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Public Sector Efficiency and the Functions of the Government*

António Afonso[1] José Alves[2] Najat Bazah[3]

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Abstract

We examine the relationship between public sector efficiency and government spending, to assess public resource management across the 27 European Union countries. Specifically, we analyze the growth of public expenditure in relation to outcomes across various public sector performance (PSP) indicators. We compute government spending efficiency using Data Envelopment Analysis (DEA) to subsequently assess the relationship between efficiency and the growth rate of public expenditure. Our findings suggest that higher efficiency can be achieved without proportionally increasing public spending, both in total expenditure and in specific areas such as social protection, economic affairs, education, healthcare, and public services. Indeed, with overall output efficiency scores between 0.77 and 0.87, with the same level of inputs, output could increase around 13%-23%. Additionally, public spending tends to rise during recessions, while it decreases with higher levels of human capital and redistribution indicators. Finally, more efficient countries tend to coalesce around Austria, Croatia, Denmark, France, Greece, Hungary, Poland, and Sweden.

JEL: C33, C61, E62, H11, H50, O47, P43
Keywords: Public Sector Performance Indicators; Efficiency; Public expenditure; Functions of the Government; Data Envelopment Analysis

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1. Introduction

The analysis of the effects of efficiency on public expenditure is a crucial issue in the management of State resources and in economic policy decision-making. This study explores the relationship between efficiency and public spending to improve the management of public resources. The main objective is to determine if the economies considered operate efficiently by comparing the growth of public expenditure (an input) with their performance in public sector performance (PSP) indicators (outputs). In this way, the public sector is considered efficient if it achieves greater growth in these indicators without significantly increasing public expenditure, in contrast to Wagner's Law, which suggests that a country's economic development drives societal pressure for increased public spending.

For this analysis, PSP indicators of opportunity were constructed in the areas of administration, education, health, and infrastructure, alongside "Musgravian" indicators reflecting distribution, stabilization, and economic performance. From the opportunity and "Musgravian" indicators, a global PSP indicator was developed. In parallel, public expenditure growth rates were calculated according to the Classification of the Functions of the Government (COFOG).

With both indicators in hand, Data Envelopment Analysis (DEA) models were calculated, where the variable of interest is public sector efficiency, measured through PSP indicators, using the growth rate of public expenditure as the input variable. For instance, with output efficiency scores between 0.77 and 0.87, with the same level of inputs, outputs could increase between 13% and 23%. After obtaining the DEA model coefficients, from both input- and output-oriented perspectives, the relationship between the growth of these indicators and public expenditure growth was evaluated.

From the input-oriented perspective, a significant and negative relationship was found between the growth of the efficiency coefficients and the total growth rate of public expenditure, suggesting that greater public sector efficiency can be achieved with lower levels of expenditure growth. Control variables revealed a positive relationship between the economic cycle and the growth rate of public expenditure, as public spending tends to increase during recessions in line with counter-cyclical fiscal policies. A negative relationship was also found between levels of human capital and the growth rate of public expenditure, translating into greater efficiency in the use of public resources. The negative and significant relationship between the S80/S20 income ratio and public expenditure growth suggests that higher income inequality may be associated with higher spending growth.

When categories of public expenditure are considered, significant and negative relationships were also observed between the growth of the efficiency coefficients and expenditure growth in areas such as social protection, education, healthcare, economic affairs, and public service provision. In these categories, greater efficiency is associated with lower expenditure growth, particularly with higher levels of human capital. In healthcare, a positive relationship was also found between the economic cycle and the growth rate of expenditure, indicating that spending increases during recessions.

From the output-oriented perspective, the results are consistent, showing negative relationships between the growth of the efficiency coefficients and public expenditure growth. The inclusion of control variables reaffirmed the positive relationship with the economic cycle and the negative relationship with human capital levels. Additionally, the youth dependency ratio variable showed a negative relationship with spending growth, suggesting that an increase in this ratio reduces pressure on public spending, particularly in areas such as pensions and elderly care.

As in the input-oriented analysis, other spending areas were included, such as social protection, education, healthcare, economic affairs, and public services. In these areas, a negative relationship was found between human capital levels and the growth rate of public expenditure. Likewise, a negative rate was observed between the youth dependency ratio and the variation in public expenditure in social protection and economic affairs.

In summary, these findings suggest that under certain conditions, economic growth does not necessarily imply a proportional increase in public spending, potentially contradicting the predictions of Wagner's Law, particularly in total public spending and in sectors such as social protection, education, healthcare, economic affairs, and public services. Finally, more efficient countries tend to coalesce notably around Austria, Croatia, Denmark, France, Greece, Hungary, Poland, and Sweden.

The paper is organized as follows. Section 2 is a literature review; section 3 provides several stylized facts; section 4 presents the methodology and data used; section 5 reports and discusses the results of our empirical analysis; and section 6 is the conclusion.

2. Literature Review

2.1. Size of the government

The different perspectives on the government's impact on macroeconomic dynamics have led to an analysis of government spending effects on economic activity. In 1883, Wagner

highlighted patterns in the relationship between increasing public expenditures and economic growth, which he termed the 'Law of Expanding State Activity'.

In this context, there are different approaches to examining the size of the government. First, it involves analyzing whether this law holds true, meaning there is a unidirectional causality from economic growth to public expenditure. Conversely, if Wagner's Law does not hold, it could be examined whether there is a unidirectional causality from public expenditure to economic growth, as suggested by the Keynesian hypothesis. Finally, some studies consider the validity of both Wagner's Law and the Keynesian hypothesis simultaneously. The results indicate that the applicability of Wagner's Law varies across regions and time periods.

Regarding studies on Wagner's Law, some do not support the law or find limited evidence for it (Peacock and Scott, 2000; Chang et al., 2004; Rauf et al., 2012; Muhammad et al., 2015). This is the case when analysing certain regions of Africa, such as Nigeria during the period from 1970 to 2006 (Babatunde, 2011), where a unidirectional relationship between public spending and economic growth is observed (Keynesian hypothesis). Loizides and Vamvoukas (2005) do not find a unidirectional relationship between economic growth and public spending for the United Kingdom and Ireland.

Additionally, some studies find Wagner's Law applicable only to certain public spending functions and specific periods. For example, in the United States, Bairam (1995) found that only non-defense government spending supported the validity of Wagner's Law. Kolluri and Wahab (2007) found no evidence of Wagner's Law for European Union countries. Conversely, Loizides and Vamvoukas (2005) found that Wagner's hypothesis held for Greece in the short term.

Thirdly, certain studies affirm the existence of Wagner's Law for specific public spending functions, regions, and periods (Ziramba, 2008; Samudram et al., 2009; Katrakilidis y Tsaliki, 2009). For instance, focusing on Africa, Ansari et al. (1997) provide evidence supporting Wagner's Law in Ghana, Kenya, and South Africa. In Mexico, Montiel (2010) found evidence of Wagner's Law.

Regarding studies that affirm Wagner's Law for particular spending functions, Afzal and Abbas (2010) found evidence in Pakistan for total public spending, defense spending, interest payments, and fiscal deficits. Additionally, Chang et al. (2004) found support for Wagner's Law in Japan, the United States, the United Kingdom, South Korea, and Taiwan during the period from 1951 to 1996. Similar findings were observed in Italy (Magazzino, 2012; Barra et al., 2015; Fedeli, 2015).

For instance, Afonso and Alves (2017) demonstrate that Wagner's Law holds true for some economies, such as the Netherlands, where environmental protection expenditures grow more than proportionally with economic growth. For France, they find that housing and community services spending aligns with Wagner's Law. Additionally, Greece is unique in showing that two categories of public spending grow faster than the economic growth rate. Conversely, a European Union study (Afxentiou, 1996) concludes that Wagner's Law does not hold for government consumption, transfers, subsidies, or their aggregate.

A study of 61 advanced and emerging economies between 1995 and 2015 indicates that Wagner's Law is more prevalent in advanced economies and when these economies are growing above their potential. However, this result varies depending on the category of public spending analyzed and its functional form. Several spending categories exhibit counter cyclicality, making Wagner's Law more the exception than the rule (Jalles, 2019).

On the other hand, other studies find a lasting relationship between economic activity and public spending (Akitoby et al., 2006; Lamartina, 2010), with a positive correlation between public spending and GDP per capita, which is consistent with Wagner's Law. Moreover, these authors find a stronger positive correlation for economies with lower GDP per capita, suggesting that the catching-up period is characterized by more robust development in government activities compared to more advanced economies. In line with this, Kuckuck (2014) shows that the relationship between public spending and economic growth has weakened in more developed economies, such as the United Kingdom, Denmark, Sweden, Finland, and Italy.

Furthermore, Akitoby et al. (2006) indicate that previous studies have found weak support for Wagner's Law in developing economies, while the relationship is stronger for industrialized countries.

Ultimately, the results regarding the validity of Wagner's Law depend on the economies considered, the public spending functions analyzed, and the fiscal policy preferences established by the governments.

2.2. Public sector efficiency

The efficiency of the public sector has garnered increasing attention in literature (Afonso et al., 2005; Tanzi and Schuknecht, 1997; Tanzi and Schuknecht, 2000). Numerous studies have examined the extent of public sector efficiency across various regions and timeframes, employing methods such as Data Envelopment Analysis (DEA) and semiparametric approaches (Simar and Wilson, 2007). While many of these studies concentrate on OECD and European

economies (Afonso et al., 2010; Adam et al., 2011; Dutu and Sicari, 2016; Afonso and Kazemi, 2017; D'Inverno et al. 2018; Antonelli and De Bonis, 2019; Afonso et al., 2021), others delve into the efficiency of public spending in African countries (Gupta and Verhoeven, 2001; Wandeda et al., 2021), segments of Latin America (Afonso et al., 2013), and certain areas of West Asia (Ouertani et al., 2018). To scrutinize differences in efficiency, potential factors such as population size, education level, income level, institutional quality, the quality level of the country's governance, political orientation, and voter participation have been considered (Afonso et al., 2005; Afonso and St. Aubyn, 2006; Hauner and Kyobe, 2008; Herrera and Ouedraogo, 2018).

Moreover, certain studies analyze the relationship between public sector efficiency and government size, suggesting methods to enhance public sector efficiency by reducing the inputs used by governments to achieve the same level of output (Afonso et al., 2020; Dutu and Sicari, 2020; Schuknecht, 2020; Afonso and Alves, 2023a; Afonso and Alves, 2023b). To do so, these studies have estimated a non-parametric production frontier and derived efficiency scores based on the relative distances of inefficient observations from the production frontier.

At the same time, some studies analyze the relevance of taxation for public spending efficiency, showing that expenditure efficiency is negatively associated with taxation for OECD case, as it negatively affects consumption and investment decisions (Auerbach and Hasset, 1992; Afonso and Gaspar, 2007; Adema et al., 2014; Johansson, 2016; Drucker et al., 2017; Afonso et al., 2021).

Thus, there are regional differences in public spending efficiency among countries, indicating potential savings in expenditure. This suggests that public spending efficiency could be improved, meaning more public services could be provided using the current level of public resources, or the same level of public services could be delivered with fewer resources. At the same time, differences between countries have been explained by factors such as population size, education level, income level, quality of institutions, quality of governance, size of government, political orientation of governments, voter turnout rate, and civil service competence (Afonso et al., 2005; Antonelli and De Bonis, 2019).

3. Stylized facts

Figure 1 illustrates the evolution of GDP, changes at market prices, in millions of euros, total expenditures in percentage of GDP, and the growth rates of the total expenditures, from 1995 to 2021 for the 27 economies of the European Union.

Initially, GDP changes show a seasonal pattern until the economic and financial crisis of 2008, triggered by the bursting of the U.S. housing bubble and the collapse of Lehman Brothers, known as the subprime mortgage crisis. This crisis, among other consequences, halted economic growth, causing a significant drop in GDP to its lowest levels within the analyzed period. In the following years, GDP recovered to pre-crisis levels. However, it fell again due to the impact of the health crisis at the end of 2019, followed by another recovery.

