

## ASSESSMENT OF THE EFFICIENCY OF GOVERNMENT HEALTHCARE EXPENDITURE IN SELECTED EUROPEAN UNION MEMBER STATES: A DEA APPROACH

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### Abstract

*The aim of this article is to assess the efficiency of expenditure of the sector “General Government” for the “Healthcare” function in the member states of the European Union (EU). To achieve this aim, the non-parametric method of data envelopment analysis (Data Envelopment Analysis (DEA)) is applied, oriented towards the input with variable returns to scale. The study uses the expenditure of the sector “General Government” for the “Healthcare” function per capita as input resource, and the indicators “life expectancy” and “mortality per 100,000 people due to non-contagious diseases, infectious diseases and unclearly diagnosed diseases” as output results. Since, historically, the EU member states have been characterized by different economic development, two relatively homogeneous groups of countries have been distinguished. The first includes the so-called „old” member states, and the second includes countries from Central and Eastern Europe (CEE). The conclusion that follows is that the final results for the „old” member states, and in particular Austria, Belgium, Germany, Finland, France and Italy, as well as for the CEE countries - Estonia, Latvia, Lithuania, Hungary and the Czech Republic, could be achieved with fewer input resources. The latter is reason to seek opportunities for optimizing the healthcare systems of the analyzed countries.*

**Keywords:** efficiency, Data Envelopment Analysis (DEA), public administration, healthcare

**JEL:** H51, C67

### Introduction

Through government healthcare expenditure one of the important functions of modern state intervention in the economy is expressed. To a large extent, the quality of human capital depends on the way healthcare expenditure is managed and the public investments made, which have an impact on the health level of the population. The economic nature of government healthcare expenditure is not limited to the medical care provided, but rather is associated with their indirect impact on economic development and social welfare, labour productivity and

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quality of life. One of the important topics in modern economic management of the public sector is related to the efficiency of government expenditure. In this context, the efficiency of government healthcare expenditure largely indicates the way the health system functions and the possibilities for it to be built as a sustainable social system with high social value. Consequently public healthcare expenditure is characterized by a clear investment potential, as it directly affects the quality of life of the population, thereby improving labour productivity and thus indirectly related to the generated economic growth. The efficient use of healthcare expenditure and the resulting output largely determines the sustainability of the social system. In addition, public healthcare expenditure helps reduce social and economic risks and generates long-term benefits for the economy. A better health level of the population is associated with higher economic activity and longer working lives. Therefore, public healthcare expenditure can be defined as a type of investment in human capital. They are a mechanism for correcting market failures, a social instrument for reducing inequalities and achieving sustainable growth and a higher level of social welfare. The latter is related to the need to apply reliable methods for assessing the efficiency of government healthcare expenditure, in order to realize the aforementioned effects of their functioning. It is known that different countries are characterized by heterogeneous healthcare systems and models of financing the offered healthcare services. Considering the dual nature of the healthcare product – on the one hand, it is a type of collective good, and on the other – a merit good, which is characterized by great public utility, there is a need to assess the efficiency of healthcare expenditure in EU countries, outlining their main parameters and development trends in individual countries. The latter is related to the possibility of correcting imperfections in public healthcare policies.

### **Theoretical Framework of the Study**

Government healthcare expenditure has clearly expressed economic features, including: a mechanism for redistributing resources and income; an example of state intervention in the economy through the provision of the collective good “healthcare”; an instrument for stabilizing the economic system by neutralizing a number of market failures in the healthcare market; an example of investment in human capital; an instrument for maintaining fiscal stability as part of economic policy, etc. In this context, government healthcare expenditure plays a significant role in maintaining the sustainability of the economic system. The above gives reason to seek mechanisms for assessing the efficiency of this type of expenditure, since this will allow us to understand whether the invested public funds lead to real health and economic results. Therefore, in recent years, the topic of the efficiency of public financial resources has been extremely relevant, consider-

ing the trends in increasing government expenditure, especially in the field of healthcare during the Covid-19 pandemic. A large part of the scientific publications related to the efficiency of the public sector emphasize the use of methods for assessing budgetary resources and the result obtained by their use (Stefanova and Velichkov, 2020, pp. 115-128; Baciú and Botezat, 2014, pp. 31-46; Kwilinski and Vysochyna, 2024, p. 87; Varabyova and Müller, 2016, pp. 252-263; Afonso and Aubyn, 2011, pp. 1427-1430; Afonso and Aubyn, 2003; Cylus, Papanicolas and Smith, 2017, pp. 60-8; Stefko, Gavurov and Kocisova, 2018; Rivera, 2010, pp. 1313-1319; Eugene, 2008; Herrera, and Pang, 2005; Asandului, Roman and Fatulescu, 2014, pp. 261-268; Romaniuk et al, 2018, p. 126; Tsoklinova and Kolev, 2023, pp. 115-130 and etc.). The presence of numerous current studies related to the assessment of the efficiency of government healthcare expenditure determines the relevance of this paper. The review of the available literature on the research problem announces the use of a large set of indicators to assess the efficiency of the aforementioned expenditure. The DEA approach in its different variants is applied as the main research method (Kremenski and Dimitrova, 2019; Arnaudov, 2017; Blatechki and Hristova, 2020; Yotova, 2018; Hollingsworth, 2003, pp. 203-218; Herrera and Pang, 2005; Eugene, 2008). In this context is the article by C. J Gómez-Gallego, M. Gómez-Gallego, F. J. García-García and U. Faura-Martinez (2021), which main objective is to assess the technical efficiency in the management of health systems in European countries by applying the DEA approach and to examine the correlation between the level of efficiency and a number of macroeconomic indicators (Gómez-Gallego et al, 2021, p. 1). The problem of the effective use of budgetary resources, especially in times of demographic and economic pressure, is the main reason for the implementation of the study by the authors R. Duti and P. Sicari (2020), in which, using the DEA approach, the efficiency of basic parameters of social security in OECD countries is assessed, including: healthcare, secondary education and public services, as the authors use the indicator “life expectancy” to describe the specifics of the health systems of the analyzed countries (Dutu and Sicari, 2020, pp. 253). The conclusions reached by the authors are related to a large difference in efficiency between OECD countries, as well as potential measures for its improvement (Dutu and Sicari, 2020, pp. 253). The efficiency of the public health system in a number of European countries is the subject of research analysis in the article by L. Asandului, C. Popescu and I. P. Fătulescu (2015), in which the DEA approach is used as the main research method (Asandului, Popescu and Fătulescu, 2015, pp. 357-368). The authors use as input variables: “number of radiotherapy departments per 1,000,000 inhabitants”, “public health expenditure as a percentage of gross domestic product (GDP)” and “number of hospital beds per 10,000 inhabitants”, and as output variables: “incidence of tuberculosis”, “number of deaths from

