PUBLIC EXPENDITURE EFFICIENCY AND THE OPTIMAL SIZE OF GOVERNMENT IN EUROPEAN UNION*

Antonija Buljan, Hrvoje Šimović, Milan Deskar-Škrbić

Abstract

This paper investigates public expenditure efficiency and its relation to the optimal size of government. It gives an insight into methods developed for estimating efficiency and possible constraints of the analysis. Literature review of related papers covering European Union and OECD countries shows significant differences in efficiency coefficients across countries with most countries having the potential for increased efficiency of public spending. Specifically, there is large space for reduction of government size by raising the efficiency. The literature includes the aggregate expenditure efficiency analysis and efficiency analysis of its main components. More disaggregated analysis of individual public functions seems to be more adequate to capture the efficiency and determine the main drivers of inefficiency and draw policy implications. In that respect, the paper gives an insight into the structure of government expenditure by function across EU countries and its changes over the period 2002-2015. Differences in tradition and priorities in financing public goods and services can be noted between countries. Due to high sensitivity of non-parametric methods to data heterogeneity, this should be taken into account when selecting the sample for the analysis.

Keywords: government expenditure efficiency, optimal size of government, functional classification

JEL classification: H11, H50, E60

Introduction

In recent years European Union (EU) countries are facing severe challenges in public finance management. Globalization (free movement of capital induces tax competition and causes revenue erosion) and demographic trends (aging population causes social protection and health expenditure to rise) have exerted pressure on both revenue and expenditure side of the budget. Given that the countries are bound to fiscal discipline through Stability and growth pact, space for further indebtedness is limited. With light on these problems, question of reduction of size of government comes to the forefront. The key question is: Is it possible to reduce the size of the government without hampering the economy's growth? If so, how can it be done?

A number of researches investigated the size of government-growth nexus. Size of the government is commonly proxied by general government expenditure in % of GDP. There have been mixed results regarding this relationship. While some researchers find positive (Ram, 1986), others find negative effect of size of government on growth (Afonso & Jalles, 2011). Recent papers describe the size-growth relationship as inverted U shaped relation. This connection is in literature often named the BARS (Barro–Armey–Rahn–Scully) curve (Barro, 1990; Rahn & Fox, 1996; Scully, 1998, 2003). Barro's (1990) endogenous growth model was first to introduce the non-monotonic relationship between size of government and growth. This

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relation implies existence of size of the government which maximizes the growth rate. His theory suggests that, while its size is small, government expenditure encourages growth. When invested in infrastructure, health care, education and law enforcement, government expenditure boosts human and physical capital productivity. However, higher expenditure needs to be financed with higher taxes. Growing government exerts more pressure on private sector, and consequently squeezes out private investment. Raising tax burden distorts incentives resulting in inefficient allocation of resources. Marginal benefit of public expenditure is diminishing and after a certain point it turns negative. The question is: How to find the optimal government size?

There are several ways of finding the optimal size of government. Most studies are based on parametric approach which implies estimating a nonlinear growth regression which needs to be maximized with government size being the independent variable. Equalizing the function's first derivation by expenditure to zero, the optimal government size can be found. Many researchers have applied this methodology and found that most countries suffer from excessive size of their government (Mutascu & Milos, 2009). The authors found the optimal size of government to be 30.42 % of GDP in the EU-15 and 27.46 % of GDP in the EU-12.

More recent line of research incorporates a slightly different approach to government size-growth relationship. Nonparametric approach to estimating the optimal size of government incorporates efficiency analysis giving this relation a new dimension. Efficiency analysis on aggregate level puts in relation the government size, usually measured by total government expenditure (% of GDP), with the economic growth. Input inefficiency gives information on whether the existing growth rate could have been reached with lower government size. Bađun et al. (2014) calculate the efficiency scores through Data envelopment analysis (DEA)/Tobit approach for a sample of EU member states and find that most countries are being inefficient. The results show that, the optimal size of government for the reviewed sample is 39.21% of GDP, meaning that countries could have attained the same growth rate with 3.54 percentage points lower government expenditure, on average. De Witte & Moesen (2010) apply the same methodology on a sample of 23 OECD countries and find that the same output could have been attained with, on average, 3.74 percentage points lower general government expenditure.

Angelopoulos et al. (2008) and Rahmayanti & Horn (2011) have gone further and combined both nonparametric and parametric approach to investigate the government size-growth relationship. Angelopoulos et al. (2008) have calculated efficiency scores applying Stohactic frontier analysis with total government expenditure (% of GDP) as the input and GDP growth as the output variable for a sample of 52 countries between 1995 and 2000. The authors incorporated these efficiency scores into a growth regression and found that efficiency has a significant role in size-growth relationship. Specifically, the efficiency-size mix is significant in explaining the relationship. The model includes efficiency threshold above which the size-growth relationship becomes negative. Rahmayanti & Horn (2011) calculate the efficiency scores for 63 developing countries between 1990 and 2003 applying DEA analysis. The scores they afterwards incorporate into standard Barro growth regression, only to find that, after a certain threshold, efficiency reduces the optimal size of government expenditure needed to maximize growth. Therefore, the higher the efficiency the more government expenditure can be saved.