The 2008 financial crisis had a significant impact on economies worldwide, and one key indicator to understand this impact is the relationship between public spending and Gross Domestic Product (GDP). We will break down the behaviour of these indicators during and after the crisis.

During the 2008 financial crisis, many governments increased public spending to mitigate the recession's effects and stimulate the economy. This increase in public spending was driven by several factors. Firstly, the bailout of financial institutions, with numerous governments implementing rescue packages for banks and other troubled financial institutions, such as the Troubled Asset Relief Program (TARP) in the U.S. and similar measures in Europe, like Germany's SoFFin program (Special Financial Market Stabilization Fund), which allowed the purchase of toxic assets and capital injections into troubled banks. Secondly, economic stimuli were included, with fiscal stimulus programs aimed at boosting aggregate demand. Additionally, there was an increase in social programs such as unemployment insurance, food aid, and social assistance to help people affected by the economic crisis.

The GDP of many countries experienced significant contraction during the crisis. Characteristics of this impact on GDP included economic contraction, slow recovery due to economic uncertainty, slow labor market recovery, and ongoing fragility of the financial system.

In summary, the growth rate of public spending concerning GDP during and after the 2008 crisis was high due to the expansionary policies adopted to mitigate the recession.

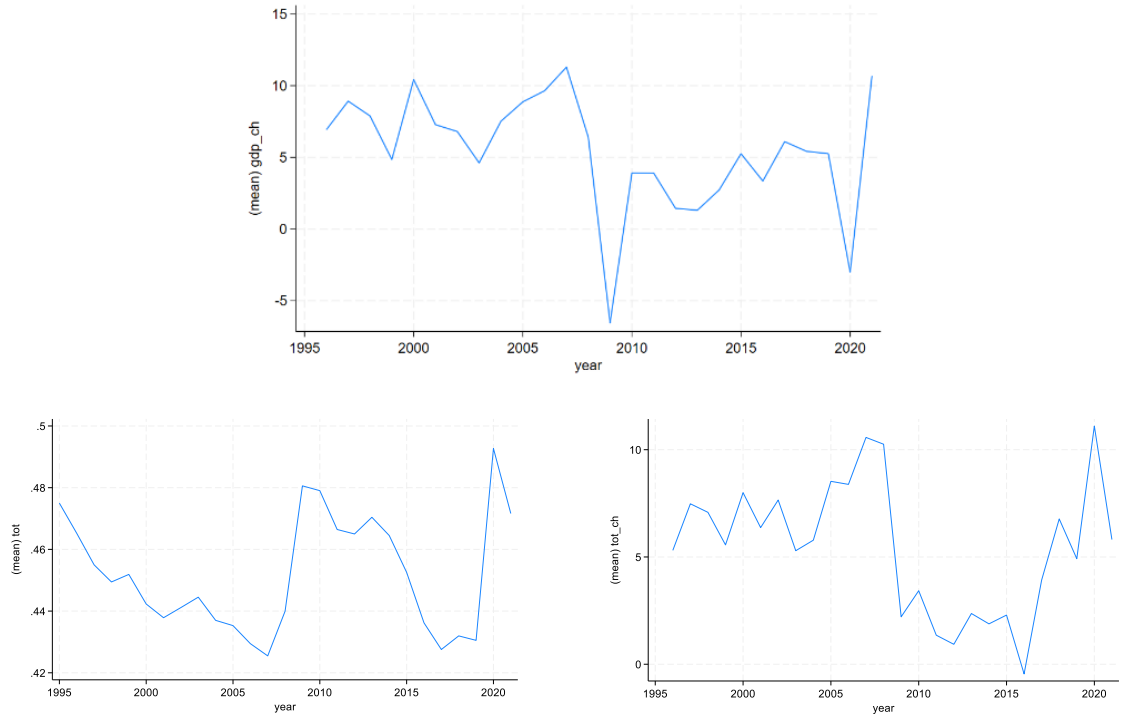
Similarly, the COVID-19 pandemic had a significant impact on global economies, and governments' fiscal responses reflected attempts to mitigate these adverse effects. Governments worldwide significantly increased public spending during the COVID-19 pandemic to address the health and economic crisis. Key areas of increased spending included healthcare expenses, with increased funding for health systems to treat COVID-19 patients, purchase medical equipment, vaccines, and build healthcare infrastructure. Secondly, subsidies and transfers, with direct aid programs to citizens affected by the pandemic, such as direct cash transfers, wage subsidies, and expanded unemployment benefits.

During the pandemic, the public expenditure (in % of the GDP) underwent several notable changes. During the acute phase of the pandemic in 2020, the public spending was high (50%) due to increased public spending by governments to address the health and economic crisis, while GDP contracted significantly. Subsequently, as economies began to recover, GDP started to grow again. In some cases, governments maintained high levels of public spending to ensure sustained recovery, while others began to reduce spending to control deficits and public debt.

The COVID-19 pandemic led to a significant increase in the public spending, especially during the initial phase of the crisis. This resulted in a high rate of growth in public spending. As economies began to recover, growth rate adjusted depending on the fiscal policies adopted by each country. The fiscal response was crucial to mitigating the pandemic's economic effects but also posed long-term challenges regarding fiscal sustainability and public debt management.

Ultimately, GDP in many countries experienced a significant contraction in 2020 due to restrictions, lockdowns, and disruptions to global supply chains. However, in 2021, numerous countries began to see economic recovery, though this was uneven and depended notably on factors such as vaccination rates and governments' ability to manage new outbreaks.

Figure 1. Evolution of the growth rate of GDP, total expenditures (in % of the GDP) and the growth rate of total expenditures (1995-2021)



Source: Own elaboration.

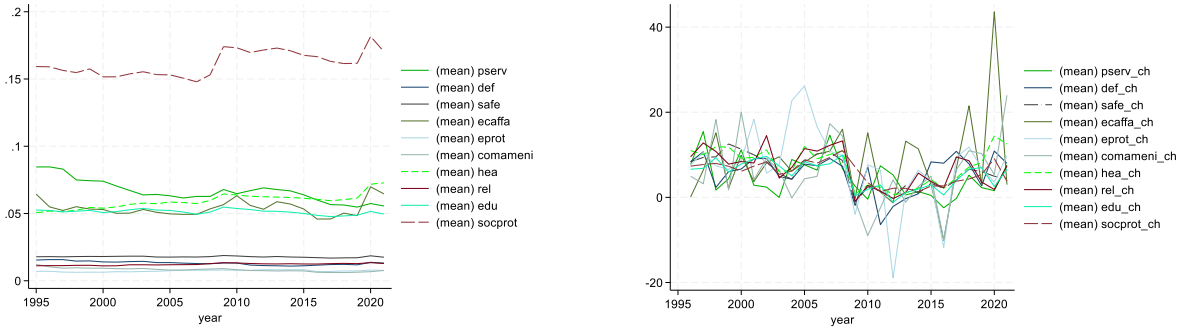
Finally, Figure 2 depicts the evolution of total government expenditures (in % of the GDP) and the growth rate of total government spending according to the COFOG, from 1995 to 2021 for the 27 European economies included in the analysis.

It is observed that the highest expenditure is on social protection (between 15% and 17%). This is followed in second place by expenditure on health, public services, economic affairs and education.

Finally, the categories with the lowest allocation in terms of GDP are security, defense, culture and religion, community amenities, and environmental protection.

Notably, following the onset of the Great Recession in 2008 and the COVID-19 pandemic crisis, spending on social protection and economic affairs has increased.

Figure 2. Evolution of the total expenditures (in % of GDP) and the growth rates of the public expenditure (1995-2021)



Source: Own elaboration.

4. Methodology and Data

4.1. Data collection

On one hand, we assess Wagner's law using a single approach. In our approach, we distinguish the growth rate of government expenditure functions with respect to economic growth for each country in our sample.

The Classification of the Functions of Government (COFOG) divides government expenditure into ten main categories (referred to as the 'COFOG I level' breakdown): general public services; defense; public order and safety; economic affairs; environmental protection; housing and community amenities; health; recreation, culture and religion; education; and social protection.

From this classification and the total GDP, in nominal levels, measured in millions of euros, we obtain the growth rates between the eleven categories of expenditure (Afonso and Alves, 2017).

On the other hand, we use a composite public sector performance (PSP) indicator. To calculate public sector efficiency scores, we utilize available data from different sources[4], constructing first a composite PSP indicator, which will be used as the output measure in the DEA assessment. The PSP is the simple average of opportunity indicators and "Musgravian" indicators. Opportunity indicators assess government performance in administration, education, health, and infrastructure sectors, each with equal weighting. "Musgravian" indicators include three sub-indicators: distribution, stability, and economic performance, also equally weighted (Afonso et al., 2005; Afonso et al., 2019). Consequently, both opportunity and "Musgravian" indicators are derived from the average of the measures included in each sub-indicator. To ensure a convenient benchmark, each sub-indicator measure is first normalized by dividing the value for a specific country by the average of that measure for all countries in the sample (Afonso et al., 2022).

4.2. Data Envelopment Analysis

Thus, public sector efficiency scores are the variables of interest, calculated through Data Envelopment Analysis (DEA). This methodology compares each observation to an optimal outcome. It is an optimal approach for several reasons. First, it does not impose an underlying production function. Second, it allows for deviations from the efficient frontier and examines a country's efficiency relative to its peers. Formally, for each country i (i = 1, . . ., 27), we consider the following function:

$$y_i = \gamma + f(X_i), i = 1, \dots, 27 \qquad (1)$$

where Y is the composite measure of output, i.e., public sector performance, and X is the composite measure of inputs, i.e., public spending. We employ both output-oriented and input-oriented approaches to measure the efficiency of countries. The output-oriented approach evaluates the proportional increase in outputs while keeping inputs constant and assuming variable returns to scale, to account for the fact that countries might not be operating at an optimal scale. In the input-oriented approach, we measure the proportional reduction in inputs required to achieve the same levels of output.

[4] For more information see Table A1 in Appendix A.

Formally, and for instance for the input-oriented approach, efficiency scores are computed solving the following linear programming problem:

$$\begin{aligned} &\min_{\theta,\lambda} \theta \\ s.t. \ &-y_i + Y\lambda \geq 0 \\ &\theta x_i - X\lambda \geq 0 \\ &I1'\lambda = 1 \\ &\lambda \geq 0 \end{aligned} \tag{2}$$

where y_i is a vector of outputs, x_i is a vector of inputs, θ is the efficiency scores, λ is a vector of constants, $I1'$ is a vector of ones, X is the input matrix and Y is the output matrix.

The efficiency scores, θ, range from 0 to 1, such that countries performing in the frontier score 1. More specifically, if θ<1, the country is inside the production frontier (i.e., it is inefficient), and if θ=1, the country is at the frontier (i.e., it is efficient).

The DEA model is a non-parametric technique used to evaluate the efficiency of Decision-Making Units (DMUs) by comparing their inputs and outputs. In our analysis, we applied this model using a single input: total public expenditure, and an output represented by the PSP indicators.

The public expenditure, which acts as the input, reflects the increase or decrease in public spending over time, representing the resources invested by the public sector. On the other hand, the PSP indicators, acting as outputs, measure government performance in the various areas previously mentioned, that is, the results obtained from public expenditure investment.

The purpose of this DEA model is to analyze the relative efficiency with which public expenditure is used to improve the performance of the public sector. The main objective is to determine whether the economies considered in our analysis are being efficient by comparing their public expenditure with their results in the PSP indicators. The public sector will be considered efficient if it achieves greater growth in these indicators without significantly increasing its public expenditure, in other words, if it manages to "do more with less."

In a second step of our analysis, regression models were used to examine the relationships between the growth rate of the coefficients obtained from the DEA model and the growth rate of total public expenditure, both overall and by categories. Positive coefficients would reflect a direct relationship between the growth rate of the efficiency indicators (as measured by the DEA model) and the growth rate of the public expenditure. Conversely, negative coefficients would imply an inverse relationship between the growth rate of efficiency and the growth rate

of public expenditure, that is, the more efficient a region is the less it would need to increase public expenditure. This implies that more efficient regions in the use of their resources do not require significant increases in public expenditure to improve their performance. The general specification is:

$$expenditure_{it} = \hat{\beta}_0 + \hat{\beta}_1 efficiency_{it} + \epsilon_{it} \quad (3)$$

where *expenditure* is the (growth rate) of relevant spending item, *efficiency* is the (growth rate) of the efficiency score (θ) previously obtained by solving the optimization problem (2), and ε_{it} is the i.i.d. error term.