ischemic diseases per 100,000 inhabitants” and “life expectancy” (Asandului, Popescu and Fătulescu, 2015, p. 360). The results that the authors empirically reach show that not all economically developed European countries are characterized by effective public health systems (Asandului, Popescu and Fătulescu, 2015, p. 365). In addition, the article focuses on countries such as Finland and Luxembourg, with good economic indicators but inefficient health systems and on those that invest significant financial resources in healthcare, but the efficiency is low. At the other extreme are countries such as Portugal and Spain, which are characterized by lower healthcare expenditure but greater efficiency (Asandului, Popescu and Fătulescu, 2015, p. 365). Such studies show the importance not only of the invested budgetary resources, but also of factors such as the quality of human capital, the efficiency of the education system, the standard of living of the population and, last but not least, an appropriate management model through which to strengthen the efficiency of the functioning of the health system of a number of European countries. In this context is the publication by B. Gavurova, K. Kocisova and J. Sopko (2021), in which the efficiency of health systems in OECD countries is assessed using a dynamic DEA approach (Dynamic Network Data Envelopment Analysis (DNDEA)). In addition to assessing the efficiency of health systems in OECD countries, the authors also use the DNDEA approach to analyze whether the decisions made in the healthcare sector lead to a positive result (Gavurova, Kocisova and Sopko, 2021, p. 25). The implementation of the DNDEA approach shows that the average overall efficiency in OECD countries for the period 2000-2016, measured over eight years, was respectively: 0.8801 in 2000, 0.8807 in 2008 and 0.8472 in 2016 (Gavurova, Kocisova and Sopko, 2021, p. 1). The calculated Malmquist Index indicates an improvement in efficiency by 19% in the field of “Public Healthcare” and 8% in the field of “Medical Care” (Gavurova, Kocisova and Sopko, 2021, p. 1). The efficiency of the education and health sectors, assessed through the application of the DEA approach, is a research topic focused on by P. Lekë and E. Alban (2022) (Lekë and Alban, 2022, pp. 92-109). When building the model, the authors use as input variables “healthcare expenditure” and “education expenditure”. As output variables for the healthcare sector are used: “life expectancy” and “infant mortality rate per 1000 live births”, while for the education sector: “secondary school enrolment (% of total)” and “number of students in primary school divided by the number of teachers in primary school” (Lekë and Alban, 2022, p. 97). The results achieved show that for the education sector, the analyzed countries have the opportunity to reduce the resources used by 24% in order not to change the level of their educational results (Lekë and Alban, 2022, p. 105). Regarding the health sector, it was found that the analyzed countries could be efficient and achieve the same level of health services with 53% less healthcare expenditure (Lekë and Alban,

2022, p. 105). In conclusion, the authors note the need to assess the efficiency of public expenditure in generating sustainable economic growth (Lekë and Alban, 2022, p. 105).

The efficiency of the public health system in Europe is a subject of research interest by the authors L. Asandului, M. Roman and P. Fatulescu (2014), who apply the DEA approach in 30 European countries (Asandului, Roman and Fatulescu, 2014, pp. 261-268). The input variables used are: “number of doctors”; “number of hospital beds” and “public health expenditure as a percentage of GDP”. The output variables used in the model are: “life expectancy”; “health-adjusted life expectancy” and “infant mortality rate” (Asandului, Roman and Fatulescu, 2014, p. 261). The study shows the presence of effective countries – both developed and developing. Among the latter are Bulgaria and Romania. Such studies outline the direction of development of subsequent research, related to the need to include a larger number of indicators, as well as tracking the results of the implemented public policies in the field of health in Europe, especially after the Covid-19 pandemic (Asandului, Roman and Fatulescu, 2014, p. 261). A large part of the available publications related to the study of health systems and the provision of health services in different countries in the last few years have been provoked by the impact of the Covid-19 pandemic and the pressure on the financing, sustainability and efficiency of health systems. In this context is the publication by D. Lupu and R. Tiganasu (2022), which analyzes the efficiency of their health systems based on 31 European countries (Lupu and Tiganasu, 2022, p. 15). The authors use the DEA approach as the main research method, justifying 15 indicators, grouped into several areas, with which they assess the efficiency of health systems in specific European countries. The input variables used are: “number of Covid-19 cases per 1 million population”; “number of doctors per 1000 population”; “number of nurses and midwives per 1000 population”; “hospital beds per 1000 population” and “healthcare expenditure per capita”, and the output variable is “number of deaths from Covid-19” (Lupu and Tiganasu, 2022, p. 15). The research period is divided into three stages, which allows more detailed conclusions to be drawn regarding the estimated efficiency of the European countries included in the empirical work, taking into account the pace of development of the health crisis. In this context, the results achieved show that in the first phase of the pandemic, inefficient health systems were found in Western European countries, including: Italy, Belgium, Spain, and the United Kingdom, while in the second phase, inefficient health systems were found in Eastern European countries such as Bulgaria, Greece, and Romania (Lupu and Tiganasu, 2022, p. 15). Such studies are useful because they allow for further specification of factors influencing the results obtained, as well as for monitoring whether the implemented policies have led to an increase in the efficiency of the studied systems

and processes. In addition to the above, there is the article by J. Kujawska (2018), in which the efficiency of health systems in 30 European countries is studied by applying Network Data Envelopment Analysis (NDEA), with the variables used being grouped into two groups – the first are beyond the control of politicians, while the second can be managed by them (Kujawska, 2018, pp. 60-70). J. Kujawska (2018) includes a large number of variables, using the following as input variables: “GDP on an annual basis”; “expenditure on preventive examinations per capita”; “population consuming fruits and vegetables at least once a week, %”; “number of doctors”; “number of nurses and midwives”; “number of CT scanners per 100,000 inhabitants” and as output variables: “life expectancy at birth for women and men”; “percentage of residents assessing their health as very good and good” and “mortality under 65 years for women and men per 100,000 inhabitants” (Kujawska, 2018, p. 63). A slightly different view on the issues of the efficiency of government healthcare expenditure is shown in the article by W. Sylviana and S. Suyanto (2024), which assesses their efficiency after the start of the decentralization process in certain areas in Indonesia, by applying the DEA approach (Sylviana and Suyanto, 2024, pp. 418-445). The authors use as input variable: “government healthcare expenditure” (this variable is calculated as the total direct expenditure of the health sector divided by the number of people for a certain period at constant prices since 2000), and as output variable “average life expectancy” (Sylviana and Suyanto, 2024, pp. 418-445). The results show that overall the efficiency of government healthcare expenditure is increasing as a result of fiscal decentralization in Indonesia.