These studies show a significant effect of efficiency and imply that examining the overall government size-growth relationship without controlling for efficiency can easily lead to biased results. Countries can reduce their government size by raising their efficiency with no negative effect on the economy. With most countries facing severe challenges in public finance management, efficiency is being given more attention in the literature. For that reason it will be the focus of this paper.

The aim of this paper is to investigate the efficiency of public expenditure and its relation to the optimal size of government in European Union countries. In that respect, methodology and literature review on government efficiency will be given. The aim is to accentuate the importance of decomposing government expenditure due to different structure of government expenditure across EU countries. The countries have different traditions in financing public goods and services and different priorities. Taking only the overall expenditure could cause losing valuable information.

The paper is organized as follows. The first part introduces the concept of public sector efficiency, second part surveys measurement techniques developed for efficiency estimation, third part gives a brief overview and discussion of the previous literature on government efficiency, fourth section gives a brief insight in size and the structure of the government expenditure of the EU countries and the last section concludes.

1. THE CONCEPT OF GOVERNMENT EXPENDITURE EFFICIENCY

Prevailing measurement of utility from public activities in general public is the amount of budget allocated to certain function. Higher budget would imply proportionally larger utility from a certain activity. In reality, that is not necessarily the case. Concept of efficiency is being introduced to explain the relation between the input and the output and to objectively measure the performance of public activities.

When it comes to efficiency, it is important to distinguish technical from allocative efficiency. Technical efficiency reveals whether the same output could have been attained with lower quantity of inputs (input inefficiency) or higher output could have been attained with the same quantity of inputs (output inefficiency). It puts unit's performance in relation with the best output-input ratio that could have been attained. On the other hand, allocative efficiency shows the best possible allocation of inputs with respect to their market prices and includes the cost and benefit analysis. Together they form the overall economic efficiency (Farrell, 1957). However, concept of efficiency is often confounded with productivity. While productivity is a simple ratio of output over input, it does not give information on the highest output-input ratio attainable.

Analysis can be conducted for aggregate level of government expenditure (Adam et al. 2011; Afonso et al., 2005a, 2010; Agasisti, 2011; Angelopoulos et al., 2008; Bađun et al., 2014; De Witte, 2009; Rahmayanti & Horn, 2011) and for each of the government services separately. Also, some researchers conduct the analysis on local government level (Balaguer-Coll et al., 2007; Afonso & Fernandes, 2008).

Aggregate level efficiency analysis has several drawbacks. Since composition of government expenditure varies among countries, data can be highly heterogeneous and lead to spurious results. Furthermore, such analysis gives weak information on environmental factors that can affect efficiency. Inefficiency can be detected but its main drivers remain unfound. In that respect, disaggregated analysis of specific government activities is more frequent recently. Most researched public expenditure functions are health and education (Adam et al. 2011; Afonso et al. 2005a; Afonso & St Aubyn, 2005b; Aristovnik, 2009; Hauner & Kyobe, 2010; Herrera & Pang, 2005; Jafarov & Gunnarsson, 2008; Prasetyo, 2013), education alone (Aristovnik, 2011; Afonso & Aubyn, 2006) while a number of researchers deal with public investment and public administration efficiency (Afonso et al., 2005a; Adam et al., 2011; Bađun et al., 2014).

2. METHODS FOR MEASURING EFFICIENCY

Methods for measuring government efficiency usually rely on formulation of a production possibility frontier. Most common methods can be divided into parametric and non-parametric methods. The main difference between them is that non-parametric methods do not require a predetermined form of the production function while the parametric do. Non-parametric methods use input-output data from the sample to form a production possibility frontier which links the best performing units in the sample following a mathematical linear programming method. Once formed, best practice frontier is used to calculate the efficiency scores based on distance of each unit to frontier.

Data Envelopment Analysis (DEA) is a non-parametric method mostly used in recent research. It was originally introduced by Charnes et al. (1978). This method uses input-output data to form the best practice frontier. The frontier is calculated as linear combination of the best performing units. Units positioned on the frontier are given the score of 1, while the units inside the frontier have an efficiency score between 0 and 1. However, the fact that a unit is positioned on the frontier does not imply that it is fully efficient. It means the unit is more efficient relative to the other units. DEA analysis can be input or output oriented. Input oriented DEA reveals how much resources can be saved maintaining the output unchanged, while the output oriented DEA shows if higher output can be reached without changing the inputs.