Finally, to conduct a more detailed analysis of the relationship between efficiency and public expenditure, we use some control variables obtained from Eurostat, World Bank and World Inequality Database, among others.[5]

- Business cycle: a binary variable that takes the value 1 during recession periods and 0 during expansion periods (*Cycle)*.
- Human capital: the natural logarithm of human capital index (*HC*).
- Elderly dependency ratio (*Elderly*)
- Youth dependency ratio (*Young*)
- S80/S20 (*S8020*)
- Redistribution: income inequality as percentage share of income or consumption that accrues to the 10th (wealthiest) decile (*Red*).

5. Main results

The DEA model is estimated for the period between 1995 and 2021, covering 27 European economies: Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Poland, Portugal, Romania, Slovak Republic, Slovenia, Spain, and Sweden.

The data used comes from various sources such as the World Economic Forum, World Bank, World Health Organization, and IMF World Economic Outlook.

[5] For more information, see Table A2 in Appendix A.

Firstly, the different PSP indicators were obtained to calculate the total PSP indicator based on the simple average of the opportunity indicator and the "Musgravian" indicator[6].

After calculating the indicators, information on public expenditure and its classification into 10 categories (according to COFOG) was gathered, using available data from Eurostat.

Once both the series of efficiency indicators and public expenditure were obtained, the DEA model was implemented, both from the input and output perspectives.

In this model, the variable of interest (output) is public sector efficiency, while the input is the total public expenditure and the 10 categories. Table 1 provides a summary of the DEA results for the period 1995-2021 using input-oriented models.

The purpose of an input-oriented approach is to assess by how much input quantities can be proportionally reduced without changing the output quantities produced. The average input efficiency scores ranged between 0.54 and 0.88, suggesting that with the same level of outputs, inputs could decrease between 12% and 46%. Overall, the more efficient countries, those located in the production possibility frontier, were Austria (2004), Belgium (2013), Bulgaria (2020), Croatia (1995-2004), Denmark (1998-2004; 2008), France (2003; 2005-2009; 2020-2021), Greece (2009; 2013; 2020-2021), Hungary (1995; 2006-2007; 2009), Poland (2006), Portugal (2005), Slovenia (2013), and Sweden (1995-1998; 2002-2003; 2005; 2008).

Table 1. Summary of DEA input-oriented efficiency scores

	1995	1998	2001	2002	2003	2004	2005	2006	2007	2008	2009	2013	2020	2021
Efficient Countries	3 HRV HUN SWE	3 DNK HRV SWE	2 DNK HRV	3 DNK HRV SWE	4 DNK FRA HRV SWE	3 AUT DNK HRV	3 FRA PRT SWE	3 FRA HUN POL	2 FRA HUN	3 DNK FRA SWE	3 FRA GRC HUN	3 BEL GRC SVN	3 BGR FRA GRC	2 FRA GRC
Average	0.671	0.540	0.653	0.721	0.754	0.797	0.793	0.832	0.771	0.716	0.875	0.577	0.833	0.794
Median	0.645	0.488	0.643	0.700	0.730	0.787	0.799	0.814	0.771	0.668	0.884	0.490	0.807	0.777
Max	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
Min	0.284	0.252	0.398	0.480	0.529	0.588	0.569	0.607	0.586	0.414	0.636	0.138	0.624	0.472
Stdev	0.188	0.203	0.173	0.155	0.148	0.111	0.128	0.108	0.101	0.181	0.105	0.363	0.106	0.128

Note: Summary of the DEA results for the periods 1995-2021, using input-oriented models. We use one input, government' normalized total spending and one output, the total PSP.

Alternatively, and by computing output-oriented measures, one can assess how much output quantities can be proportionally increased without changing the input quantities used. Table 2 provides a summary of the DEA results for the period 1995-2021 using output-oriented models.[7]

[6] For a summary table of the different PSP indicators, see Appendix C, Tables C1-C10

[7] To see the complete table, see Table D1 in Appendix D.

The average output efficiency scores ranged between 0.77 and 0.87, suggesting that with the same level of inputs, outputs could increase between 13% and 23%.

In general, the more efficient countries were Austria (2004), Bulgaria (2001; 2003), Croatia (1998; 2001-2004), Czech Republic (1998), Denmark (1998; 2001-2004; 2008), Estonia (2008), France (2003; 2005-2009; 2020-2021), Greece (2009-2010; 2020-2021), Hungary (1996; 2006-2007; 2009), Ireland (2010), Latvia (2008; 2010), Poland (2002-2003; 2005-2006), Portugal (2005), Romania (1998), and Sweden (1996; 1998; 2002-2003; 2005; 2008).

Table 2. Summary of DEA output-oriented efficiency scores

	1996	1998	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2020	2021
Efficient	2	5	3	4	6	3	4	3	2	5	3	3	2	2
Countries	HUN	CZE	BGR	DNK	BGR	AUT	FRA	FRA	FRA	DNK	FRA	GRC	FRA	FRA
	SWE	DNK	DNK	HRV	DNK	DNK	POL	HUN	HUN	EST	GRC	IRL	GRC	GRC
		HRV	HRV	POL	FRA	HRV	PRT	POL		FRA	HUN	LVA		
		ROU		SWE	HRV		SWE			LVA				
		SWE			POL					SWE				
					SWE									
Average	0.775	0.830	0.854	0.857	0.869	0.842	0.856	0.859	0.824	0.860	0.870	0.772	0.808	0.802
Median	0.739	0.834	0.896	0.884	0.909	0.877	0.887	0.875	0.835	0.846	0.846	0.773	0.803	0.808
Max	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
Min	0.539	0.606	0.610	0.614	0.608	0.613	0.620	0.642	0.650	0.694	0.724	0.588	0.444	0.413
Stdev	0.138	0.126	0.116	0.115	0.122	0.117	0.118	0.113	0.106	0.109	0.089	0.114	0.119	0.126

Note: Summary of the DEA results for the periods 1995-2021, using output-oriented models. We use one input, government' normalized total spending and one output, the total PSP.

Finally, the relationship between the estimated coefficients of the DEA model and the public expenditure growth rate was analyzed. In the estimates, some control variables were included such as the political business cycle, human capital, youth dependency ratio, adult dependency ratio, the S80/S20 indicator, and redistribution.

5.1. Relationship between growth rates of total public sector efficiency (input-oriented) and growth rates of government expenditure (dependent variable)

Initially, the estimates were collected when the DEA model coefficients were obtained from the input perspective, that is, resources used (public expenditure) were minimized while keeping outputs (public sector efficiency) constant.

Table 3 shows the relationship between the growth rate of the efficiency coefficient obtained from the DEA model (θgr) and the total public expenditure growth rate (the dependent variable), along with some combinations with the control variables. In the 15 regressions carried out, a negative relationship can be observed between the growth rate of the efficiency coefficient and the total public expenditure growth rate. This indicates that greater efficiency is associated with lower levels of public expenditure growth. When including the control variables, a negative

significance is observed when considering the *HC*, *Young*, and *Red*. However, the coefficients become positive when *Cycle* and *S8020* are included.

The positive relationship between the *Cycle* and the total public expenditure growth rate may be due to the fact that during recessions, public spending tends to increase. A positive coefficient suggests that, during recessions, the public expenditure growth rate is higher compared to periods of economic expansion. This behavior is consistent with countercyclical fiscal policies, where the government increases public spending to stimulate aggregate demand and mitigate the effects of economic slowdown. In summary, the positive and significant coefficient in the regression suggests that during recessions, the government increases public spending, reflecting an expansive fiscal policy aimed at countering the negative effects of the economic cycle.

The inverse relationship between *HC* levels and the public expenditure growth rate can be explained by greater efficiency in resource use. That is, higher levels of human capital could be associated with more efficient use of public resources, so a more skilled workforce requires lower increases in public spending to improve services or maintain efficiency.

Thirdly, *S8020* measures income inequality, specifically the ratio between the richest 20% and the poorest 20% of the population. A negative coefficient indicates that the greater the income inequality, the higher the growth in public spending. This could be explained by the fact that in more unequal societies, the public sector may face greater pressure to increase public spending to mitigate inequality, through social assistance programs, subsidies, or greater investment in health and education.

Next, the estimates by public expenditure categories that showed the most significant coefficients are presented[8]. These categories include:

- Social protection: includes spending on sickness and disability, old age, survivors, family and children, unemployment, housing, etc.
- Education: includes all levels of education —primary, secondary, tertiary— as well as spending on research and development in education.
- Health: includes spending on healthcare services, hospitals, disease prevention, medicine supply, and public health promotion.
- Public services: include executive and legislative bodies, financial and fiscal affairs, foreign economic aid, general services, basic research, public debt transactions, etc.

[8] For the relationships with the public expenditure growth rates of the other categories with less significant coefficients, see Appendix E (online).

Tables 4, 5, 7 and 8 show the relationship between the growth rate of the efficiency coefficient and the growth rate of public spending in social protection, education, public services, and economic affairs, respectively. Again, a significant and negative relationship is observed in most regressions between the efficiency coefficients and the public expenditure growth rate. This indicates that higher levels of efficiency can be achieved without proportionally increasing spending on social protection, education, and public services.

Secondly, as in the estimate of total public expenditure growth, there is an inverse relationship between *HC* levels and public expenditure growth, which can be explained by an improvement in resource use.

Table 6 shows the relationship between the growth rate of the efficiency coefficient and public spending growth in healthcare. Again, a significant and negative relationship is observed in most regressions between the efficiency coefficients and the public expenditure growth rate. This indicates that higher levels of efficiency can be achieved without proportionally increasing healthcare spending.

Secondly, just as in the total public expenditure estimate, *Cycle* is positively and significantly related to the growth rate of healthcare spending, which could indicate that during recessions, the public sector tends to spend more proportionally on healthcare.

Finally, as in the estimate of total public expenditure growth, there is an inverse relationship between *HC* levels and the growth rate of public healthcare spending, which could be explained by improved resource use.

Table 3. Relationship between growth rates of total public sector efficiency (input-oriented) and growth rates of total government expenditure (dependent variable)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
θgr	-8.192***	-8.108***	-9.174***	-8.200***	-8.201***	-7.221***	-7.725***	-8.064***	-7.936***	-5.570*	-6.125**	-5.582*	-6.103***	-6.484**	-6.124**
	(1.805)	(1.834)	(2.018)	(1.756)	(1.818)	(2.051)	(1.753)	(2.081)	(2.088)	(2.795)	(2.344)	(2.795)	(2.259)	(2.748)	(2.355)
cycle		1.607						2.151	2.178	3.504**	1.861	3.496**	1.595	2.745*	1.834
		(1.555)						(1.567)	(1.631)	(1.402)	(1.340)	(1.426)	(1.279)	(1.466)	(1.356)
HC			-70.907					-118.233**	-114.813**	-88.319*	-104.591**	-88.077*	-112.275**	-123.450**	-104.264**
			(52.214)					(52.420)	(51.921)	(49.420)	(47.655)	(50.717)	(48.925)	(45.930)	(47.634)
young				-0.888***				-0.199				-0.019	-0.470		
				(0.325)				(0.496)				(0.815)	(0.482)		
elderly					-0.071				0.143					1.946*	0.055
					(0.267)				(0.425)					(0.982)	(0.336)
s8020						2.969*				2.397**		2.403**		2.889**	
						(1.637)				(1.040)		(1.029)		(1.123)	
red							38.195				-45.319*		-54.454**		-44.754*
							(26.751)				(24.571)		(25.748)		(24.221)
Obs.	159	115	132	159	159	109	153	95	95	63	90	63	90	63	90
R^2	0.545	0.631	0.612	0.575	0.545	0.668	0.606	0.707	0.706	0.805	0.764	0.805	0.769	0.824	0.764

Notes: * indicates the level of significance of 10%, ** a level of 5% and *** a level of 1%. In brackets we report the robust standard errors. Obs. are the observations for each regression. Constant term was computed but for reasons of parsimony those results are not displayed.