The importance of the education and health sectors for public welfare is extremely high, as evidenced by the research interest in the topic related to the way in which government funds are used and the opportunities for increasing social welfare by increasing their efficiency. In this context is the publication of S. Hibatulmedina and R. A. Rambe (2021), who, using a DEA approach oriented to the outcome, measures the efficiency of educational and healthcare expenditure in 154 settlements in Sumatra (Hibatulmedina and Rambe, 2021, pp. 223-232). The input variable used in healthcare is “government healthcare expenditure”, and the output variable is “life expectancy”. Accordingly, for the provision of educational services, “government expenditure on education” is used as the input variable in the model, and “average years of schooling” is used as the output variable (Hibatulmedina and Rambe, 2021, p. 223). The results obtained show existing differences in the efficiency of government expenditure on health and education in the analyzed population areas in Sumatra. Assessing the efficiency of government healthcare expenditure is an important element of public governance, because when using budget resources, there is always the question of whether they are spent as rationally as possible. In addition, the government budget is always

limited and by assessing the efficiency of government healthcare expenditure, it is ensured that with the limited resources available maximum benefit is provided to society, including: more lives saved, better access to health services, better quality treatment, corresponding to modern technological progress in health. In this context, the publication of Ch. Xu, J. Chen, Y. Li, D. Huang and Y. Xue (2025), which uses the DEA approach and The Malmquist Index to assess the efficiency of social health expenditure in 31 Chinese provinces for the period 2012 - 2020, and examines the factors influencing its increase through panel data analysis (Xu et al, 2025, p. 19). The authors build their model using as input variables “social healthcare expenditure” and “healthcare expenditure per capita” and as output variables “number of medical and health facilities”, “number of beds in medical facilities” and “number of health technicians” are used (Xu et al, 2025, p. 2). For the purposes of the Tobit Regression Model, “GDP per capita”, “population density”, “illiterate population aged 15 and over” and “share of urban population at the end of the year” are used (Xu et al 2025, p. 2). The aforementioned study found that there is still a need to act on increasing the efficiency of social health expenditure in the analyzed Chinese provinces, with an emphasis on the use of technology to improve the total factor productivity of the health sector. The usefulness of such studies is related to the ability to identify ineffective policies and to direct funds to more effective activities in the health sector related to the application of digital technologies. At the same time, assessing the efficiency of public healthcare expenditure leads to opportunities to increase the transparency and accountability of the spent budget funds and to compare them with the results obtained. Also, assessing the efficiency of public health expenditure allows for informed political decisions to be made, to change financing models, to take actions to reform the health system in case of low effectiveness.

Through the measuring the efficiency of public healthcare expenditure, inefficient expenditure of the limited financial resources of the state can be prevented and reduced. In addition, in this way, a number of activities in healthcare sector are subject to verification and subsequent control, which results in decrease of duplication of activities, reducing administrative costs, decreasing inefficient hospital structures, selecting those programs that have a great impact on social welfare, etc. In addition, assessing the efficiency of public healthcare expenditure, allows comparing health systems of countries and introducing established good practices in the field of financial management. In this context is the publication of P. Jankovič and P. Mandžák (2019), who study the efficiency of healthcare expenditure in EU countries by applying the DEA approach (Jankovič and Mandžák, 2019, pp. 415-428). The authors construct two models. The first includes the variables: “healthcare expenditure per capita”; “healthy life years” and “preventable deaths per million people”. The second model is constructed using the

variables “accumulated healthcare expenditure for the last 10 years”; “summary healthy life years” and “preventable deaths in the population” (Jankovič and Mandžák, 2019, p. 421). The issue of effective budgeting is extremely important, especially in periods of increasing public debt due to increased government expenditure. The latter is associated with increased interest from politicians, citizens and researchers. In this context is the publication of R. K. Mohanty and N. R. Bhanumurthy (2018), who, using the DEA approach, assess the efficiency of the so-called social expenditure, including healthcare expenditure and education expenditure in twenty-seven Indian states (Mohanty and Bhanumurthy, 2018, p. 35). To assess the efficiency of government expenditure on education, two output variables are included – “gross enrolment ratio in school education” and “gross enrolment ratio in higher education”. As input variables are used: “ratio of education expenditure to GDP” and “ratio of expenditure on non-educational activities to GDP” (Mohanty and Bhanumurthy, 2018, p. 12). When assessing the efficiency of government healthcare expenditure, two output variables are also used – “infant mortality rate” and “life expectancy” and two input – “ratio of health expenditure to GDP” and “ratio of non-health expenditure to GDP” (Mohanty and Bhanumurthy, 2018, p. 17). The authors place special emphasis on factors that stimulate the different levels of efficiency achieved between the individual states in India, assessed in the article and which are actually the main driver of the differences found between the individual units studied (Mohanty and Bhanumurthy, 2018, p. 17). A comparative analysis of the efficiency of healthcare expenditure in OECD countries and USA is the subject of research interest by H. Lim and J. Kim (2022), in which, through the application of the DEA approach, inefficiency in healthcare expenditure in the USA is identified (Lim and Kim, 2022, pp. 990-1001). The model used in the article includes three input variables and one output variable. The input variables are “healthcare expenditure per capita”; “gross national income per capita” and “alcohol consumption (litters per capita)” and the output variable is “life expectancy at birth” (Lim and Kim, 2022, pp. 990-1001). There are a number of factors that influence the level of efficiency of healthcare expenditure. In addition, it is necessary to clarify that high expenditure does not always generate better results. To a large extent, the improvement of the result is also influenced by the type and structure of financing of the healthcare system, the effectiveness of budget management, as well as digitalization and the use of digital technologies. In addition to economic prerequisites, the level of efficiency of healthcare expenditure is also influenced by the quality of management of health institutions, the regulatory framework in which the healthcare sector operates, the way hospitals are managed, and the degree of decentralization of the healthcare system. The above is also confirmed by the results obtained in the article by H. Lim and J. Kim (2022), that despite

high healthcare expenditure, the USA does not show better health outcomes than other OECD countries characterized by high incomes (Lim and Kim, 2022, pp. 990-1001).