The main advantage of DEA analysis is simplicity of its application, given that it does not require a predetermined production function. It is mainly data driven, simply takes the output-input data, and does not need input or output prices so it is appropriate for analyzing non-profit institutions. However, this method has its downsides. Important shortcoming of this method is the sensitivity to outliers and measurement errors since it interprets random errors as inefficiency. Having that in account, homogenous data would be a prerequisite for the analysis, which is already an issue given the fact that expenditure is relatively heterogeneous among countries. Another shortcoming of this method, it does not account for possible exogenous macroeconomic and environmental factors that could affect efficiency which could result in biased efficiency coefficients.

There are many ways to deal with this issue. The most common is the two stage DEA/Tobit approach while some researchers use simple least square regression (OLS). Both approaches are parametric methods. Tobit approach is commonly considered appropriate due to censored nature of the efficiency coefficients. It is a maximum likelihood method used for limited data with lower and upper bound (efficiency coefficients range between 0 and 1). The coefficients, previously calculated through DEA, are being regressed on a number of possible determinants. This approach has been recently criticized for being inconsistent since efficiency scores are estimated through nonparametric method, while the efficiency determinants are detected by using parametric method. Alternative approach is using nonparametric approach in first and in the second stage applying single and double bootstrap procedures.[1]

Another nonparametric method for efficiency estimation is Free Disposal Hull (FDH) suggested by Deprins et al. (1984) and Tulkens (1986). FDH poses the least restrictions compared to the other methods. The units that are efficient under DEA are efficient under FDH method but not necessarily vice-versa. The only difference between the two is that in DEA analysis any linear combination of the efficient units forms the frontier, while FDH does not require convexity.

An example of a parametric approach for estimating efficiency is stochastic frontier analysis (SFA). Its advantage is it can include other exogenous and environmental factors affecting

[1]For more details on bootstrapping techniques, see Simar and Wilson (2007)

efficiency aside from the production inputs which gives more robust results. Its most important shortcoming is that it requires a predetermined shape of the production function.

Composite indicators are another measure that can be used to compare different countries' performance and efficiency. They can serve as input or output indicator in the efficiency analysis or an overall efficiency indicator. Developed by Afonso et al. (2005a) the Public Sector efficiency index (PSE) takes the performance (PSP) of each of selected disaggregated government functions and compares it to related expenditure. Afterwards, the calculated sub indicators are given weights and composed into a composite overall indicator of government efficiency. However, the results are dependent on the arbitrary selection of sub indicators and given weights and can vary substantially depending on the sample selection.

A few important issues regarding input and the output measurement in the efficiency analysis need to be noted. Inputs are usually defined in monetary but can also be referred to in physical terms. When measuring resources in monetary rather than physical terms, countries that have comparably more expensive resources can wrongly result to be inefficient. On the other hand, countries where the resources are less expensive can have overestimated efficiency scores. The former is called the Baumol (1967) effect. Moreover, some issues with output measurement can occur. Since public goods are not tradable, there is no information on their prices. With no information on output prices it becomes difficult to take the quality of the output in account. By comparing only quantity, important information might be omitted causing biased results.

3. REVIEW OF THE RECENT LITERATURE ON GOVERNMENT EXPENDITURE EFFICIENCY

Systematic review of the related papers on efficiency and the optimal size of government can be found in the appendix. While a number of them apply on EU countries, OECD countries are the most investigated in this field. Considering that most EU countries are members of OECD, literature review includes papers based on both samples. The results suggest that there is high space for reducing the government expenditure by using the resources more efficiently (Afonso et al., 2005a, 2010; Afonso & St Aubyn, 2005b; Aristovnik, 2009, 2011; Bađun et al., 2014). Afonso et al. (2005a) find that the average input efficiency of the 15 EU shows that the same level of output could be attained using only 73% of the inputs. Bađun et al. (2014), on the other hand, find that the average optimal size of government in old EU countries is larger than that in new EU countries. Moreover, old EU member states have, on average, more efficient governments than new EU countries regarding education expenditure, health care, public investment and public administration.

Research in individual spending areas is more frequent than aggregate level analysis with health and education in the lead. Usual monetary input for education is public expenditure on education (% of GDP) or (public) expenditure per student (% of GDP per capita), while quantitative is hours per year in school. The education output is usually test results (PISA), secondary or tertiary school enrollment or teacher/pupil ratio. Usual monetary input for health sector is average public spending on health (% GDP) or health spending per capita (private and public) while quantitative inputs are number of doctors, nurses, hospital beds etc. The most common health outputs are infant mortality rate and life expectancy at birth. For the efficiency at aggregate level the usual input is total government expenditure (% GDP) and the output is per GDP growth rate or a public sector performance composite indicator (PSP). Some researchers use Human development index as the output (Prasetyo, 2013).