Table 4. Relationship between growth rates of total public sector efficiency (input-oriented) and growth rates of government expenditure on social protection (dependent variable)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
θgr	-4.591**	-6.558***	-5.459***	-4.597**	-4.613**	-3.438*	-3.822**	-7.822***	-7.462***	-6.079**	-6.203**	-5.883**	-6.153***	-7.085**	-6.204**
	(1.807)	(1.970)	(1.995)	(1.796)	(1.820)	(1.892)	(1.721)	(2.092)	(2.169)	(2.613)	(2.482)	(2.630)	(2.246)	(2.621)	(2.530)
cycle		-0.447						0.050	0.530	0.116	0.114	0.270	-0.501	-0.720	0.205
		(1.913)						(1.697)	(1.670)	(1.631)	(1.659)	(1.712)	(1.587)	(1.691)	(1.577)
HC			-32.792					-48.322	-37.624	-117.754**	-28.123	-121.983**	-45.923	-156.443***	-29.245
			(41.110)					(35.679)	(40.834)	(43.940)	(44.972)	(47.847)	(36.535)	(44.647)	(44.316)
young				-0.630**				-0.855				0.330	-1.090*		
				(0.303)				(0.530)				(0.777)	(0.555)		
elderly					-0.172				-0.149					2.143**	-0.188
					(0.372)				(0.508)					(0.976)	(0.515)
s8020						1.931				1.509		1.398		2.051	
						(1.406)				(1.450)		(1.490)		(1.358)	
red							35.505				-25.252		-46.416		-27.192
							(25.446)				(33.857)		(34.371)		(34.705)
Obs.	159	115	132	159	159	109	153	95	95	63	90	63	90	63	90
R^2	0.480	0.551	0.545	0.495	0.480	0.685	0.531	0.685	0.670	0.791	0.686	0.792	0.712	0.813	0.686

Notes: * indicates the level of significance of 10%, ** a level of 5% and *** a level of 1%. In brackets we report the robust standard errors. Obs. are the observations for each regression. Constant term was computed but for reasons of parsimony those results are not displayed.

Table 5. Relationship between growth rates of total public sector efficiency (input-oriented) and growth rates of government expenditure on education (dependent variable)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
θgr	-3.174*	-4.549**	-4.125**	-3.180*	-3.186*	-0.158	-2.205	-4.271*	-4.287*	-2.801	-3.054	-2.259	-3.055	-3.639	-3.053
	(1.838)	(2.025)	(1.842)	(1.806)	(1.844)	(2.132)	(1.772)	(2.219)	(2.170)	(2.452)	(2.388)	(2.444)	(2.413)	(2.741)	(2.388)
cycle		0.965						1.544	1.405	1.849	1.832	2.274	1.850	1.153	1.769
		(2.033)						(2.315)	(2.323)	(2.383)	(2.242)	(2.631)	(2.272)	(2.614)	(2.267)
HC			-110.218					-124.382*	-125.181*	-51.133	-93.537	-62.809	-93.011	-83.356	-92.776
			(68.746)					(73.307)	(76.811)	(46.258)	(86.961)	(51.482)	(82.372)	(63.029)	(86.859)
young				-0.686**				0.125				0.912	0.032		
				(0.338)				(0.739)				(0.837)	(0.767)		
elderly					-0.091				0.167					1.785	0.128
					(0.374)				(0.534)					(1.107)	(0.497)
s8020						3.539*				4.435*		4.129*		4.886*	
						(2.101)				(2.586)		(2.494)		(2.484)	
red							18.849				-15.003		-14.376		-13.687
							(25.067)				(35.178)		(32.827)		(35.333)
Obs.	159	115	132	159	159	109	153	95	95	63	90	63	90	63	90
R^2	0.531	0.541	0.590	0.547	0.531	0.645	0.554	0.600	0.600	0.711	0.598	0.716	0.598	0.727	0.598

Notes: * indicates the level of significance of 10%, ** a level of 5% and *** a level of 1%. In brackets we report the robust standard errors. Obs. are the observations for each regression. Constant term was computed but for reasons of parsimony those results are not displayed.

Table 6. Relationship between growth rates of total public sector efficiency (input-oriented) and growth rates of government expenditure on health (dependent variable)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
θgr	-4.503	-4.189	-4.894	-4.516	-4.581	-2.403	-5.286*	-6.605**	-6.201**	-1.449	-5.544*	-0.624	-5.493*	-2.011	-5.547*
	(2.844)	(2.893)	(3.320)	(2.890)	(2.871)	(3.051)	(2.952)	(2.936)	(3.011)	(3.917)	(3.248)	(4.115)	(3.035)	(4.255)	(3.337)
cycle		0.903						2.811	3.357	4.111	4.685**	4.757	4.063*	3.643	4.855**
		(2.953)						(2.764)	(2.894)	(2.822)	(2.137)	(3.206)	(2.121)	(3.038)	(2.200)
HC			-8.577					-62.905	-50.879	-156.350**	3.021	-174.130*	-15.000	-177.966**	0.944
			(65.972)					(65.874)	(68.431)	(70.636)	(65.584)	(88.745)	(60.006)	(70.781)	(63.557)
young				-1.379*				-0.965				1.389	-1.103*		
				(0.723)				(0.608)				(1.734)	(0.618)		
elderly					-0.611				-0.177					1.197	-0.348
					(0.523)				(0.606)					(1.439)	(0.575)
s8020						6.453**				1.330		0.865		1.633	
						(2.472)				(1.536)		(1.911)		(1.649)	
red							59.602				-14.736		-36.162		-18.323
							(38.162)				(37.173)		(39.350)		(37.998)
Obs.	159	115	132	159	159	109	153	95	95	63	90	63	90	63	90
R^2	0.335	0.414	0.434	0.367	0.340	0.477	0.365	0.538	0.525	0.697	0.603	0.703	0.621	0.701	0.604

Notes: * indicates the level of significance of 10%, ** a level of 5% and *** a level of 1%. In brackets we report the robust standard errors. Obs. are the observations for each regression. Constant term was computed but for reasons of parsimony those results are not displayed.

Table 7. Relationship between growth rates of total public sector efficiency (input-oriented) and growth rates of government expenditure on public services (dependent variable)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
θgr	-11.395**	-7.092**	-13.588**	-11.387**	-11.435**	-12.537**	-12.387**	-5.809*	-6.602*	-5.525	-6.550*	-6.391	-6.621*	-5.709	-6.546*
	(4.534)	(3.370)	(5.583)	(4.568)	(4.561)	(6.051)	(4.952)	(3.527)	(3.637)	(3.880)	(3.542)	(3.974)	(3.669)	(4.151)	(3.548)
cycle		-0.318						0.821	-0.325	4.706	-1.549	4.026	-0.674	4.553	-1.739
		(2.470)						(3.324)	(3.239)	(2.909)	(3.260)	(2.968)	(3.234)	(3.167)	(3.308)
HC			-335.115**					-206.003	-229.776	-57.274	-300.908*	-38.606	-275.566*	-64.350	-298.576*
			(147.408)					(138.441)	(165.747)	(63.203)	(176.671)	(68.224)	(150.546)	(81.428)	(175.138)
young				0.815				1.945				-1.459	1.551		
				(0.705)				(1.409)				(1.484)	(1.358)		
elderly					-0.319				0.449					0.392	0.391
					(0.653)				(0.860)					(1.774)	(0.854)
s8020						2.836				-0.151		0.338		-0.052	
						(3.576)				(2.034)		(2.038)		(2.209)	
red							16.638				-74.827		-44.696		-70.798
							(68.731)				(68.162)		(64.160)		(65.703)
Obs.	159	115	132	159	159	109	153	95	95	63	90	63	90	63	90
R^2	0.344	0.374	0.385	0.350	0.344	0.486	0.361	0.461	0.425	0.529	0.488	0.538	0.511	0.530	0.489

Notes: * indicates the level of significance of 10%, ** a level of 5% and *** a level of 1%. In brackets we report the robust standard errors. Obs. are the observations for each regression. Constant term was computed but for reasons of parsimony those results are not displayed.

Table 8. Relationship between growth rates of total public sector efficiency (input-oriented) and growth rates of government expenditure on economic affairs (dependent variable)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
θgr	-27.651***	-27.221***	-27.808**	-27.706***	-27.685***	-32.445*	-26.513**	-20.208***	-20.130***	-17.587**	-13.965***	-18.856**	-13.946***	-20.014***	-13.970***
	(10.229)	(6.943)	(10.777)	(9.777)	(10.418)	(17.834)	(11.753)	(5.465)	(5.441)	(6.873)	(4.861)	(7.191)	(4.858)	(6.845)	(4.916)
cycle		8.054						5.530	5.861	5.851	3.510	4.856	3.273	3.835	3.756
		(5.450)						(3.980)	(3.878)	(6.167)	(4.000)	(5.565)	(4.203)	(5.688)	(3.973)
HC			213.823					-258.249*	-255.329*	180.250	-218.980	207.577	-225.849	86.949	-221.991
			(406.893)					(145.577)	(148.246)	(359.576)	(140.500)	(369.003)	(146.927)	(281.622)	(151.740)
young				-5.901				-0.351				-2.135	-0.420		
				(4.001)				(1.126)				(2.587)	(1.157)		
elderly					-0.266				-0.341					5.167	-0.504
					(2.319)				(1.705)					(4.187)	(1.655)
s8020						-2.510				9.731***		10.447***		11.038***	
						(7.784)				(2.899)		(2.992)		(3.599)	
red							223.646				-81.449		-89.616		-86.651
							(175.331)				(73.094)		(79.808)		(72.077)
Obs.	159	115	132	159	159	109	153	95	95	63	90	63	90	63	90
R^2	0.329	0.632	0.290	0.383	0.329	0.346	0.354	0.509	0.509	0.630	0.544	0.635	0.545	0.653	0.545

Notes: * indicates the level of significance of 10%, ** a level of 5% and *** a level of 1%. In brackets we report the robust standard errors. Obs. are the observations for each regression. Constant term was computed but for reasons of parsimony those results are not displayed.

5.2. Relationship between growth rates of total public sector efficiency (output-oriented) and growth rates of government expenditure (dependent variable)

In a second exercise, the estimates were obtained when the DEA model coefficients were calculated from the output perspective, meaning the outputs (public sector efficiency) were maximized, given fixed or limited resources (public expenditure).

Table 9 shows the relationship between the growth rate of the efficiency coefficient (θgr) and the growth rate of the total public expenditure, along with the control variables. Like the input-oriented DEA estimates, a negative relationship can be observed between the growth rate of the efficiency coefficient and the total public expenditure growth rate across the 15 regressions. This suggests that higher growth rates in public sector efficiency are associated with lower public expenditure growth rates. When including the control variables, a negative and significant relationship is observed when considering *HC*, *young*, and *red*. However, the coefficients turn positive when the *S8020* variable and *Cycle* are included.

As mentioned in the previous section, the positive relationship between the economic cycle and the public expenditure growth rate may be linked to increases in public spending during recessions.

Similarly, the negative coefficients between human capital and public spending growth reflect greater efficiency in the use of public resources. As in the input-oriented estimates, a negative relationship is observed with the *S8020* variable, as greater income inequality could lead to increased public spending.

Regarding *young*, a negative relationship is identified with the public expenditure growth rate, suggesting that a high youth dependency ratio may exert less pressure on public spending, especially in areas like pensions and elderly care.

As in the input-oriented results, the estimates by public expenditure categories that showed the most significant coefficients are presented[9].

Tables 10 and 14 show the relationship between the growth rate of the efficiency coefficient and the growth rate of public spending on social protection and economic affairs, respectively. Most of the regressions indicate a negative and significant relationship between the growth rate of the efficiency coefficient and the growth rate of social protection spending, meaning that higher levels of efficiency are possible without proportionally increasing spending in these areas.