A large part of the publications in recent years related to measuring the efficiency of healthcare expenditure have focused on the period of the Covid-19 pandemic. It was during this period that a number of countries spent significant financial resources to combat the disease, which affected the dynamics of government healthcare expenditure. The latter provokes the question of the efficiency of healthcare expenditure and the healthcare system in general. In this regard, the publication of Biernacki (2025) examines the degree of effective use of healthcare resources in EU countries in relation to the fight against Covid-19 (Biernacki, 2025). The author uses the DEA approach as the main research method for assessing the efficiency of health resources. The final assessment is obtained as the subtraction between the results obtained during the pandemic and those before the pandemic. The findings from the study show that smaller countries such as Denmark, Estonia, Austria, Slovenia and the Czech Republic are more efficient during the pandemic, compared to larger on the one hand and poorer countries on the other hand (Biernacki, 2025, p. 1). Such studies emphasize the importance of government healthcare expenditure in terms of generating economic growth. The effective use of this type of expenditure provides an opportunity to improve total factor productivity and is perceived as a significant investment in human capital. A healthy population works more productively, is absent from work less, is more competitive in the labour market, develops better cognitive abilities, receives higher incomes and has higher economic activity, which is associated with increased labour productivity and achieving greater economic growth. In this regard, the assessment of the efficiency of government expenditure is an important research task, since their too large size can cause several negative effects – an increase in the budget deficit; relocation of other important investments for the national economy and an increase in the tax burden, as a result of which consumption, savings and investments are reduced. Research studies support the generally accepted thesis that the effect of government healthcare expenditure on growth is stronger when it reduces and prevents diseases, reduces deaths, improves the quality of medical services and improves the prevention of life-threatening diseases. In conclusion, it is essential for growth to analyze not only the amount of government health expenditure, but also its efficiency. Therefore, government healthcare expenditure stimulates economic growth when it is effective and aimed at improving the health status of the population. This effect is indirect, but with a strong impact. Assessing efficiency is a key tool for policies, reforms, and budget planning. In addition, assessing the efficiency of government healthcare expenditure shows the relationship between how much is spent and

what results are achieved. A positive result can take the form of the following characteristics: achieving lower mortality and lower morbidity; ensuring better access to health services and longer life expectancy; improving the quality of health services; reducing losses and eliminating inefficient health policies; conducting a comparative analysis of different health systems and/or financing methods internationally; identifying underfunded areas such as emergency care, prevention and hospital care. Therefore, in a large part of the available publications on the analyzed issues, in addition to measuring and assessing the efficiency of government healthcare expenditure, special emphasis is placed on the factors influencing its quantitative aspects. In this context is the article by R. Ravangard, N. Hatam, A. Teimourizad and A. Jafari (2014), in which the authors assess the technical efficiency of health systems in the countries of the Organization for Economic Cooperation through the application of the DEA approach, as well as examine the factors affecting their efficiency through panel analysis (Ravangard et al, 2014, pp. 63-69). Regarding the assessment of the technical efficiency of government healthcare expenditure, the authors construct two models. The first is used the input variables: “GDP per capita”, educational level” and “smoking” and the output variables – “life expectancy” and “child mortality” (Ravangard et al, 2014, p. 63). The second DEA model includes as input variables “healthcare expenditure per capita”, “number of doctors per thousand people” and “number of hospital beds per thousand people” and as output variables – “life expectancy” and “under 5 years mortality” (Ravangard et al, 2014, p. 63). Regarding the panel analysis, the authors prove that “GDP per capita” and “healthcare expenditure per capita” are the factors that influence the assessment of the technical efficiency of healthcare expenditure in the analyzed countries. In addition, Turkey has the highest average assessment of the technical efficiency of the health system, in contrast to Turkmenistan, which is characterized by the lowest average values (Ravangard et al, 2014, p. 63). The use of the DEA approach and panel analysis for a more detailed study of the efficiency of the health sector is used as a methodology in the publication by K. Miszczyńska and P. M. Miszczyński (2022) (Miszczyńska and Miszczyński, 2022, pp. 2743-2770). The results achieved show that there are differences in the efficiency of the healthcare sector between regions in Poland and that the efficiency of the Polish healthcare system depends on a number of factors, among which the most influential are: “accreditation certificates received”; “length of the waiting list of patients” and “number of medical staff” (Miszczyńska and Miszczyński, 2022, p. 2751). In addition, the efficiency of the health system largely depends on the amount of funding and the way it is financed. Therefore, in most publications, the research interest is focused on assessing the efficiency of expenditure (public, private or mixed), but in order to analyze the functioning of the health sector in more detail, a number of authors

also emphasize panel analysis, which reveals the influence of a number of factors on the quantitative value of the efficiency of the health system. These factors are different for individual countries, regions and units, and at the same time are characterized by a different degree of impact. The latter is related to the need to compare individual countries in order to identify good practices. Comparing and ranking the quantitative assessment of the efficiency of the health system allows optimizing the way of distribution of public financial resources, as well as to increase accountability and transparency in order to create an additional incentive for improvements in public health policies. The above determines the usefulness of the present study, the main purpose of which is to assess the efficiency of expenditure of sector “General Government” for the function “Healthcare” in European Union (EU) member states. To achieve this goal, the non-parametric method of Data Envelopment Analysis (DEA) input-oriented under variable returns to scale.

### **Data and Methodology**

Data envelopment analysis (DEA) allows an estimation of the relative efficiency of the decision-making units (DMUs) under study. In this regard, based on data on the inputs and the results achieved by the DMUs an efficiency frontier is constructed. It shows that no additional output can be produced by using additional inputs. The efficiency frontier is determined by efficiently functioning DMUs, which receive a score of 1, while inefficient ones receive a score of less than 1 (Šporčić and Landekić, 2014; Stefanova and Velichkov, 2019, pp. 490-497; Krištáková et al, 2021).