As mentioned previously, recent papers include the analysis of determinants of efficiency. As the analysis has a more in-depth scope, determinants of efficiency become more specific and targeted. Due to limited space, only the most frequent ones are reviewed in this paper. One of them is the size of government expenditure. Afonso et al. (2005a) find that "small" governments are the most efficient among industrialized countries, implying diminishing marginal products of higher public spending. Hauner & Kyobe (2010) and Herrera & Pang (2005) come to the same conclusion for health and education sector, that higher government expenditure (% of GDP) is associated with lower efficiency. Aristovnik (2009) finds negative effect of high public spending on health efficiency. On the other hand, at local government level, the efficiency scores are found to be higher for large municipalities. (Balaguer - Coll et al., 2007).

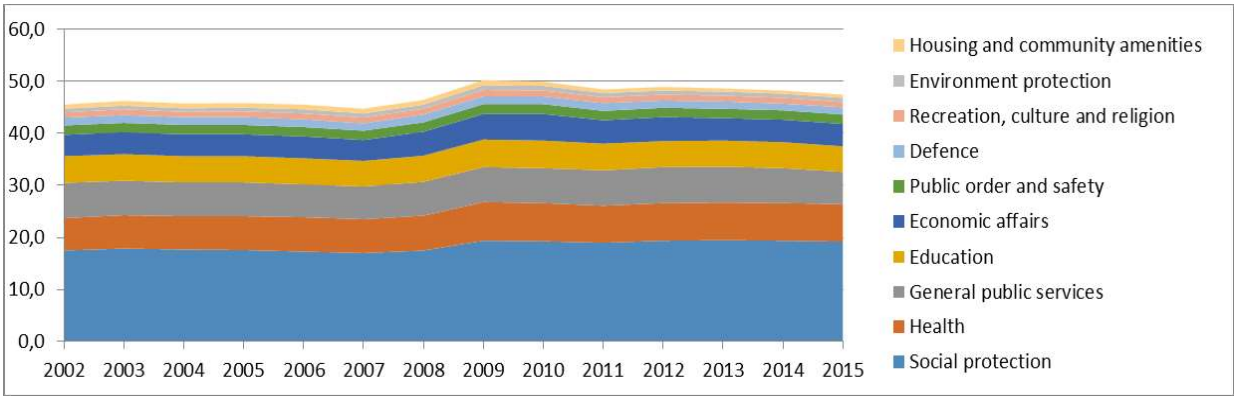
Another determinant is income per capita, was found to have a positive effect of efficiency on aggregate level (Agasisti, 2011; Afonso et al. 2010) and for health and education (Herrera & Pang, 2005; Afonso & Aubyn, 2006; Hauner & Kyobe, 2010). Country's openness was found to have a negative effect on efficiency (Bađun et al., 2014; De Witte & Moesen, 2010). The explanation would be that open economies are more sensitive to external shocks and need a larger government take on a role of a stabilizer of the economy (Rodrik, 1998*).*Family size is shown to have a positive effect on gross efficiency (Bađun et al., 2014; De Witte & Moesen, 2010). Countries with larger average family size can attain the same growth rates with lower government expenditure. Findings show that higher degree of urbanization has a positive effect on aggregate level efficiency (De Witte & Moesen, 2010)*,* also in health and education (Herrera & Pang, 2005). Higher urbanization enables providing public services at lower costs through the economy of scale. Regarding capital stock of a country, Afonso et al. (2010) point out that physical capital has a positive effect on government efficiency. Countries with larger physical capital stock, measured by the share of gross investment in GDP, can attain the same growth rates with less government expenditure (Bađun et al. 2014). Higher population density, similar as urbanization, was found to have a positive effect on efficiency due to economies of scale which enable the provision of public goods and services at a lower cost (Herrera and Pang, 2005; De Witte & Moesen, 2010). Higher population density was also found to improve the performance in education and health (Hauner & Kyobe, 2010).

4. THE STRUCTURE OF GOVERNMENT EXPENDITURE IN EUROPEAN UNION

The average EU-28 general government expenditure is continuously stagnating, since its peak in 2009 (induced by the economic crisis, increases in unemployment and social protection) when it amounted to 50.1% of GDP. It decreased from 47.3% of GDP in 2015 to 46.6% of GDP in 2016. The highest reduction was reported in Greece, Bulgaria and Slovakia respectively. General government expenditure in EU varied between 29.4% of GDP in Ireland and 57.0 % of GDP in both France and Finland in 2015. Regarding the general government expenditure structure, notably four government functions amount to 79.2% of total expenditure in 2015. Those are respectively social protection (40.6% of total), health (15.2% of total), general public services (13.1% of total) and education (10.3% of total).