[9] For the relationships with the public expenditure growth rates of the other categories with less significant coefficients, see Appendix F (online).

In terms of the relationship between public spending growth and *HC*, it is negative and significant, which translates into greater efficiency in the use of public resources. A negative relationship is also observed between *young* and the public expenditure growth rate, which could be explained by less pressure on public spending.

Tables 11, 12, and 13 show the relationship between the growth rate efficiency coefficient and the growth of public spending on education, healthcare, and public services, respectively. Again, a significant and negative relationship is observed in most regressions between the growth rate of the efficiency coefficients and the public expenditure growth rate. This indicates that higher levels of efficiency can be achieved without proportionally increasing spending on education, healthcare, and public services.

Finally, an inverse relationship is observed between human capital levels and public expenditure growth, which may be explained by greater efficiency in the use of public resources.

Table 9. Relationship between growth rates of total public sector efficiency (output-oriented) and growth rates of total government expenditure (dependent variable)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
θ_{gr}	-4.639***	-4.542***	-5.536***	-4.629***	-4.622***	-3.401***	-4.587***	-5.247***	-5.673***	-3.596**	-5.580***	-2.889*	-5.1165***	-3.9793**	-5.618***
	(0.951)	(0.994)	(1.133)	(0.946)	(0.952)	(1.193)	(0.974)	(1.167)	(1.195)	(1.619)	(1.224)	(1.509)	(1.182)	(1.593)	(1.231)
cycle		1.528*						1.986**	1.909*	0.780	1.597	0.928	1.780*	0.819	1.612
		(0.920)						(0.896)	(0.977)	(1.091)	(1.037)	(0.841)	(0.918)	(1.022)	(1.035)
HC			-0.127					-33.353**	-15.636	-22.830	-16.709	-59.664***	-47.129**	-33.432*	-21.225
			(17.807)					(16.324)	(19.646)	(20.612)	(22.078)	(15.275)	(18.429)	(17.621)	(22.494)
young				-0.371*				-0.833**				-1.313***	-0.970***		
				(0.201)				(0.353)				(0.303)	(0.329)		
elderly					0.089				-0.135					-0.604**	-0.155
					(0.163)				(0.173)					(0.232)	(0.168)
s8020						2.370				2.045*		1.637*		1.445	
						(1.567)				(1.169)		(0.925)		(1.202)	
red							22.055				-15.076		-34.621*		-16.471
							(17.262)				(20.520)		(17.972)		(20.456)
Obs.	270	199	216	270	270	166	260	160	160	86	152	86	152	86	152
R^2	0.466	0.489	0.480	0.473	0.466	0.603	0.506	0.539	0.514	0.711	0.564	0.770	0.601	0.728	0.565

Notes: * indicates the level of significance of 10%, ** a level of 5% and *** a level of 1%. In brackets we report the robust standard errors. Obs. are the observations for each regression. Constant term was computed but for reasons of parsimony those results are not displayed.

Table 10. Relationship between growth rates of total public sector efficiency (output-oriented) and growth rates of government expenditure on social protection (dependent variable)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
θ_{gr}	-3.204***	-4.201***	-3.412***	-3.195***	-3.201***	-1.5425	-3.121***	-4.744***	-5.131***	-1.5583	-5.010***	-0.7514	-4.705***	-2.129	-5.155***
	(0.993)	(1.071)	(1.175)	(0.986)	(0.998)	(1.135)	(1.015)	(1.256)	(1.270)	(1.882)	(1.278)	(1.771)	(1.269)	(1.859)	(1.289)
cycle		0.856						1.303	1.243	0.340	0.777	0.508	0.933	0.398	0.800
		(1.023)						(0.990)	(1.018)	(1.217)	(1.077)	(0.915)	(1.028)	(1.091)	(1.078)
HC			6.702					-20.673	-8.545	-20.957	-2.542	-62.962***	-28.432	-36.764**	-9.216
			(15.625)					(16.290)	(17.568)	(23.012)	(19.967)	(18.713)	(19.624)	(17.579)	(19.815)
young				-0.369*				-0.708**				-1.497***	-0.825**		
				(0.198)				(0.336)				(0.352)	(0.338)		
elderly					0.015				-0.229					-0.901***	-0.230
					(0.202)				(0.209)					(0.244)	(0.206)
s8020						1.136				0.313		-0.153		-0.582	
						(1.263)				(1.191)		(1.030)		(1.172)	
red							24.685				-12.218		-28.852		-14.278
							(16.936)				(20.697)		(20.430)		(20.479)
Obs.	270	199	216	270	270	166	260	160	160	86	152	86	152	86	152
R^2	0.410	0.479	0.408	0.417	0.410	0.637	0.436	0.541	0.525	0.704	0.534	0.773	0.559	0.737	0.537

Notes: * indicates the level of significance of 10%, ** a level of 5% and *** a level of 1%. In brackets we report the robust standard errors. Obs. are the observations for each regression. Constant term was computed but for reasons of parsimony those results are not displayed.

Table 11. Relationship between growth rates of total public sector efficiency (output-oriented) and growth rates of government expenditure on education (dependent variable)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
θgr	-3.440**	-3.941***	-4.265***	-3.429**	-3.443**	-0.224	-3.069**	-4.785***	-5.118***	-0.927	-4.763***	-0.542	-4.494**	-1.045	-4.831***
	(1.337)	(1.422)	(1.608)	(1.332)	(1.341)	(1.493)	(1.364)	(1.692)	(1.734)	(1.749)	(1.816)	(1.725)	(1.780)	(1.748)	(1.819)
cycle		-1.636						-1.230	-1.267	-0.888	-1.613	-0.808	-1.507	-0.876	-1.585
		(1.740)						(1.775)	(1.833)	(1.457)	(2.031)	(1.334)	(1.962)	(1.446)	(2.032)
HC			-11.761					-41.565*	-36.199	-48.905	-19.508	-68.939**	-37.108	-52.176*	-27.775
			(24.399)					(23.714)	(27.534)	(31.198)	(31.824)	(27.150)	(26.489)	(28.877)	(32.070)
young				-0.462*				-0.549				-0.714	-0.561		
				(0.266)				(0.469)				(0.516)	(0.453)		
elderly					-0.017				-0.335					-0.187	-0.285
					(0.212)				(0.276)					(0.367)	(0.266)
s8020						2.412*				2.019		1.797		1.834	
						(1.468)				(1.741)		(1.572)		(1.739)	
red							33.616*				5.724		-5.584		3.172
							(20.054)				(25.635)		(23.667)		(25.480)
Obs.	270	199	216	270	270	166	260	160	160	86	152	86	152	86	152
R^2	0.330	0.375	0.339	0.337	0.330	0.475	0.345	0.422	0.418	0.591	0.414	0.607	0.421	0.592	0.416

Notes: * indicates the level of significance of 10%, ** a level of 5% and *** a level of 1%. In brackets we report the robust standard errors. Obs. are the observations for each regression. Constant term was computed but for reasons of parsimony those results are not displayed.

Table 12. Relationship between growth rates of total public sector efficiency (output-oriented) and growth rates of government expenditure on health (dependent variable)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
θgr	-3.809*	-5.637***	-4.780*	-3.785*	-3.862*	-2.542	-3.627*	-7.228***	-7.509***	-6.564*	-6.754***	-6.102*	-6.441***	-6.728*	-6.773***
	(2.062)	(1.707)	(2.499)	(2.042)	(2.049)	(2.230)	(2.056)	(1.991)	(2.004)	(3.357)	(1.966)	(3.406)	(1.981)	(3.444)	(1.977)
cycle		1.529						1.943	1.892	2.249	2.297	2.345	2.421	2.266	2.304
		(1.563)						(1.517)	(1.558)	(1.774)	(1.604)	(1.759)	(1.534)	(1.789)	(1.610)
HC			43.169*					-13.644	-2.284	-7.766	2.056	-31.788	-18.459	-12.304	-0.177
			(25.732)					(21.159)	(27.030)	(27.154)	(31.194)	(27.448)	(22.252)	(27.995)	(31.851)
young				-0.977**				-0.545				-0.856*	-0.654		
				(0.440)				(0.566)				(0.451)	(0.543)		
elderly					-0.287				-0.098					-0.259	-0.077
					(0.305)				(0.277)					(0.381)	(0.263)
s8020						2.481				1.967		1.700		1.701	
						(2.206)				(1.426)		(1.327)		(1.467)	
red							-8.499				-8.201		-21.381		-8.890
							(30.165)				(28.325)		(25.946)		(28.345)
Obs.	270	199	216	270	270	166	260	160	160	86	152	86	152	86	152
R^2	0.286	0.351	0.289	0.303	0.287	0.411	0.297	0.389	0.382	0.505	0.396	0.519	0.407	0.507	0.397

Notes: * indicates the level of significance of 10%, ** a level of 5% and *** a level of 1%. In brackets we report the robust standard errors. Obs. are the observations for each regression. Constant term was computed but for reasons of parsimony those results are not displayed.

Table 13. Relationship between growth rates of total public sector efficiency (output-oriented) and growth rates of government expenditure on public services (dependent variable)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
θgr	-4.811*	-2.977*	-4.647	-4.825*	-4.834*	-5.858**	-4.870*	-3.331*	-3.290*	-1.499	-3.728*	-1.273	-3.755*	-1.791	-3.763*
	(2.528)	(1.570)	(3.083)	(2.535)	(2.558)	(2.582)	(2.603)	(1.971)	(1.910)	(2.084)	(1.969)	(2.151)	(2.067)	(2.094)	(1.994)
cycle		1.618						1.912	1.927	1.340	2.052	1.387	2.041	1.370	2.066
		(1.789)						(1.894)	(1.897)	(1.369)	(2.152)	(1.350)	(2.160)	(1.362)	(2.156)
HC			-26.379					-21.301	-25.990	-20.719	-39.845	-32.474	-38.112	-28.815	-44.018
			(33.974)					(30.776)	(39.128)	(23.073)	(47.627)	(28.387)	(41.479)	(22.967)	(49.718)
young				0.536				0.117				-0.419	0.055		
				(0.514)				(0.683)				(0.601)	(0.646)		
elderly					-0.125				-0.067					-0.462	-0.144
					(0.379)				(0.298)					(0.359)	(0.312)
s8020						3.570				2.560**		2.430*		2.102*	
						(4.379)				(1.191)		(1.234)		(1.242)	
red							30.243				-19.538		-18.426		-20.827
							(51.558)				(43.288)		(41.268)		(43.701)
Obs.	270	199	216	270	270	166	260	160	160	86	152	86	152	86	152
R^2	0.272	0.359	0.274	0.275	0.272	0.422	0.281	0.386	0.386	0.615	0.408	0.620	0.408	0.622	0.409

Notes: * indicates the level of significance of 10%, ** a level of 5% and *** a level of 1%. In brackets we report the robust standard errors. Obs. are the observations for each regression. Constant term was computed but for reasons of parsimony those results are not displayed.

Table 14. Relationship between growth rates of total public sector efficiency (output-oriented) and growth rates of government expenditure on economic affairs (dependent variable)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
θgr	-8.724***	-8.171***	-10.652***	-8.712***	-8.559***	-7.105*	-8.798***	-8.563***	-9.492***	-10.445*	-9.733***	-8.756*	-8.485***	-10.693**	-9.648***
	(2.921)	(3.128)	(2.921)	(2.933)	(2.899)	(4.115)	(2.958)	(3.012)	(3.021)	(5.302)	(3.111)	(5.000)	(2.999)	(5.278)	(3.070)
cycle		2.627						3.287	3.041	-1.758	1.761	-1.406	2.254	-1.733	1.726
		(2.877)						(2.700)	(2.600)	(4.395)	(2.251)	(4.414)	(2.257)	(4.422)	(2.236)
HC			-29.319					-80.636	-14.276	64.968	-43.778	-22.960	-125.619**	58.095	-33.459
			(44.788)					(51.297)	(59.686)	(76.629)	(60.189)	(65.114)	(58.460)	(81.210)	(68.276)
young				-0.452				-2.155**				-3.134**	-2.609***		
				(0.758)				(0.938)				(1.194)	(0.912)		
elderly					0.905				0.451					-0.392	0.355
					(0.684)				(0.750)					(0.682)	(0.747)
s8020						0.709				1.528		0.553		1.139	
						(4.883)				(4.785)		(4.973)		(4.799)	
red							-1.664				-60.242		-112.824**		-57.055
							(53.261)				(57.475)		(54.102)		(57.715)
Obs.	270	199	216	270	270	166	260	160	160	86	152	86	152	86	152
R^2	0.409	0.444	0.229	0.410	0.412	0.521	0.441	0.233	0.207	0.322	0.237	0.374	0.282	0.323	0.238

Notes: * indicates the level of significance of 10%, ** a level of 5% and *** a level of 1%. In brackets we report the robust standard errors. Obs. are the observations for each regression. Constant term was computed but for reasons of parsimony those results are not displayed.

