services, *Local Government Studies*, 26(3), 71-90. <https://doi.org/10.1080/03003930008434000>.

- Caves, D. W., Christensen, L. R., Diewert, W. E. (1982), The economic theory of index numbers and the measurement of input, output, and productivity, *Econometrica: Journal of the Econometric Society*, 50(6), 1393-1414. <https://doi.org/10.2307/1913388>.
- Chapelle, K., Plane, P. (2005), Technical efficiency measurement within the manufacturing sector in Côte d'Ivoire: A stochastic frontier approach, *Journal of Development Studies*, 41(7), 1303-1324. <https://doi.org/10.1080/00220380500170964>.
- Cuadrado-Ballesteros, B., Bisogno, M. (2019), Efficiency as a determinant of financial condition: an assessment of Italian and Spanish local governments, *International Public Management Journal*, 22(5), 743-774. <https://doi.org/10.1080/10967494.2018.1476426>.
- Daraio, C., Kerstens, K., Nepomuceno, T., Sickles, R. C. (2020), Empirical surveys of frontier applications: A meta-review, *International Transactions in Operational Research*, 27(2), 709-738. <https://doi.org/10.1111/itor.12649>.
- De Borger, B., and Kerstens, K. (1996), Cost efficiency of Belgian local governments: A comparative analysis of FDH, DEA, and econometric approaches, *Regional Science and Urban Economics*, 26(2), 145-170. [https://doi.org/10.1016/0166-0462\(95\)02127-2](https://doi.org/10.1016/0166-0462(95)02127-2).
- Demographic Yearbook of Poland (2018), Warszawa Statistics.
- EBRD (2019), Transition report 2019-2020, Better Governance, Better Economies, retrieved from: <https://www.ebrd.com/news/publications/transition-report/transition-report-201920-better-governance-better-economies.html>. (accessed 20 May 2021).
- EBRD (2020), Transition report 2020-2021, The State Strikes Back, retrieved from: <https://www.ebrd.com/news/publications/transition-report/transition-report-202021.html>. (accessed 20 May 2021).
- Emrouznejad, A., Yang, G. L. (2018), A survey and analysis of the first 40 years of scholarly literature in DEA: 1978–2016, *Socio-economic Planning Sciences*, 61, 4-8. <https://doi.org/10.1016/j.seps.2017.01.008>.
- European Commission (2012), Social Impact of Emigration and Rural-Urban Migration in Central and Eastern Europe, retrieved from: <https://ec.europa.eu/social/main.jsp?catId=89andfurtherNews=yesandnewsId=1778andlangId=en>. (accessed 22 May 2021).
- Geys, B., Heinemann, F., Kalb, A. (2010), Voter involvement, fiscal autonomy and public sector efficiency: Evidence from German municipalities, *European Journal of Political Economy*, 26(2), 265-278. <https://doi.org/10.1016/j.ejpoleco.2009.11.002>.
- Grzebyk, M., Pierscieniak, A., Stec, M. (2021), Assessment of Management Efficiency in Local Administrative Offices: Case Study Poland, *Lex Localis-Journal of Local Self-Government*, 19(2). [https://doi.org/10.4335/19.2.329-351\(2021\)](https://doi.org/10.4335/19.2.329-351(2021)).
- Guziejewska, B. (2013), Intergovernmental fiscal relations. Theoretical aspects and Poland's experience, *Financial Internet Quarterly "e-Finance"*, 9(3), 24-32.
- Hassine-Belghith, N. B. (2009), Exporting, technical efficiency and product quality: An empirical analysis of the agricultural sector in the Mediterranean countries, *The Journal of Development Studies*, 45(5), 769-788. <https://doi.org/10.1080/00220380902753201>.
- Hodžić, S., Muharemović, A. (2019), Fiscal Decentralization and Efficiency of Regional Government in Croatia: A Data Envelopment Analysis, *Lex Localis-Journal of Local Self-Government*, 17(3), 453-470. DOI:10.4335/17.3.453-470(2019).
- Hunjet, D., Neralić, L., Wendell, E. R. (2012), An application of categorical models of data envelopment analysis, in: V. Charles and M. Kumar (Eds.), *Data Envelopment Analysis and its Applications to Management*, Newcastle upon Tyne: Cambridge Scholars Publishing.
- Hunjet, D., Neralić, L., Wendell, R. E. (2015), Evaluation of the dynamic efficiency of Croatian towns using Data Envelopment Analysis, *Central European Journal of Operations Research*, 23(3), 675-686. <https://doi.org/10.1007/s10100-014-0363-6>.