Growing share of government expenditure in GDP was primary driven by growing social protection and health expenditure. Social protection expenditure as the largest function is becoming more important in terms of share of GDP and in share of total expenditure. It rose in share of GDP by 1.7 p.p. between 2002 and 2015. A slight slowdown can be noticed in the last two years when it decreased from 19.4% of GDP in 2014 to 19.2% of GDP in 2015. It was accompanied by total general government expenditure slowdown. Health expenditure kept a stable share in the last 4 years (7.2% of GDP). The evolution of EU 28 general government expenditure by function as share of GDP between 2002 and 2015 is illustrated in graph 1.

Graph 1 - EU-28 average general government expenditure by function 2002 - 2015 (% of GDP)

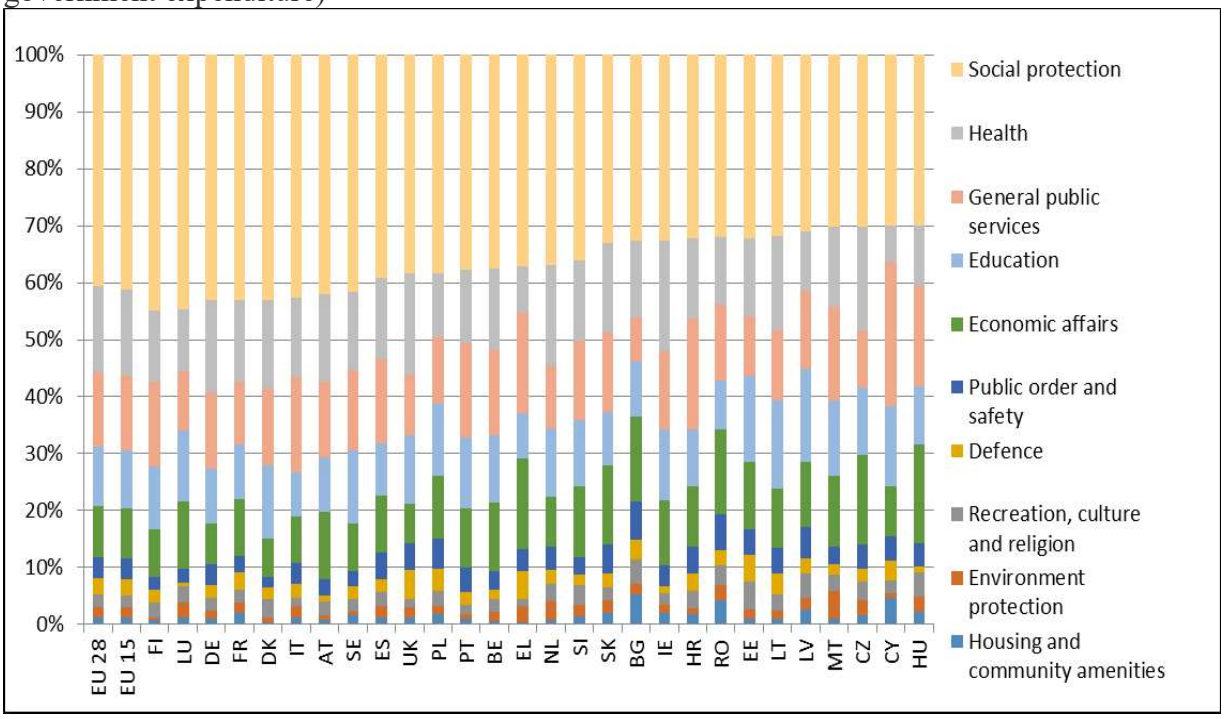


Source: Eurostat; author's calculations

Regarding the average shares of total expenditure, social protection in EU increased in share of total expenditure from 38.4% in 2002 to 40.6% in 2015, and is continuing upwards. Health expenditure increased from 13.7% in 2002 to 15.2% in 2015, while education is on a downward trend in the last years (from 11.1% in 2002 to 10.3% in 2015). General public services ranged from 14.9 % in 2002 to 13.1 % of total expenditure in 2015. The shares of each function in total expenditure are considerably stable. However, a trend towards increase in social protection (+2.2 p.p.) and health (+1.5 p.p.) shares at the expense of general public services (-1.8 p.p.), education (-0.8 p.p.), housing and community amenities (-0.6 p.p.) and defence (-0.4 p.p.) shares can be noticed in period 2002-2015.