There are two main DEA models – the CCR model, created by A. Charnes, W. Cooper and W. Rhodes (1978), which is grounded on the assumption of constant returns to scale (CRS) and the BCC model, developed by R. D. Banker, A. Charnes and W. Cooper, 1984), which is grounded on the assumption of variable returns to scale (VRS). (Banker, Charnes and Cooper, 1984, pp. 1078-1092; Charnes, Cooper and Rhodes, 1978, pp. 429-444). The models can be input-oriented or output-oriented. The goal of the input-oriented model is to minimize input resources while preserving output results, while the goal of the latter is to maximize output results without changing input resources (Ramanathan, 2003; Huguenin, 2012, p. 79). In present paper an input-oriented model under VRS is preferred. The reasons for this are as follows: first, the health system has the ability to control input resources, but does not have the ability to influence the demand for health services as the output; second, public institutions and in particular the health systems of the analyzed EU member states rarely operate at optimal scale, which makes the VRS model suitable. It should be noted that the DEA, BCC model measures the so-called pure technical efficiency, which is a consequence

of management skills and the technology used, and does not depend on the scale of the respective DMU. In other words, DEA under VRS measures pure technical efficiency by evaluating how well a DMU transforms inputs into outputs relative to best-practice DMUs of a similar scale. The formalized expression of the DEA input-oriented BCC model is derived on the basis of a model with CRS. For this reason, the analytical expressions of the models under CRS and VRS are presented below. Before that should be underlined that DEA under CRS measures overall technical efficiency, capturing both managerial performance and technology, as well as scale efficiency under the assumption of constant returns to scale. The last means that each DMU is compared to all others, regardless of the size. Under CRS, the two-stage input-oriented DEA process is presented by formula (1) (Zhu, 2014, p. 411; Zhu, 2009, p. 323; Cooper, Seiford and Zhu, 2011, p. 497; Huguenin, 2012, p. 79; Ramanathan, 2003):

$$\begin{aligned}
 & \min \theta - \varepsilon \sum_{i=1}^m s_i^- - \varepsilon \sum_r s_r^+ \\
 \text{Subject to} & \\
 & \sum_{j=1}^n \lambda_j x_{ij} + s_i^- = \theta x_{i0} \quad i = 1, 2, \dots, m \\
 & \sum_{j=1}^n \lambda_j y_{rj} - s_r^+ = y_{r0} \quad r = 1, 2, \dots, s \\
 & \lambda_j \geq 0 \quad j = 1, 2, \dots, n \\
 & s_r^+ \geq 0 \quad r = 1, 2, \dots, s \\
 & s_i^- \geq 0 \quad i = 1, 2, \dots, m
 \end{aligned} \tag{1}$$

where  $\theta$  is the efficiency of  $DMU_0$  (one of the DMUs under assessment, in this case the healthcare system of a certain EU member state). When  $\theta = 1$ ,  $DMU_0$  is efficiently functioning, and if  $\theta$  is less than 1,  $DMU_0$  is inefficiently functioning. It should be noted here that efficiently functioning DMUs, form the non-parametric efficiency frontier. They can be divided into weakly efficient and strongly efficient. In the former, similarly to the inefficiently functioning DMUs, the so-called input slacks (Ramanathan, 2003).

$n$  – the number of DMUs under assessment;

$x_{i0}$  – the  $i$ -th input resource of  $DMU_0$  and specifically the Expenditures of Sector “General Government” for the “Healthcare” function per capita;

$y_{r0}$  – the  $r$ -th output of  $DMU_0$ . The number of outputs is two – the life expectancy at birth and the mortality per 100 000 people due to noncommunicable diseases, infectious diseases and ill-defined diseases;

$\lambda_j$  – the weight of DMU<sub>j</sub>, with which it “participates” in the construction of the hypothetical reference unit for DMU<sub>0</sub>;

$\varepsilon$  – accepts values  $10^{-5}$  and  $10^{-6}$  and in the English literature it is known as the non-Archimedean constant. Including the constant in the model allows first to establish minimum values for  $\theta$  and after that to calculate optimal values for the input and output slacks (Zhu, 2014, p. 411; Zhu, 2009, p. 323; Cooper, Seiford and Zhu, 2011, p. 497; Huguenin, 2012, p. 79; Ramanathan, 2003).

If an additional constraint is added to the input-oriented model under CRS (formula (1)), and namely  $\lambda_j = 1$ , an input-oriented BCC model is obtained (Zhu, 2014, p. 411; Zhu, 2009, p. 323; Cooper, Seiford and Zhu, 2011, p. 497; Huguenin, 2012, p. 79; Neykov et al, 2019, pp. 228-235):

$$\begin{aligned}
 & \min \theta - \varepsilon \sum_{i=1}^m s_i^- - \varepsilon \sum_r^s s_r^+ \\
 \text{Subjects to} & \\
 & \sum_{j=1}^n \lambda_j x_{ij} + s_i^- = \theta x_{i0} \quad i = 1, 2, \dots, m \\
 & \sum_{j=1}^n \lambda_j y_{rj} - s_r^+ = y_{r0} \quad r = 1, 2, \dots, s \\
 & \sum \lambda_j = 1 \\
 & \lambda_j \geq 0 \quad j = 1, 2, \dots, n \\
 & s_r^+ \geq 0 \quad r = 1, 2, \dots, s \\
 & s_i^- \geq 0 \quad i = 1, 2, \dots, m
 \end{aligned} \tag{2}$$

Based on the established efficiency coefficients for CRS and VRS, the so-called scale efficiency (SE) is calculated using formula (3). It is normalized in the interval between 0 and 1. (Neykov et al, 2019, pp. 228-235). When the value of the indicator is equal to 1, it means that the respective DMU operates at constant returns to scale and is not characterized with scale inefficiency, i.e. the scale of the activity does not generate additional inefficiency. At the same time, when SE is less than 1, part of the technical inefficiency is a consequence of the fact that the respective DMU does not operate at optimal scale, i.e. at CRS.

$$\text{Scale efficiency} = \frac{\theta_{CRS}}{\theta_{VRS}} \tag{3}$$

## Results and Discussion

The efficiency of the expenditures of sector “General Government” for the “Healthcare” function per capita in relation to the health status of the population is assessed on the basis of an input-oriented BCC model. The indicators “life expectancy at birth” and “mortality per 100 000 people due to noncommunicable diseases, infectious diseases and ill-defined diseases”<sup>2</sup> in 2019 and 2022 are used as the outputs in the model. Since there is a time lag between the periods of expenditures of sector “General Government” for the “Healthcare” function per capita and the achieved results, in the model are used the accumulated for the periods 2015 – 2019 and 2018 – 2022, expenditures for the “Healthcare” function at constant prices (2010 = 100), divided respectively on the average number of the population for the periods 2015 – 2019 and 2018 – 2022. For the above mentioned variables data from Eurostat and the World Health Organization are used. The data are publicly available and comparable as of November 2025 for the following European Union member states: Austria, Belgium, Bulgaria, Croatia, Czech Republic, Estonia, Finland, France, Germany, Hungary, Ireland, Italy, Latvia, Lithuania, Poland, Portugal, Romania, Slovakia, Slovenia, Spain and Sweden.