- Jackson, P. M. (2011), Governance by numbers: what have we learned over the past 30 years?, *Public Money and Management*, 31(1), 13-26. <https://doi.org/10.1080/09540962.2011.545542>.
- Jedynak, T., Wąsowicz, K. (2021), The Relationship between Efficiency and Quality of Municipally Owned Corporations: Evidence from Local Public Transport and Waste Management in Poland, *Sustainability*, 13(17), 9804. <https://doi.org/10.3390/su13179804>.
- Kalb, A. (2010), The impact of intergovernmental grants on cost efficiency: Theory and evidence from German municipalities, *Economic Analysis and Policy*, 40(1), 23-48. [https://doi.org/10.1016/S0313-5926\(10\)50002-X](https://doi.org/10.1016/S0313-5926(10)50002-X).
- Kalb, A., Geys, B., Heinemann, F. (2011), Value for money? German local government efficiency in a comparative perspective, *Applied Economics*, 44(2), 201-218. <https://doi.org/10.1080/00036846.2010.502110>.
- Kodde, David A., Franz C. Palm. (1986), Wald criteria for jointly testing equality and inequality restrictions, *Econometrica: Journal of the Econometric Society*, 54(5), 1243-1248. <https://doi.org/10.2307/1912331>.
- Kopańska, A. (2018), Partial fiscal decentralization and local government spending policy, *Financial Internet Quarterly "e-Finanse"*, 14(3), 21-31.
- Kumbhakar, S., Gosh, S., McGuckin, J. (1991), A generalized production frontier approach for estimating determinants of inefficiency in U.S. dairy firms, *Journal of Business and Economic Statistics*, 9, 279-86.
- Kumbhakar, S. C., Wang, H., Horncastle, A. P. (2015), *A practitioner's guide to stochastic frontier analysis using Stata*, New York: Cambridge University Press.
- Lazović-Pita, L., Šćeta, L. (2021), A stochastic frontier approach to measuring inefficiency of local communities in Bosnia and Herzegovina, *The South East European Journal of Economics and Business*, 16(1), 18-29. DOI: 10.2478/jeb-2021-0002.
- Milán-García, J., Rueda-López, N., De Pablo-Valenciano, J. (2022), Local government efficiency: reviewing determinants and setting new trends, *International Transactions in Operational Research*, 29(5), 2871-2898. <https://doi.org/10.1111/itor.13032>.
- Musgrave, R. (1959), *The Theory of Public Finance: A Study in Public Economy*, New York: McGraw-Hill.
- Narbón-Perpiñá, I., De Witte, K. (2018a), Local governments' efficiency: A systematic literature review - part I, *International Transactions in Operational Research*, 25(2), 431-468. <https://doi.org/10.1111/itor.12364>.
- Narbón-Perpiñá, I., De Witte, K. (2018b), Local governments' efficiency: A systematic literature review - part II, *International Transactions in Operational Research*, 25(4), 1107-1136. <https://doi.org/10.1111/itor.12389>.
- Nikolov, M., Brosio, G. (2015), Efficient delivery of local public services in ethnically fragmented municipalities, *Lex Localis*, 13(3), 299-319. DOI:10.4335/13.3.299-319(2015).
- Nikolov, M., Hrovatin, N. (2013), Cost efficiency of Macedonian municipalities in service delivery: Does ethnic fragmentation matter?, *Lex Localis*, 11(3), 743-775. DOI:10.4335/11.3.743-775(2013).
- Oates, W. (1972), *Fiscal Federalism*, Harcourt Brace Jovanovich: NY.
- Onaran, Ö. (2011), From transition crisis to the global crisis: Twenty years of capitalism and labour in the Central and Eastern EU new member states, *Capital and Class*, 35(2), 213-231. <https://doi.org/10.1177/0309816811402648>.
- Pevcin, P. (2013), Costs and Efficiency of Municipalities in Slovenia, *Lex Localis-Journal of Local Self-Government*, 11(3), 417-429. [https://doi.org/10.4335/11.3.531-543\(2013\)](https://doi.org/10.4335/11.3.531-543(2013)).
- Pevcin, P. (2014), Efficiency levels of sub-national governments: a comparison of SFA and DEA estimations, *The TQM Journal*, 26(3), 275-283. <https://doi.org/10.1108/TQM-12-2013-0127>.