Looking at government expenditure structure across EU countries, from Graph 2 it is evident that shares show significant heterogeneity. Relatively higher shares of social protection are reported in the old EU member states compared to the new EU member states (joined 2004 or after). Social protection varies from 29.9% of total in Cyprus to 44.9% of total expenditure in Finland. The divergence across EU countries is can be noted in public health expenditure. It ranges from 6.4% in Cyprus to 19.3% of total government expenditure in Ireland.

Graph 2 – EU-28 General government expenditure by function in 2015 (% of total government expenditure)



Source: Eurostat; author's calculations

With the fact that education and health have features of private goods, it is important to account not only for the public expenditure but include also the private expenditure on education and health. According to WHO data, high variety can be found across countries. Public expenditure on health in EU amounted to, on average, 73 % of total health expenditure in 2014. The reported range is between 45% of total in Cyprus and 87% of total health expenditure in Netherlands. Public expenditure on education is generally larger in share to private, when compared to health expenditure. Public expenditure accounts for on average 88% of education expenditure with range from 79% in United Kingdom to 98% of education expenditure in Finland in 2011 (Eurostat, 2017).

Reported data show a large variety of government expenditure size and structure across countries which can be a serious drawback in efficiency analysis. Moreover, with different tradition of financing the public services among countries (private vs. public funding), some countries are not suitable for comparison. Leaving out the private sources of health and education expenditure could result in serious bias. All of these constraints need to be born in mind when selecting the sample, conducting the research and interpreting the results.

Conclusion

In environment of government expenditure cuts being in center of attention of both economists and the public, the question of optimal size of government and its efficiency is taking the center stage. Numerous researches have been conducted on this topic, both parametric and non-parametric. From the literature review it can be concluded that most countries suffer from government inefficiency and could retain the same output with lower government size. With fiscal pressure most countries are facing, these findings give a positive sign that substantial resources can be saved without hampering the economy's growth. However, more recent

researches include 2-stage or 3-stage approaches to investigate the possible exogenous environmental factors affecting efficiency. These newer, more sophisticated methods are able to distinguish inefficiency from other factors that affect the performance that are out of control of policy makers. Substantial gains in measurement techniques have been made in the last years, but yet the availability of data is being a drawback in the analysis. For future research, it would be useful to track efficiency progress in countries over time. Given the drawback of non-parametric methods and their sensitivity of results to sample variation it would be beneficial to apply the parametric methodology to check the robustness of the results. The future lays in a more targeted analysis on specific public functions where the inputs, outputs and drivers of efficiency can be more accurately measured. A more in-debt analysis can help create a targeted policy mix to improve efficiency and asses the performance of public sector. A more detailed research of causes of inefficiency in specific public services would help reveal the mystery behind the varying efficiency coefficients across countries. Nowadays, efficiency analysis is a developing area of research, expected to become even more important in the future years with substantial contributions to public finance management.

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Contact information

Antonija Buljan
Faculty of Economics & Business, University of Zagreb
Trg J. F. Kennedyja 6, Zagreb, Croatia
abuljan2@efzg.hr

Hrvoje Šimović
Faculty of Economics & Business, University of Zagreb
Trg J. F. Kennedyja 6, Zagreb, Croatia
hsimovic@efzg.hr

Milan Deskar Škrbić
Erste & Steiermarkische Bank
Ivana Lučića 2, Zagreb, Croatia
mdskrbic@erstebank.com

Appendix: Literature review

Author	Analysis subject	Method and sample	Input and output	Results
Adam et al. (2011)	efficiency of public spending on: education, health, social security and welfare, general public services, economic affairs, overall government spending	**1.Input oriented DEA** **2.SFA (**to account for environmental factors) **3. DEA sensitivity analysis** **Sample** 19 OECD countries 1980–2000	INPUT: Government spending (% GDP) for each function OUTPUT: EDUCATION:(secondary school enrollment, quality indicator) HEALTH: (infant mortality rate, life expectancy at birth) WELFARE: (GINI coefficient) ECONOMIC AFFAIRS: (the electric power transmission losses, standard telephone access lines) GENERAL PUBLIC SERVICES: (the corruption in government, the bureaucratic quality measures) GENERAL GOVERNMENT: general economic performance indicator (unemployment rate, GDP per capita, annual GDP growth rate) and economic stability indicator (standard deviation of the GDP growth rate, the inflation rate)	-The results in all 3 stages are not significantly different, implying than sound governance is more important than the environmental factors. **Efficiency determinants** -urbanization rate, the population density, the proportion of population above 65 years of age, international market openness, government stability measure, the investment profile variable, general proxy of the socioeconomic conditions
Afonso et al. (2005a)	-public sector performance (PSP) -public sector efficiency (PSE) composite and 7sub-indicators (administrative, education and health outcomes, quality of public infrastructure, the rule of law, allocation, distribution and stabilization functions)	-PSP -PSE -FDH (input and output efficiency) **Sample** 23 industrialized countries 1990, 2000	INPUT: PSP, PSE, total public spending, average spending on goods services, transfers, functional spending on education and health and public investment OUTPUT: Administration (corruption, red tape, quality of the judiciary, the size of the shadow economy) The education indicator(secondary school enrolment, OECD educational attainment indicators) The health performance indicator(infant mortality, life expectancy) public infrastructure indicator(communications quality, transport infrastructure quality) Income distribution (income share of the poorest 40% of the households) Economic stability (the coefficient of variation of output growth and average inflation) Economic performance (per-capita GDP, GDP growth, unemployment) FDH-INPUT: Public spending % GDP OUTPUT: PSP indicator	-small governments are the most efficient among industrialized countries, implying diminishing marginal products of higher public spending. -large potential for expenditure savings in many countries FDH: -The average input efficiency of the 15 EU shows the same level of output could be attained using only 73% of the inputs -The output efficiency score implies that with given public expenditures, PSP is 82% (or 18% less) of what it could be attained with the same level of expenditure