Before presenting the results from the applied DEA, BCC input-oriented model, it should be underliend that since the outcome “Mortality per 100 000 people due to noncommunicable diseases, infectious diseases and ill-defined diseases” is undesirable it should be transformed into a positive one. For this purpose the approach proposed by L, Seiford and J, Zhu (2002) is applied, according to which the reciprocal value of the undesirable result should be used (Seiford and Zhu, 2002, pp. 16-20). In particular case:

$$\frac{1}{\text{Mortality per 100 000 people}}$$

In the values of the variables used in the substantiated DEA model, significant differences are observed (see data in Table 1, Table 2, Table 3 and Table 4) between the old EU member states and those from Central and Eastern Europe (CEE). To a large extent, they are a consequence of the size of investments, technologies applied in the health sector, etc. In this regard in order to achieve a more realistic measurement of efficiency it is appropriate to divide the above-mentioned 21 EU member states as of 2025 into two groups, and namely “old” member states

<sup>2</sup> Non-communicable diseases are long-lasting and cannot be spread directly from one person to another. The category of “ill-defined diseases” refers to clinical examination on the grounds of which there are not diagnosis. Deaths in this category are an indicator of the quality of the medical examination performed. Deaths caused by infectious diseases also include maternal and newborn deaths related to pregnancy and childbirth, as well as deaths due to inadequate nutritional intake (<https://platform.who.int/mortality/themes/theme-details/MDB/all-causes>).

and CEE countries. With regard to the latter, it is established that in 2019 and 2022 Bulgaria has the lowest expenditures of sector “General Government” for the “Healthcare” function per capita and the highest mortality rate per 100,000 people, respectively 1604.12 euros/capita and 1513 people, and 2143.98 euro/capita and 1801 people. For this reason, in order not to “distort” the efficiency frontier and to achieve correct results from the application of the DEA, BCC model, input-oriented the data for Bulgaria are excluded from the analysis.

**Table 1:** Means, standard deviations, minimum and maximum values of the variables for the so-called “old” EU member states in 2019

Indicators	Expenditures of Sector “General Government” for the “Healthcare” function per capita, euro/capita	Life expectancy at birth	Mortality per 100 000 people due to noncommunicable diseases, infectious diseases and ill-defined diseases
Mean	12313.34	80.12	901.58
Std. deviation	3527.73	1.01	137.50
Minimum	6016.59	78.70	607.40
Maximum	16998.36	81.50	1081.60

*Source:* Eurostat, World Health Organization and Own Calculations

**Table 2:** Means, standard deviations, minimum and maximum values of the variables for the so-called “old” EU member states in 2022

Indicators	Expenditures of Sector “General Government” for the “Healthcare” function per capita, euro/capita	Life expectancy at birth	Mortality per 100 000 people due to noncommunicable diseases, infectious diseases and ill-defined diseases
Mean	13680.10	79.75	976.62
Std. deviation	3941.94	1.06	153.94
Minimum	6764.40	78.30	664.50
Maximum	18252.10	81.40	1177.00

*Source:* Eurostat, World Health Organization and Own Calculations

**Table 3:** Means, standard deviations, minimum and maximum values of the variables for countries from CEE, members of EU in 2019

<b>Indicators</b>	<b>Expenditures of Sector “General Government” for the “Healthcare” function per capita, euro/capita</b>	<b>Life expectancy at birth</b>	<b>Mortality per 100 000 people due to noncommunicable diseases, infectious diseases and ill-defined diseases</b>
Mean	3995.45	73.87	1175.11
Std. deviation	1743.49	2.37	192.57
Minimum	1604.12	70.90	922.30
Maximum	6940.15	78.70	1512.90

*Source:* Eurostat, World Health Organization and Own Calculations

**Table 4:** Means, standard deviations, minimum and maximum values of the variables for countries from CEE, members of EU in 2022

<b>Indicators</b>	<b>Expenditures of Sector “General Government” for the “Healthcare” function per capita, euro/capita</b>	<b>Life expectancy at birth</b>	<b>Mortality per 100 000 people due to noncommunicable diseases, infectious diseases and ill-defined diseases</b>
Mean	4772.59	73.66	1326.93
Std. deviation	2115.08	3.25	251.43
Minimum	2143.98	69.40	984.40
Maximum	8393.02	79.70	1800.80

*Source:* Eurostat, World Health Organization and Own Calculations

Before beginning with the assessment of the efficiency of the healthcare expenditures of the so-called “old” EU member states and CEE countries, it should be noted that the basic rule for the application of DEA, related to the number of available DMUs, is fulfilled for both groups of countries. The rule states that the number of DMUs assessed (in this case EU member states) should be greater than or equal to the sum of the input resources and the achieved results multiplied by three (Huguenin, 2012, p. 79). The scores of efficiency of Expenditures of Sector “General Government” for the “Healthcare” function per capita for the “old” EU member states and CEE countries, members of EU are presented in Tables 5-8. In bracket is pointed out the ranking of the certain DMU according to its efficiency under VRS, input-oriented model.

From the data in table 5 can be concluded that the efficiently functioning “old” European member states in 2019 are Ireland, Spain, Italy, Portugal and Sweden. These countries form the best-practice frontier under VRS. At the same time the inefficient countries are Austria, Belgium, Germany, Finland, and France. In 2019 they are able to maintain the same life expectancy and mortality rate and at the same time are able to reduce the expenditures on healthcare per capita respectively with 56.5%, 44.58%, 52.62%, 47.26% and 43.50%. The input slacks indicate that several countries could reduce healthcare expenditure per capita without lowering their healthcare outcomes, even after accounting for proportional input reductions. For example, Ireland and Sweden, despite being radially efficient ( $\theta_{vrs} = 1$ ), have substantial input slacks, suggesting potential for cost savings. Output slacks are negligible across countries, showing that inefficiencies are primarily due to excess inputs rather than deficits in the outcomes. It should be mentioned that nine from the tenth countries show efficiency at constant return of scale below the efficiency at variable return of scale, which indicates scale inefficiency and decreasing returns to scale (drs), except Portugal, whose healthcare system operates at optimal scale (Scale Efficiency = 1), achieving maximum output for its level of health expenditure. In relation with the last one should be pointed out that the healthcare systems of Austria, Belgium, Germany, Ireland, Italy, Finland, France, Spain and Sweden generate inefficiency due to excessive scale. To improve to some extent the efficiency of healthcare system they should reduce their scale.