- Rabar, D. (2013), Assessment of regional efficiency in Croatia using data envelopment analysis, *Croatian Operational Research Review*, 4(1), 76-88.
- Radulovic, B., Dragutinovic, S. (2015), Efficiency of local self-governments in Serbia: An SFA approach, *Industrija*, 43(3), 123-142. DOI: 10.5937/industrija43-8846.
- Šastná, L., Gregor, M. (2015), Public sector efficiency in transition and beyond: Evidence from Czech local governments, *Applied Economics*, 47(7), 680-699. <https://doi.org/10.1080/00036846.2014.978077>.
- Skica, T., Leśniowska-Gontarz, M., Miszczyńska, K. (2019), Measuring the efficiency of Polish municipalities in terms of sustainable development—data envelopment analysis approach, *The South East European Journal of Economics and Business*, 14(2), 54-66. DOI: 10.2478/jeb-2019-0013.
- Škuflić, L., Rabar, D., Šokčević, S. (2010), Assessment of the efficiency of Croatian counties using data envelopment analysis, *Economic research-Ekonomska Istraživanja*, 23(2), 88-101. <https://doi.org/10.1080/1331677X.2010.11517414>.
- Slijepčević, S. (2019), Measuring Efficiency at the Regional Level: A Data Envelopment Analysis Approach, *Lex Localis*, 17(3), 679-696. <https://doi.org/10.4335/17.3.679-696>(2019).
- Sobczak, I. (2014), Bilans Ludności. in: Z. Strzelecki (Ed.), *Sytuacja demograficzna Polski 2013-2014* (pp. 40-56), Zakład Wydawnictw Statystycznych, Warszawa. (Original work published in Polish).
- Soko, A. (2018), (DIS) Advantages of decentralization models driven by non-economic reasons: the case of Bosnia and Herzegovina, *The South East European Journal of Economics and Business*, 13(1), 81-92. DOI: 10.2478/jeb-2018-0007.
- Soko, A., Zorič, J. (2018), Municipal efficiency and economies of scale in Bosnia and Herzegovina, *Lex Localis*, 16(4), 715-734. DOI:10.4335/16.4.715-734(2018).
- Stastna, L., Gregor, M. (2011). Local government efficiency: Evidence from the Czech municipalities, Institute of Economic Studies Working Paper, No. 14, 1-72.
- Świrska, A. (2014), Performance-Based Budget as an element of New Public Management in the Public Finance System in Poland, *Hyperion International Journal of Econophysics and New Economy*, 7(1), 109-124.
- Swirska, A., Marciniuk-Kluska, A. (2015), Selected issues of the local finance system in Poland, *Prosperitas*, 2(1), 199-223.
- Tiebout, C. (1956), A pure theory of local expenditures, *The Journal of Political Economy* 64, 416-424.
- The Council of Europe. (1985, October 15), The European Charter of Local Self-Government, retrieved from: <https://rm.coe.int/168007a088>. (accessed 20 June 2021).
- Worthington, A. C., Dollery, B. E. (2000), Measuring efficiency in local governments' planning and regulatory function, *Public Productivity and Management Review*, 23(4), 469-485. <https://doi.org/10.2307/3380564>.
- Worthington, A. C., Dollery, B. E. (2001), Measuring efficiency in local government: An analysis of New South Wales municipalities' domestic waste management function, *Policy Studies Journal*, 29(2), 232-249. <https://doi.org/10.1111/j.1541-0072.2001.tb02088.x>.

Lejla Lazović-Pita is an associate professor at the School of Economics and Business, University of Sarajevo, Bosnia and Herzegovina, and a CERGE-EI Foundation Teaching Fellow. She holds a PhD from the Otto-Friedrich University of Bamberg, Germany. Her academic and professional areas of interest are public finance and policies where she has published more than 30 papers and studies in referred journals. Her academic rigor and teaching

focuses on public finance and local governance which has been recognised locally and internationally through her participation in domestic and international research projects. As of April 2022, Lejla holds a Certificate in Evaluation Practice from the Evaluators' Institute, Claremont Graduate University, USA. ORCID no. 0000-0001-9421-1842

Tomasz Skica is the Head of the Department of Entrepreneurship at the University of Information Technology and Management in Rzeszow. He is a habilitated doctor in social sciences in the discipline of economics and finance (Maria Curie-Skłodowska University in Lublin, Faculty of Economics, Institute of Finance, 2021) and the author of courses and teaching programmes in Polish and English. He has been the promoter of over 200 diploma theses in the field of economics, finance and management, as well as the author of several dozen scientific articles, monographs and chapters in scientific monographs, reports, strategies and expert opinions in the field of public finance. He conducts research in the field of entrepreneurship support by local government units, the efficiency of the public sector and the public finance system. He is an associate of domestic and foreign universities and scientific institutions. ORCID no. 0000-0002-5620-610X

Lamija Šćeta is an associate professor at the Department of Quantitative Economics at the University of Sarajevo, Bosnia and Herzegovina. She holds a PhD in mathematical sciences in the field of number theory (Department of Mathematics, Faculty of Science, University of Sarajevo, 2015), and is a member of the organising committee of four international mathematical conferences held in Sarajevo. She currently teaches mathematics for economists, methods and models of optimisation, educational mathematics and mathematics (for PhD students at the School of Economics and Business, University of Sarajevo). She is the promoter of master's degree theses in the fields of mathematics and economics. She conducts research in the fields of number theory, educational mathematics and efficiency measurement methods. ORCID no. 0000-0002-0410-0311