Afonso & St Aubyn, 2005b)	Education efficiency Health efficiency	DEA, FDH input and output efficiency (quantity and monetary inputs) **Sample:** 30 OECD	INPUT: 1. monetary – Spending per student (secondary) 2. quantitative - Hours per year in school, teachers per 100 students OUTPUT:PISA results INPUT: 1.monetary - Health spending per capita (private and public) 2. quantitative-doctors, nurses, hospital beds. OUTPUT: The infant survival rate, life expectancy	**FDH education** -In the education sector, the average input efficiency varies between 0.859 and 0.886 In health, between 0.832 and0.946 - There is scope for attaining higher output using the existing resources.
Afonso &Aubyn, (2006)	Secondary education efficiency	DEA/Tobit, Single and double bootstrap **Sample:** 25 OECD	INPUT: teachers per student, time spent at school OUTPUT:PISA results	-countries could attain higher output by 11.6% using the same resources, on average **Efficiency Determinants:** Country's wealth and parents' education levels is associated with higher education efficiency
Afonso et al. (2010)	General government spending efficiency	PSP,PSE DEA/Tobit **Sample**: 12 EU	INPUT: the total Government spending (% GDP) OUTPUT: PSP	-countries with public expenditure around 30% of GDP are the most efficient according to PSP and PSE -from the average input scores countries could attain the same output with 45% less resources -Average output scores show that countries are attaining around two-thirds of the output they could attain with the same resources **Efficiency Determinants:** higher income, civil service competence, education levels and the security of property rights prevent government inefficiency
Afonso & Fernandes (2008)	efficiency of Portuguese local municipalities	DEA/Tobit approach **Sample:** 278 Portuguese municipalities, 2001	INPUT: level of per capita municipal spending for the input measure. OUTPUT: composite local government indicator of municipal performance	-results suggest that most municipalities could attain higher output with the same resources
Angelopoulos et al.(2008)	General government spending efficiency and growth	PSP, PSE,SFA, growth regression **Sample:** 64develpoing countries1980-2000	INPUT: Total government expenditure % GDP OUTPUT:PSP Growth regression: INDEPENDENT VARIABLES: Total government expenditure (% GDP), PSE, TE, control variables DEPENDENT VARIABLE:GDP per capita growth	-when the fiscal size is measured by the government consumption share in GDP, the size-efficiency mix is significant in explaining the size-growth relationship.
Aristovnik (2009)	Health and education efficiency	DEA, FDH **Sample:** EU new member states	Health: INPUT: average public spending on health (% GDP) in 2001-2004 OUTPUT: standardized death rates (per 100,000 people) Education: INPUT: average public spending on health (% GDP) in 2001-2004 period	-efficiency and effectiveness differs across the sample -health inefficiencies are related to high public spending -education inefficiencies appear in the transforming intermediate output into real outcomes. -space to reduce public (health and education) spending and retain the same output.