The results presented in Table 6 indicate that the healthcare systems of Ireland, Spain, Italy, Portugal, and Sweden achieve a technical efficiency in 2022. On the contrary the healthcare system of Austria, Belgium, Germany, Finland, and France exhibit technical inefficiency under VRS with efficiency scores below 1. This suggests that these countries could proportionally reduce healthcare expenditure per capita while maintaining the same health outcomes. Specifically, the results imply potential proportional reductions of approximately

54.5% for Austria, 35.97% for Belgium, 52.05% for Germany, 47.22% for Finland, and 42.87% for France. Furthermore the examination of input slacks reveals additional inefficiencies beyond the radial reductions. The healthcare systems of seven countries display excess in healthcare expenditure per capita even after proportional input contraction, and namely: Austria (261.15 euro/capita), Belgium (320.18 euro/capita), Finland (124.91 euro/capita), France (293.89 euro/capita), Germany (128.33 euro/capita) and Ireland (1269.67 euro/capita). Here should be mentioned that the healthcare system of Ireland, despite being efficient under VRS, shows considerable input slack. At the same time a comparison of the efficiency scores under CRS and VRS shows that nearly for all countries  $\theta_{CRS}$  is lower than  $\theta_{VRS}$ , which means the presence of scale inefficiency. Once again, Portugal stands out as the only country operating under constant returns to scale, i.e. its healthcare system is functioning at an optimal scale. By the way the healthcare systems of Austria, Belgium, Ireland, Spain, Italy, France, and Sweden exhibit decreasing returns to scale (drs), implying that their inefficiency is partly attributable to excessive scale of operation and that efficiency gains could be achieved through a reduction in scale. On the contrary the healthcare systems of Germany and Finland display increasing returns to scale (irs), which suggest that their healthcare systems operate below the optimal scale.

The results for efficiency of state expenditures on healthcare of the countries from CEE members of EU-27 are presented in table 7. The state expenditures on healthcare for Poland, Romania, and Slovenia achieve a technical efficiency and therefore construct the efficiency frontier for CEE countries in 2019. The state expenditures on healthcare of the remaining countries – Croatia, the Czech Republic, Estonia, Hungary, Latvia, Lithuania and Slovakia generate technical inefficiency, with efficiency scores below 1. This implies that these healthcare systems could proportionally reduce their state healthcare expenditure per capita while at the same time maintaining the present health outcomes. For instance the results suggest potential proportional reductions of nearly 7.91% for Croatia, 26.62% for the Czech Republic, 17.68% for Estonia, 7.41% for Hungary, 12.22% for Latvia, 35.64% for Lithuania and 26.63% for Slovakia. By the way the analysis of input slacks reveals that several countries could further reduce state healthcare expenditure per capita even after the proportional reductions determined through DEA input-oriented model under VRS. Here should be pointed out that the healthcare system of Poland and Slovenia, despite being radially efficient, display input slacks respectively of 103.51 euro/capita and 136.18 euro/capita, revealing additional potential for cost savings without diminishing the outcomes. At the same time the comparison between the efficiency scores of the state expenditures on

healthcare under CRS and VRS shows that CEE countries in 2019 have lower efficiency scores under CRS. This finding points out to the widespread presence of scale inefficiency among CEE healthcare systems. The healthcare system of Romania is the exclusion from this statement as it is the only one functioning at an optimal scale in 2019. In this connection should underlined that the healthcare system of Croatia, Czech Republic, Estonia, Hungary, Poland, Slovakia and Slovenia exhibit decreasing return to scale (drs), indicating that their health systems operate at a large scale relative to outcomes and that efficiency gains could be achieved through a reduction in scale. On the contrary the healthcare systems of Lithuania and Latvia display increasing returns to scale (irs), which suggests that their healthcare systems operate below the optimal scale and could improve their efficiency by expanding the scale of the healthcare system in the long term.

In 2022 the scores of the efficiency of state healthcare expenditures of the countries from CEE, member of EU are presented in table 8. Considering the state expenditures on helthcare should be pointed out that the healthcare systems of Croatia, Poland, Romania and Slovenia achieve technical efficiency and due to this form the efficiency frontier. The remaining countries – Estonia (0.802), Latvia (0.670), Lithuania (0.623), Slovakia (0.730), Hungary (0.958), and the Czech Republic (0.740) are technically inefficient, indicating that their healthcare systems could proportionally reduce the expenditures per capita while maintaining the current outcomes. Input slacks analysis indicates that even radially efficient healthcare systems like the Polish (133.25 euro/capita) and the Slovenian (607.02 euro/capita) have additional potential for cost savings without compromising the outcomes. The healthcare systems of most of the countries, including Croatia, Czech Republic, Estonia, Hungary, Lithuania, Poland, Slovenia reveal decreasing returns to scale (drs), which suggest that their healthcare systems operate above the optimal scale and could improve their efficiency by reducing their size. At the same time the healthcare system of Latvia shows increasing returns to scale (irs), which means that the efficiency could be improved by increasing the size of the healthcare system. Considering the healthcare system of Romania should be pointed out that in 2022 it operates again at an optimal scale.

**Table 5:** Efficiency of expenditures of the sector “General Government” for the “Healthcare” function per capita in the so-called “old” EU member states in 2019

Countries	$\theta_{TGS}$	Input slacks ( $s_{\bar{I}}$ ) in relation to expenditures of the sector “General Government” for the “Healthcare” function per capita, euro/capita	Output slacks ( $s_{\bar{I}}$ ) in relation to life expectancy at birth, years	Output slacks ( $s_{\bar{I}}$ ) in relation to Mortality per 100 000 people due to noncommunicable diseases, infectious diseases and ill-defined diseases (1/Mortality per 100 000)	$\theta_{CRS}$	Scale Efficiency	Return to Scale
Austria (10)	0.435052	133.48	0	0	0.418155	0.961161	drs
Belgium (7)	0.551698	119.46	0	0	0.530258	0.961138	drs
Finland (8)	0.527419	117.77	0	0	0.511550	0.969912	drs
France (6)	0.564937	165.04	0	0	0.539262	0.954553	drs
Germany (9)	0.473775	0.000018	0	0.000559	0.459294	0.969436	drs
Ireland (4)	1.000000	1307.99	0	0	0.739285	0.739285	drs
Italy (1)	1.000000	0	0	0	0.681791	0.681791	drs
Portugal (1)	1.000000	0	0	0	1.000000	1.000000	crs
Spain (1)	1.000000	0	0	0	0.953959	0.953959	drs
Sweden (5)	1.000000	1316.22	0	0	0.487296	0.487296	drs

Source: Own Calculations

**Table 6:** Efficiency of expenditures of the sector “General Government” for the “Healthcare” function per capita in the so-called “old” EU member states in 2022