6. Conclusion

The analysis of the effects of efficiency on public spending is a crucial topic in the management of government resources and in economic policy decision-making. Efficiency in the public sector not only determines the optimal use of resources but also directly impacts the sustainability and growth of public spending over time. Understanding how efficiency influences spending levels is therefore essential for designing policies aimed at maximizing social welfare without compromising fiscal stability. Consequently, the main objective of this study is to explore the relationship between government spending efficiency and public spending growth in order to assess improvements in public resource management.

Therefore, we first computed public sector performance (PSP) indicators, which allow for the measurement and evaluation of the effectiveness, and quality, of public services and policies implemented by the public sector. Initially, an opportunity indicator was constructed from indicators of administration, education, health, and public infrastructure. Subsequently, "Musgravian" indicators were calculated based on distribution, stabilization, and economic performance indicators. Finally, an overall PSP indicator was developed by taking a simple average between the opportunity and “Musgravian” indicators.

In addition, public spending growth rates were calculated according to the COFOG classification (Classification of the Functions of Government).

Next, we have used Data Envelopment Analysis models, where the output variable of interest is public sector performance, measured through PSP indicators, and using public spending as the input variable. For instance, with output efficiency scores between 0.77 and 0.87, with the same level of inputs, outputs could increase between 13% and 23%. After obtaining the DEA model coefficients from both input- and output-oriented perspectives, the relationship between the growth rate of the efficiency scores and the growth rate of public spending was evaluated. Additionally, we have found that more efficient countries tend to coalesce notably around Austria, Croatia, Denmark, France, Greece, Hungary, Poland, and Sweden.

From an input-oriented perspective, a significant negative relationship was found between the growth rate of the efficiency coefficients and the total growth rate of public spending, suggesting that higher public sector efficiency can be achieved with lower levels of public spending growth. When introducing control variables, a positive relationship was observed between the economic cycle and public spending growth, as public spending tends to increase during recessions, in line with counter-cyclical fiscal policies. Additionally, a negative relationship was identified between human capital levels and public spending growth,

indicating greater efficiency in the use of public resources. The negative and significant relationship between the S80/S20 ratio and public spending growth suggests that higher income inequalities may be associated with greater spending growth.

When analyzing the COFOG, significant negative relationships were also observed between the growth rate of the efficiency coefficients and public spending growth in areas such as social protection, education, health, economic affairs, and public service provision. In these categories, greater efficiency is associated with lower spending growth, especially with high levels of human capital. In the case of health, a positive relationship was also found between the economic cycle and spending growth, indicating that spending increases during recessions.

In the output-oriented analysis, the results are consistent with the previous findings, with negative relationships observed between the growth rate of the efficiency coefficients and public spending growth. The inclusion of control variables reaffirmed the positive relationship with the economic cycle and the negative relationship with human capital levels. Additionally, the youth dependency ratio showed a negative relationship with spending growth, suggesting that an increase in this ratio reduces pressure on public spending, especially in areas such as pensions and elderly care.

Similar to the input-oriented exercise, other spending areas included in COFOG, such as social protection, education, health, economic affairs and public services, were examined. In these areas, a negative relationship was found between human capital levels and public spending growth. Likewise, in social protection and economic affairs expenditures, a negative rate was observed between the youth dependency ratio and public spending variation.

In conclusion, these results suggest that, under certain conditions, economic growth does not necessarily imply a proportional increase in public spending, which could contradict Wagner's Law predictions, especially regarding total public spending and in sectors such as social protection, education, health, public services, and economic affairs.

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Appendix
Appendix A

Table A1. Summary of variables used for Public Sector Performance (PSP)

Sub Index	Variable	Source/Period	Series
Opportunity Indicators			
Administration	Corruption	Transparency International Corruption Perception Index (CPI), (1998-2019)	Corruption on a scale from 10 (Perceived to have low levels of corruption) to 0 (highly corrupt), 1998-2011; Corruption on a scale from 100 (Perceived to have low levels of corruption) to 0 (highly corrupt), 2012-2019.
	Red Tape	World Economic Forum: The Global Competitiveness Report, (2007-2017)	Burden of government regulation on a scale from 7 (not burdensome at all) to 1 (extremely burdensome)
	Judicial Independence	World Economic Forum: The Global Competitiveness Report, (2007-2017)	Judicial independence on a scale from 7 (entirely independent) to 1 (heavily influenced).
	Property Rights	World Economic Forum: The Global Competitiveness Report, (2007-2017)	Property rights on a scale from 7 (very strong) to 1 (very weak).
	Shadow Economy	Medina and Schneider (2017), (1997-2017)	Shadow economy measured as percentage of official GDP. Reciprocal value 1/x
Education	Secondary School Enrollment	World Bank, World Development Indicators, (1997-2019)	Ratio of total enrolment, regardless of age, in secondary education.
	Quality of Educational System	World Economic Forum: The Global Competitiveness Report, (2007-2017)	Quality of educational system on a scale from 7 (very well) to 1 (not well at all).
Health	Infant Survival Rate	World Bank, World Development Indicators, (1997-2019)	Infant survival rate = (1000-IMR)/1000. IMR is the infant mortality rate measured per 1000 lives birth in a given year.
	Life expectancy	World Bank, World Development Indicators, (1997-2019)	Life expectancy at birth, measured in years
	CVD, cancer, diabetes or CRD Survival Rate	World Health Organization, Global Health Observatory Data Repository, (2000-2019)	CVD, cancer and diabetes survival rates = 100-M. M is the mortality rate between the ages 30 and 70.
Public infrastructure	Infrastructure Quality	World Economic Forum: The Global Competitiveness Report, (2008-2018)	Infrastructure quality on a scale from 7 (extensive and efficient) to 1 (extremely underdeveloped)
"Musgravian" indicators			
Distribution	Gini Index	World Bank, World Development Indicators, (1997-2019)	Gini index on a scale from 1 (perfect inequality) to 0

			(perfect equality). Transformed to 1-Gini.
Stabilization	Coefficient of Variation of Growth	IMF World Economic Outlook (WEO database), (1997-2019)	Coefficient of variation = standard deviation/mean of GDP growth based on 5-year data. GDP constant prices (percent change). Reciprocal value 1/x.
	Standard Deviation of Inflation	IMF World Economic Outlook (WEO database), (1997-2019)	Standard deviation of inflation based on 5-year consumer prices (percent change) data. Reciprocal value 1/x.
Economic Performance	GDP per Capita	IMF World Economic Outlook (WEO database), (1997-2019)	GDP per capita based on PPP, current international dollar.
	GDP Growth	IMF World Economic Outlook (WEO database), (1997-2019)	GDP constant prices (percent change).
	Unemployment	IMF World Economic Outlook (WEO database), (1997-2019)	Unemployment rate, as a percentage of total labor force. Reciprocal value 1/x.

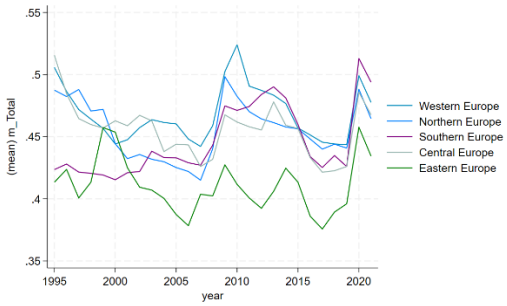
Table A2. Summary of the control variables used for the regressions

Variable	Source/Period	Series
Business cycle	Federal Reserve Economic Data (1995-2021)	OECD based Recession Indicators from the period following the Peak through the Trough (monthly data). A value of 1 is a recessionary period, while a value of 0 is an expansionary period.
Young dependency ratio	World Bank (1995-2021)	Age dependency ratio, young (% of working-age population)
Old dependency ratio	World Bank (1995-2021)	Age dependency ratio, old (% of working-age population)
Human capital	Groningen Growth and Development Centre (1995-2021)	Human capital index, based on year of schooling and returns to education (in ln)
S80/S20	Eurostat (2003-2021)	Income quintile share ratio S80/S20 for disposable income
Redistribution	World Inequality Database (1995-2021)	Income inequality (top 10% share)

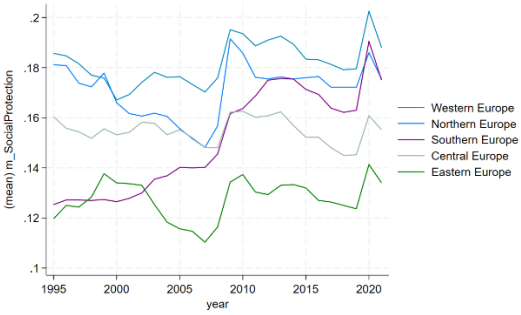
Appendix B

Figure B1. Evolution of Public Expenditure (in % of the GDP) by regions (1995-2020)

Total

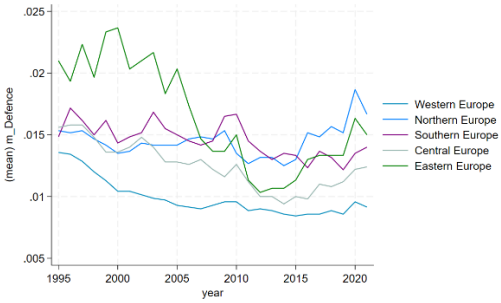


Social Protection

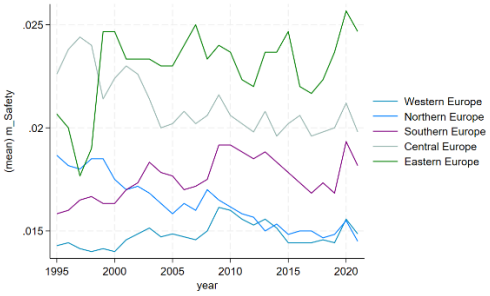


General Public Services

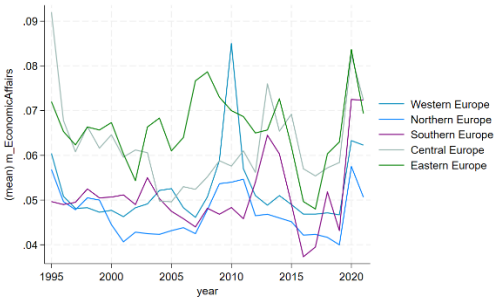
Defence



Public Order and Safety

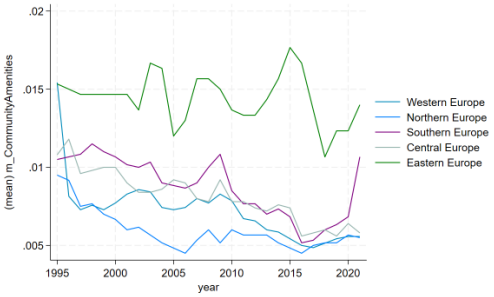


Economic Affairs

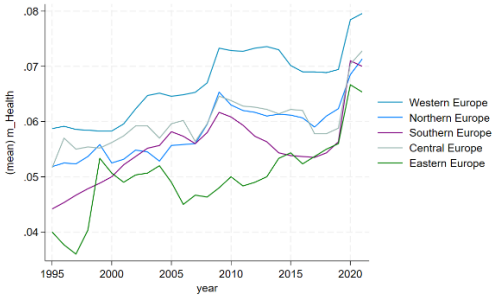


Environmental protection

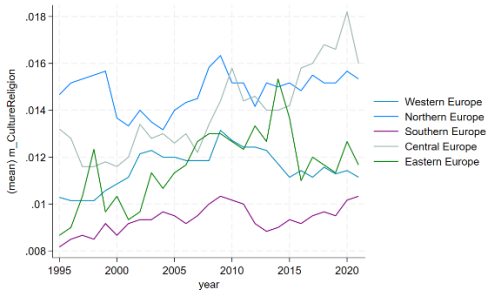
Housing and Community Amenities



Health



Recreation, Culture and Religion



Education

Graph B1. Evolution of the growth rate of the GDP (1995-2020)