			OUTPUT:PISA test scores	
Aristovnik (2011)	**Education efficiency (primary, secondary, tertiary and total)**	DEA output oriented **Sample:** 37 EU, OECD	INPUT: -(public) expenditure per student, tertiary (% of GDP per capita) - total expenditure on education (% GDP) OUTPUT: school enrolment tertiary, teacher/pupil ratio, primary completion rate, unemployment with tertiary education, labor force with tertiary education, and PISA 2006 average score.	-new EU member states show relatively high efficiency in tertiary education efficiency -CEE countries, Hungary, Estonia and Slovenia have high efficiency in primary, secondary and tertiary education, respectively. -most CEE countries have potential for increased efficiency in (public) spending
Bađun et al. (2014)	Total government spending efficiency, optimal government size, Public investment efficiency, public administration efficiency	DEA/Tobit approach **Sample**: EU member states plus Iceland and Norway	Total: INPUT: general government expenditure % GDP , OUTPUT: average GDP growth rate Public investment: INPUT: general Government gross investment in% GDP OUTPUT: The public infrastructure quality Public administration: INPUT: share of expenditure on general government employees' salaries in GDP OUTPUT: government effectiveness, 2) regulatory quality and 3) rule of law efficiency of the legal framework in settling disputes and the number of days to start a business (both from GCR).	-The average optimal size of government in old EU countries is larger than that in new EU countries -the optimal government size for the sample is 39.21%, thus countries should, on average, reduce their general government expenditure (% GDP) by 3.54 p. p. **Efficiency determinants** -family size has appositive effect on gross efficiency, Openness has negative effect on efficiency -GDP per capita, the share of population over 65, total population, population density, are insignificant. -Countries with larger physical capital stock can achieve the same growth rates with less government expenditure. -countries with longer life expectancy show a larger optimal government size with given growth rates.
De Witte & Moesen (2010)	Optimal government size	DEA/Tobit regression **Sample:** 23 OECD, 1999	INPUT: General government spending OUTPUT: GDP growth, PSP composite indicator	-the public sectors should decrease by3.74 p. p. to reach an overall tax burden of 41.22% of GDP. **Efficiency determinants:** larger exports negative effect on efficiency, GDP per capita shows a positive but insignificant effect on efficiency, family size, country size, population density and urbanization show a positive effect on efficiency
Herrera & Pang (2005)	Efficiency of government spending in health and education	DEA, FDH, input and output oriented **Sample:** 140 countries 1996 - 2002.	INPUT: Public expenditure on health per capita in PPP terms, Public expenditure on education per capita in PPP terms OUTPUT: Education- Primary school enrollment, secondary school enrollment, literacy of youth, average years of school, first level complete, second level complete, and learning scores. Health- Life expectancy at birth, immunization, the disability, adjusted life expectancy	- higher expenditure levels ,the wage bills a larger share of the total budget, publicly financed service provision, the prevalence of the HIV/AIDS epidemic, income inequality, and the degree of external aid financing(negatively associated with efficiency) - the degree of urbanization (positively correlated with efficiency)

Jafarov & Gunnarson (2008)	Health care, education, social protection efficiency	DEA **Sample:** Social spending in Croatia is evaluated against Frontiers estimated for the EU-15, the EU-10, Cyprus, Malta, and OECD countries.	INPUT: public health expenditures (PPP per capita), public expenditure social benefits (PPP dollars per capita) OUTPUT: -Health care: intermediate output (the density of physicians, pharmacists, and healthcare workers, number of hospital beds, number of immunization vaccines.), outcome (infant, child, and maternal mortality rates; the standardized death rate from all causes per 1,000people, incidences of tuberculosis, healthy average life expectancy) -Education: Intermediate output indicator (primary pupil-teacher ratios, enrollment rates, rates of progression to secondary education, and graduation rates), outcome indicator (PISA). -Social protection: The key outcome indicator is poverty rates	-evidence of significant inefficiencies in Croatia's social spending (inadequate cost recovery for health and Education services, weaknesses in the financing mechanisms and institutional arrangements, weak competition in the provision of social services, and weaknesses in targeting benefits. **Efficiency determinants:** -inefficiencies in health spending in Croatia partly related to high pharmaceutical spending, long stays in hospitals, low levels of out-of-pocket spending and of private participation. -positive relationship between overall efficiency and the share of current expenditure in total education, classroom size, parent's education and school quality and autonomy indicators
Prasetyo (2013)	government expenditure efficiency in health, education, transfers and subsidies	DEA, Malmquist Index **Sample:** 81 countries, 2006-2010	INPUT: government expenditures per capita on education and health sectors and also on subsidies and other transfers OUTPUT: Human development index	-Armenia, Australia, Bangladesh, Chile, Georgia, Japan, Korea Republic, Lao PDR, Madagascar, Niger, Norway, Philippines, Sierra Leone, Singapore, US, and Zambia remained efficient in the sample period
Rahmayant & Horn (2011)	-Government efficiency -optimal government size	DEA, panel fixed effect regression, (GMM-HAC) **Sample**: 63 developing countries 1990-2003	INPUT: Government share to GDP (%) OUTPUT: -literacy rate for education (%), electricity use for infrastructure, life expectancy for health (%)	-Above a certain threshold, efficiency reduces the government expenditure required to maximize growth. - Optimal size for government expenditure exists if country's efficiency score is higher than 0.865. -with the average sample efficiency score of 0.89, the optimal government expenditure is around 15% of GDP.