Countries	$\theta_{HS}$	Input slacks ( $\bar{s}_I$ ) in relation to expenditures of the sector “General Government” for the “Healthcare” function per capita, euro/capita	Output slacks ( $\bar{s}_T$ ) in relation to life expectancy at birth, years	Output slacks ( $\bar{s}_T^+$ ) in relation to Mortality per 100 000 people due to noncommunicable diseases, infectious diseases and ill-defined diseases (1/Mortality per 100 000)	$\theta_{CRS}$	Scale Efficiency	Return to Scale
Austria (10)	0,454980	261.15	0	0	0.449091	0.987057	drs
Belgium (6)	0.640277	320.18	0	0	0.602545	0.941070	drs
Finland (8)	0.527794	124.91	0.200005	0	0.524680	0.994101	irs
Ftance (7)	0,571307	293.89	0	0	0.560070	0.980331	drs
Germany (9)	0.479531	128.33	0.599998	0	0.476631	0,993953	irs
Ireland (5)	1.000000	1269.67	0	0	0.666192	0.666192	drs
Italy (1)	1.000000	0	0	0	0.704041	0.704041	drs
Portugal (1)	1.000000	0	0	0	1.0000000	1.000000	crs
Spain (1)	1.000000	0	0	0	0.984861	0.984861	drs
Sweden (1)	1.0000000	0	0	0	0.574320	0.574320	drs

Source: Own Calculations

**Table 7:** Efficiency of expenditures of the sector “General Government” for the “Healthcare” function per capita in countries from CEE members of the EU in 2019

Countries	$\theta_{VRS}$	Input slacks ( $s_i^-$ ) in relation to expenditures of the sector “General Government” for the “Healthcare” function per capita, euro/capita	Output slacks ( $s_r^+$ ) in relation to life expectancy at birth, years	Output slacks ( $s_r^+$ ) in relation to Mortality per 100 000 people due to noncommunicable diseases, infectious diseases and ill-defined diseases (1/Mortality per 100 000)	$\theta_{CRS}$	Scale Efficiency	Return to Scale
Estonia (7)	0.823133	65.5164	0	0	0.630935	0.766505	drs
Croatia (8)	0.920826	9.45105	0	0	0.522784	0.567734	drs
Czech Republic(10)	0.733770	104.401	0	0	0.429796	0.585736	drs
Hungary (4)	0.925918	0	0	0	0.773772	0.835681	drs
Latvia (3)	0.877824	0.0000149	0	0.000329	0.865615	0.986092	irs
Lithuania (6)	0.643646	1.85746	0	0	0.643546	0.999845	irs
Poland (2)	1.000000	103.517	0	0	0.897923	0.897923	drs
Romania (1)	1.000000	0	0	0	1.000000	1.000000	crs
Slovakia (5)	0.733658	169.898	0	0	0.700627	0.954979	drs
Slovenia (9)	1.000000	136.795	0	0	0.463154	0.463154	drs

Source: Own Calculations

**Table 8:** Efficiency of expenditures of the sector “General Government” for the “Healthcare” function per capita in countries from CEE members of the EU in 2022

Countries	$\theta_{VRS}$	Input slacks ( $s_{\bar{I}}$ ) in relation to expenditures of the sector “General Government” for the “Healthcare” function per capita, euro/capita	Output slacks ( $s_{\bar{T}}$ ) in relation to life expectancy at birth, years	Output slacks ( $s_{\bar{T}}^+$ ) in relation to Mortality per 100 000 people due to noncommunicable diseases, infectious diseases and ill-defined diseases (1/Mortality per 100 000)	$\theta_{CRS}$	Scale Efficiency	Return to Scale
Estonia (6)	0.802391	90.8715	0	0	0.579959	0.722788	drs
Croatia (1)	1.000000	0	0	0	0.480499	0.480499	drs
Czech Republic (7)	0.739864	371.257	0	0	0.382639	0.517174	drs
Hungary (5)	0.958174	20.3269	0	0	0.782827	0.816999	drs
Latvia (9)	0.669791	1.6500	1.9	0.00073	0.651942	0.973352	irs
Lithuania (10)	0.623178	0.000124	0	0.0000261	0.614352	0.985836	drs
Poland (3)	1.000000	133.248	0	0	0.742605	0.742605	drs
Romania (1)	1.000000	0	0	0	1.000000	1.000000	drs
Slovakia (8)	0.729532	151.469	0	0	0.577762	0.791963	crs
Slovenia (4)	1.000000	607.016	0	0	0.417126	0.417126	drs

Source: Own Calculations

## Conclusion

On the grounds of the estimation of the efficiency of expenditures of the sector “General Government” for the “Healthcare” function per capita by means of non-parametric DEA, input oriented the following conclusions can be drawn up:

- In 2019 and 2022 it is established that among the analyzed “old” EU member states technically efficient are the healthcare systems of Ireland, Italy, Portugal, Spain and Sweden. In both years the healthcare systems of the five countries form the efficiency frontier. On the contrary the healthcare systems of Austria, Belgium, Finland, France and Germany are technically inefficient, which indicates potential for proportional reductions in healthcare expenditure per capita.
- In 2019 and 2022 it is established that among the analyzed countries from CEE members of the EU technically efficient are the healthcare systems of Croatia, Poland, Romania and Slovenia while the healthcare systems of Czech Republic, Estonia, Hungary, Latvia, Lithuania and Slovakia are inefficient.
- Several countries, including the efficient ones like Ireland, Sweden, Poland, and Slovenia, display substantial input slacks, which indicates further opportunities for cost savings without affecting healthcare outcomes. This suggests that radial efficiency alone does not capture all potential improvements in resource allocation.
- In 2019 the most healthcare systems of the “old” EU member states operate at decreasing returns to scale, reflecting excessive scale in comparison to the outcomes. The healthcare system of Portugal is an exception and it is functioning at optimal scale in 2019 and 2022. At the same time in 2022 differently from the other healthcare system which are functioning at decreasing return of scale the healthcare systems of Germany and Finland are functioning at increasing returns to scale. This means that there are potential efficiency gains from expanding healthcare systems of both countries.
- In 2019 and 2022 the most of the healthcare systems of CEE countries, members of EU operate at decreasing returns to scale, which suggest that efficiency could be improved by reducing their system size. In 2019 the exceptions from the above conclusion are the healthcare systems of Latvia and Lithuania, which are functioning at increasing returns to scale, and Romanian, which operates at constant return to scale. In 2022 only the healthcare system of Latvia is operating at increasing return to scale while the healthcare system of Romania is still functioning at optimal scale.

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