Appendix C

Table C1. Summary of Administration PSP indicator

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
max(country)	AUT	AUT	AUT	AUT	AUT	AUT	AUT	AUT	AUT	AUT	AUT	AUT	AUT	AUT	AUT	LUX	AUT	FIN	FIN	FIN	LUX	LUX	LUX	FIN	FIN	DNK	DNK
min(country)	HRV	HRV	HRV	HRV	HRV	ROU	ROU	ROU	ROU	ROU	ROU	ROU	ROU	BGR	BGR	BGR	HRV	HRV	GRC	HRV	BGR	HRV	HRV	HRV	HRV	BGR	BGR
Average	1.000	1.000	1.000	1.077	1.043	1.043	1.043	1.043	1.032	1.020	1.020	1.020	1.020	1.007	1.007	1.007	1.006	1.006	1.006	1.006	1.006	1.006	1.006	1.007	1.013	1.038	1.038
Median	0.803	0.849	0.799	0.998	0.946	0.935	0.916	0.911	0.875	0.871	0.893	0.935	0.923	0.937	0.942	0.939	0.923	0.898	0.904	0.926	0.938	0.947	0.935	0.986	0.976	0.978	0.987
Max	2.131	2.114	2.073	1.799	1.714	1.737	1.767	1.793	1.791	1.790	1.788	1.768	1.771	1.416	1.387	1.392	1.404	1.383	1.411	1.420	1.407	1.394	1.385	1.402	1.416	1.423	1.424
Min	0.539	0.550	0.578	0.549	0.522	0.530	0.531	0.517	0.511	0.511	0.510	0.515	0.563	0.662	0.700	0.686	0.681	0.706	0.701	0.704	0.687	0.709	0.695	0.676	0.666	0.711	0.679
Stdev	0.432	0.420	0.417	0.434	0.401	0.396	0.389	0.387	0.377	0.367	0.362	0.359	0.352	0.225	0.225	0.239	0.245	0.234	0.236	0.241	0.239	0.233	0.236	0.220	0.212	0.229	0.234

Note: Summary of the Administration PSP indicator results for the periods 1995-2021. For the calculation of the Administration PSP indicator, we calculate the simple average of the normalized variables of corruption, red tape, judicial independence, property rights and shadow economy.

Table C2. Summary of Education PSP indicator

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
max(country)	BEL	BEL	SWE	SWE	SWE	SWE	BEL	BEL	BEL	BEL	BEL	BEL	BEL	BEL	BEL	BEL	BEL	BEL	BEL	BEL	BEL	BEL	BEL	FIN	BEL	BEL	FIN
min(country)	ROU	ROU	ROU	ROU	BGR	BGR	BGR	BGR	ROU	ROU	ROU	ROU	ROU	GRC	GRC	BGR	SVK	BGR	ROU	SVK	SVK	SVK	ROU	ROU	ROU	ROU	ROU
Average	1.038	1.038	1.227	1.080	1.038	1.038	1.000	1.000	1.000	1.038	1.000	1.000	1.000	1.015	1.051	1.020	1.019	1.019	1.042	1.042	1.000	1.021	1.021	1.000	1.038	1.000	1.000
Median	0.982	0.969	1.143	1.011	0.999	0.985	0.943	0.954	0.953	1.008	0.975	0.967	0.963	1.004	1.039	1.005	0.997	1.008	1.018	1.032	0.984	1.010	1.006	0.977	1.002	0.955	0.955
Max	1.472	1.461	1.716	1.681	1.589	1.520	1.488	1.491	1.496	1.528	1.513	1.525	1.527	1.399	1.460	1.386	1.393	1.413	1.402	1.389	1.336	1.361	1.353	1.312	1.472	1.368	1.297
Min	0.798	0.802	0.988	0.874	0.807	0.800	0.772	0.794	0.793	0.832	0.780	0.823	0.807	0.784	0.781	0.865	0.875	0.875	0.865	0.861	0.828	0.846	0.830	0.789	0.811	0.778	0.780
Stdev	0.184	0.184	0.196	0.186	0.192	0.180	0.173	0.162	0.154	0.130	0.132	0.130	0.130	0.122	0.133	0.112	0.112	0.113	0.130	0.128	0.123	0.129	0.137	0.142	0.151	0.144	0.141

Note: Summary of the Education PSP indicator results for the periods 1995-2021. For the calculation of the Education PSP indicator, we calculate the simple average of the normalized variables of secondary school enrollment and quality of educational system.

Table C3. Summary of Health PSP indicator

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
max(country)	SWE	SWE	SWE	SWE	SWE	SWE	SWE	ITA	SWE	ITA	ITA	ITA	ITA	ITA	ITA	ITA	SWE	SWE	ESP	ITA	SWE	ITA	ITA	ITA	SWE	IRL	SWE
min(country)	LVA	ROU	ROU	LVA	LVA	LVA	LVA	LVA	LVA	LVA	LVA	LVA	LVA	LVA	LVA	LVA	LVA	LVA	LVA	BGR	BGR	BGR	BGR	BGR	BGR	BGR	BGR
Average	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
Median	1.008	1.008	1.008	1.008	1.007	1.018	1.018	1.019	1.020	1.021	1.023	1.023	1.021	1.021	1.019	1.018	1.017	1.017	1.014	1.015	1.015	1.014	1.015	1.013	1.014	1.009	1.012
Max	1.032	1.031	1.030	1.030	1.029	1.044	1.042	1.041	1.042	1.041	1.040	1.041	1.041	1.038	1.037	1.037	1.034	1.033	1.033	1.033	1.032	1.033	1.030	1.032	1.031	1.019	1.025
Min	0.943	0.956	0.953	0.956	0.960	0.939	0.933	0.933	0.936	0.936	0.931	0.923	0.925	0.933	0.939	0.938	0.938	0.942	0.943	0.937	0.940	0.938	0.937	0.937	0.936	0.961	0.950
Stdev	0.026	0.023	0.024	0.023	0.022	0.037	0.037	0.037	0.036	0.036	0.037	0.038	0.038	0.036	0.035	0.034	0.033	0.032	0.031	0.032	0.031	0.031	0.030	0.030	0.029	0.019	0.024

Note: Summary of the Health PSP indicator results for the periods 1995-2021. For the calculation of the Health PSP indicator, we calculate the simple average of the normalized variables of infant survival rate, life expectancy and CVD, cancer, diabetes or CRD survival rate.

Table C4. Summary of Public Infrastructure PSP indicator

	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
max(country)	DEU	DEU	AUT	FRA	FRA	FIN	FIN	FIN	NLD	NLD	NLD
min(country)	ROU	ROU	ROU	ROU	ROU	ROU	ROU	BGR	ROU	ROU	ROU
Average	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
Median	0.950	0.991	1.029	1.031	1.063	1.023	0.986	0.971	0.977	0.956	0.953
Max	1.376	1.386	1.324	1.275	1.258	1.240	1.232	1.224	1.249	1.255	1.258
Min	0.492	0.482	0.476	0.457	0.451	0.537	0.654	0.689	0.715	0.677	0.669
Stdev	0.255	0.271	0.244	0.213	0.207	0.185	0.159	0.149	0.151	0.155	0.158

Note: Summary of the Public Infrastructure PSP indicator results for the periods 2008-2018. For the calculation of the Public Infrastructure PSP indicator, we obtain the normalized value of the variable infrastructure quality.

Table C5. Summary of Opportunity PSP indicator

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
max(country)	AUT	AUT	AUT	SWE	SWE	SWE	SWE	SWE	FIN	AUT	AUT	AUT	AUT	FIN	FIN	FIN	FIN	FIN	FIN	FIN	FIN	FIN	FIN	FIN	FIN	FIN	FIN
min(country)	HRV	HRV	EST	HRV	BGR	ROU	ROU	ROU	ROU	ROU	ROU	ROU	ROU	BGR	BGR	BGR	ROU	ROU	ROU	ROU	BGR	BGR	ROU	ROU	SVK	ROU	BGR
Average	1.010	1.010	1.058	1.048	1.024	1.024	1.014	1.014	1.011	1.016	1.007	1.007	1.007	1.005	1.014	1.007	1.006	1.006	1.012	1.012	1.001	1.007	1.007	1.002	1.018	1.011	1.011
Median	0.982	0.969	0.972	0.971	0.966	0.957	0.952	0.951	0.958	0.973	0.955	0.954	0.964	1.005	1.026	1.010	1.011	1.023	1.013	1.004	0.989	0.966	0.968	0.971	1.003	0.990	0.982
Max	1.407	1.398	1.459	1.454	1.395	1.382	1.328	1.316	1.281	1.273	1.260	1.254	1.253	1.222	1.244	1.213	1.196	1.202	1.254	1.256	1.232	1.232	1.238	1.242	1.266	1.227	1.246
Min	0.776	0.780	0.826	0.808	0.781	0.767	0.757	0.753	0.748	0.762	0.744	0.761	0.772	0.757	0.765	0.761	0.766	0.760	0.769	0.799	0.795	0.814	0.807	0.806	0.847	0.818	0.814
Stdev	0.187	0.184	0.195	0.198	0.185	0.183	0.175	0.170	0.165	0.154	0.149	0.146	0.142	0.142	0.146	0.138	0.131	0.127	0.128	0.123	0.119	0.120	0.124	0.122	0.111	0.118	0.120

Note: Summary of the Opportunity PSP indicator results for the periods 1995-2021. For the calculation of the Opportunity PSP indicator, we obtain the simple average of the Administration, Education, Health and Public Infrastructure indicators.

Table C6. Summary of Distribution PSP indicator

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
max(country)	DNK	CZE	BEL	DEU	NLD	DNK	DEU	SWE	SWE	SVN	SVN	SVN	SVN	SVN	SVN	SVN	SVN	SVN	SVN	SVN	SVN	SVN	SVK	SVN	SVK	SVN
min(country)	GRC	ESP	ESP	ITA	ESP	ITA	FRA	IRL	PRT	PRT	LVA	ROU	LVA	LVA	LTU	PRT	PRT	ROU	CYP	LTU	BGR	BGR	BGR	BGR	BGR	BGR
Average	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
Median	1.021	1.023	1.012	1.010	1.010	0.991	1.003	0.987	1.005	1.015	1.008	1.003	1.001	0.996	0.995	0.995	0.986	0.983	1.001	0.998	0.999	1.004	1.009	1.008	1.000	1.006
Max	1.103	1.074	1.048	1.060	1.035	1.100	1.017	1.053	1.085	1.093	1.098	1.099	1.098	1.107	1.092	1.091	1.093	1.089	1.087	1.089	1.092	1.097	1.116	1.096	1.110	1.103
Min	0.902	0.919	0.926	0.933	0.953	0.934	0.980	0.961	0.889	0.888	0.889	0.878	0.908	0.911	0.912	0.933	0.927	0.930	0.928	0.913	0.899	0.867	0.866	0.853	0.863	0.864
Stdev	0.076	0.058	0.043	0.045	0.031	0.051	0.019	0.039	0.058	0.058	0.058	0.059	0.055	0.054	0.050	0.047	0.050	0.054	0.053	0.055	0.054	0.057	0.060	0.057	0.054	0.058

Note: Summary of the Distribution PSP indicator results for the periods 1995-2020. For the calculation of the Distribution PSP indicator, we obtain the normalized value of the Gini Index.

Table C7. Summary of Stabilization PSP indicator

	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
max(country)	IRL	NLD	ESP	GRC	HUN	HUN	ESP	ESP	ESP	BGR	POL	POL	POL	POL	GRC	LUX	SWE	LTU	MLT	DNK	MLT	IRL	IRL
min(country)	BGR	ROU	ROU	ROU	BGR	ROU	ROU	ROU	ROU	EST	EST	LVA	GRC	GRC	POL	GRC	GRC	ITA	GRC	GRC	ROU	GRC	ESP
Average	1.017	1.022	1.029	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
Median	0.907	1.012	1.093	1.088	1.019	0.948	0.958	0.886	0.943	0.855	0.882	0.978	1.023	1.357	0.801	0.941	1.102	0.958	0.890	0.955	0.974	0.833	0.975
Max	2.801	2.742	2.258	2.435	1.765	1.995	2.120	2.044	2.147	3.466	3.058	3.307	5.017	45.377	10.354	1.997	2.102	2.091	2.600	1.722	1.690	2.642	2.193
Min	-0.055	-0.026	-0.017	0.109	0.216	0.306	0.323	0.342	0.372	0.296	0.301	0.108	-0.556	-26.917	-7.725	-0.570	-0.111	0.268	0.275	0.483	0.486	0.232	0.391
Stdev	0.765	0.718	0.568	0.509	0.429	0.461	0.432	0.420	0.401	0.626	0.561	0.646	1.025	12.185	3.266	0.696	0.570	0.527	0.475	0.317	0.311	0.519	0.362

Note: Summary of the Stabilization PSP indicator results for the periods 1999-2021. For the calculation of the Stabilization PSP indicator, we calculate the simple average of the normalized variables of Coefficient of variation of growth and Standard deviation of inflation.

Table C8. Summary of Economic Performance PSP indicator

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
max(country)	CYP	LUX	LUX	LUX	LUX	LUX	LUX	LUX	LUX	LUX	LUX	LUX	LUX	ROU	LUX	SWE	LUX	GRC	MLT	IRL	IRL	LUX	IRL	IRL	LUX	LUX	IRL
min(country)	LTU	HUN	BGR	CZE	BGR	SVK	DNK	DNK	DNK	DNK	POL	HRC	DNK	EST	POL	LVA	GRC	LVA	CYP	CYP	GRC	GRC	GRC	GRC	DNK	SWE	CZE
Average	1.068	1.079	1.055	1.054	1.077	1.066	1.043	1.033	1.048	1.067	1.073	1.073	1.048	1.032	1.064	1.151	1.093	1.264	1.180	1.073	1.083	1.075	1.066	1.052	1.054	1.057	1.057
Median	1.029	1.027	1.110	0.978	1.076	1.007	1.013	0.995	1.033	0.992	1.018	1.011	0.976	1.051	1.043	1.169	1.051	-0.081	1.225	1.054	0.879	1.046	1.066	0.956	1.018	1.071	0.954
Max	2.428	2.322	2.621	2.683	3.210	3.000	2.718	2.627	2.381	2.369	2.169	2.305	2.386	2.834	2.099	3.560	2.186	22.508	7.328	2.463	3.373	2.390	2.018	2.112	1.980	1.753	2.138
Min	0.136	0.434	-1.006	-0.094	-0.775	0.326	0.270	0.147	0.121	0.610	0.577	0.650	0.177	-0.644	0.334	-0.570	-1.538	-21.543	-7.169	0.256	0.333	0.275	0.419	0.488	0.503	0.496	0.494
Stdev	0.543	0.403	0.672	0.565	0.797	0.545	0.506	0.471	0.408	0.382	0.377	0.340	0.400	0.862	0.337	0.887	0.737	9.126	2.784	0.539	0.587	0.378	0.386	0.372	0.380	0.322	0.363

Note: Summary of the Economic Performance PSP indicator results for the periods 1995-2021. For the calculation of the Economic Performance PSP indicator, we calculate the simple average of the normalized variables of GDP per capita, GDP growth and Unemployment.

Table C9. Summary of "Musgravian" PSP indicator

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
max(country)	CYP	LUX	IRL	LUX	IRL	NLD	ESP	GRC	LVA	LUX	LUX	LUX	LUX	BGR	NLD	SWE	POL	POL	GRC	LUX	IRL	LUX	MLT	IRL	MLT	IRL	IRL
min(country)	LTU	HUN	BGR	CZE	BGR	BGR	BGR	POL	POL	POL	ROU	PRT	HUN	EST	PRT	LVA	GRC	LVA	POL	GRC	GRC	GRC	GRC	GRC	LVA	GRC	ESP
Average	1.011	1.024	1.005	1.005	1.000	0.992	1.016	1.007	1.008	1.013	1.017	1.026	1.019	1.009	1.021	1.050	1.031	1.088	1.060	1.024	1.028	1.025	1.022	1.017	1.018	1.019	1.028
Median	1.004	1.027	1.066	0.971	1.063	1.021	1.093	1.062	1.023	0.983	1.025	1.015	1.047	1.004	0.973	0.991	1.048	1.602	1.235	1.058	1.024	1.006	0.997	0.959	1.023	1.025	0.991
Max	2.428	1.675	1.861	1.853	2.602	2.231	1.660	1.715	1.490	1.397	1.449	1.376	1.418	2.146	1.504	2.015	2.503	14.020	2.911	1.757	1.869	1.614	1.832	1.517	1.447	1.500	2.166
Min	0.136	0.434	-1.006	-0.094	-0.415	0.248	0.326	0.453	0.486	0.649	0.597	0.728	0.665	0.213	0.781	0.161	-0.382	-8.673	-1.726	0.269	0.386	0.506	0.549	0.648	0.700	0.750	0.563
Stdev	0.460	0.299	0.605	0.477	0.671	0.488	0.375	0.327	0.263	0.204	0.207	0.162	0.179	0.414	0.182	0.440	0.500	3.737	0.918	0.377	0.330	0.243	0.251	0.192	0.172	0.176	0.312

Note: Summary of the "Musgravian" PSP indicator results for the periods 1995-2021. For the calculation of the "Musgravian" PSP indicator, we obtain the simple average of the Distribution, Stabilization and Economic Performance indicators.

Table C10. Summary of Total PSP indicator

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
max(country)	CYP	LUX	IRL	LUX	IRL	NLD	LUX	LUX	LUX	LUX	LUX	LUX	LUX	BGR	NLD	SWE	POL	POL	GRC	LUX	IRL	LUX	MLT	IRL	MLT	IRL	IRL
min(country)	LTU	LVA	BGR	ROU	BGR	BGR	BGR	BGR	ROU	POL	ROU	ROU	ROU	LVA	HUN	LVA	GRC	LVA	POL	GRC	GRC	GRC	GRC	GRC	GRC	BGR	GRC
Average	1.010	1.017	1.032	1.027	1.012	1.008	1.015	1.010	1.009	1.015	1.012	1.016	1.013	1.007	1.018	1.029	1.019	1.047	1.036	1.018	1.014	1.016	1.014	1.010	1.018	1.015	1.020
Median	0.989	0.998	1.022	0.963	1.042	0.968	1.052	1.076	1.063	1.054	1.014	0.993	0.988	1.015	0.974	1.059	1.009	1.356	1.144	1.050	0.996	0.983	1.013	1.007	1.015	1.027	1.007
Max	1.639	1.439	1.551	1.552	1.878	1.772	1.384	1.358	1.296	1.285	1.301	1.269	1.292	1.451	1.346	1.599	1.681	7.448	1.890	1.451	1.482	1.376	1.396	1.309	1.225	1.317	1.656
Min	0.465	0.648	-0.053	0.375	0.183	0.511	0.551	0.637	0.617	0.755	0.671	0.746	0.757	0.601	0.856	0.528	0.251	-3.880	-0.416	0.570	0.628	0.688	0.710	0.763	0.813	0.822	0.782
Stdev	0.283	0.204	0.345	0.297	0.412	0.319	0.244	0.207	0.169	0.144	0.144	0.122	0.128	0.202	0.130	0.259	0.273	1.871	0.467	0.223	0.198	0.162	0.158	0.133	0.118	0.125	0.182

Note: Summary of the Total PSP indicator results for the periods 1995-2021. For the calculation of the Total PSP indicator, we obtain the simple average of the Opportunity and "Musgravian" PSP indicators.

Appendix D

Table D1. Summary of DEA output-oriented efficiency scores

	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Efficient Countries	2 HUN SWE	2 BGR SWE	5 CZE DNK HRV ROU SWE	2 BGR HRV	2 BGR HRV	3 BGR DNK HRV	4 DNK HRV POL SWE	6 BGR DNK FRA HRV POL SWE	3 AUT DNK HRV	4 FRA POL PRT SWE	3 FRA HUN POL	2 FRA HUN	5 DNK EST FRA LVA SWE	3 FRA GRC HUN	3 GRC IRL LVA	2 DNK GRC	3 DNK GRC LVA	4 BEL GRC POL SVN	2 FIN GRC	2 FRA GRC	2 FRA GRC	2 FRA GRC	2 FRA GRC	2 FRA GRC	2 FRA GRC	2 FRA GRC
Average	0.775	0.829	0.830	0.812	0.827	0.854	0.857	0.869	0.842	0.856	0.859	0.824	0.860	0.870	0.772	0.829	0.822	0.807	0.834	0.805	0.797	0.788	0.798	0.800	0.808	0.802
Median	0.739	0.839	0.834	0.818	0.852	0.896	0.884	0.909	0.877	0.887	0.875	0.835	0.846	0.846	0.773	0.835	0.814	0.785	0.837	0.790	0.796	0.782	0.783	0.783	0.803	0.808
Max	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
Min	0.539	0.583	0.606	0.575	0.560	0.610	0.614	0.608	0.613	0.620	0.642	0.650	0.694	0.724	0.588	0.599	0.591	0.578	0.606	0.511	0.497	0.462	0.455	0.439	0.444	0.413
Stdev	0.138	0.125	0.126	0.115	0.122	0.116	0.115	0.122	0.117	0.118	0.113	0.106	0.109	0.089	0.114	0.108	0.115	0.133	0.124	0.127	0.132	0.130	0.123	0.123	0.119	0.126

Note: Summary of the DEA results for the periods 1995-2021, using output-oriented models. We use one input, government' normalized total spending and one output, the total PSP.

Appendix E (online)

Table E1. Relationship between growth rates of total public sector efficiency (input-oriented) and growth rates of government expenditure on defence (dependent variable)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
θgr	-5.592	-6.361	-9.509*	-5.589	-5.841	1.176	-1.722	-8.062	-8.375	-7.372	-0.051	-8.815	-0.055	-6.865	-0.053
	(4.420)	(4.746)	(4.843)	(4.423)	(4.503)	(5.449)	(4.558)	(5.788)	(5.914)	(7.856)	(5.406)	(8.200)	(5.473)	(7.829)	(5.442)
cycle		-2.763						-0.948	-1.222	1.898	-3.638	0.767	-3.591	2.320	-3.518
		(3.902)						(3.790)	(3.994)	(6.219)	(3.697)	(6.400)	(3.671)	(6.129)	(3.772)
HC			8.083					-62.111	-71.024	207.953	-32.331	239.036	-30.990	227.460	-33.791
			(134.619)					(148.126)	(147.037)	(377.012)	(149.168)	(401.011)	(150.897)	(439.963)	(147.485)
young				0.332				0.638				-2.429	0.082		
				(1.135)				(1.099)				(3.863)	(1.084)		
elderly					-1.946				-0.065					-1.080	-0.245
					(1.618)				(1.247)					(4.727)	(1.174)
s8020						5.943				6.576		7.390		6.303	
						(5.302)				(7.310)		(7.843)		(6.777)	
red							-145.958*				-131.076		-129.482		-133.599
							(76.823)				(91.402)		(94.553)		(92.798)
Obs.	159	115	132	159	159	109	153	95	95	63	90	63	90	63	90
R^2	0.346	0.338	0.352	0.347	0.367	0.394	0.389	0.399	0.397	0.415	0.433	0.422	0.433	0.416	0.433

Notes: * indicates the level of significance of 10%, ** a level of 5% and *** a level of 1%. In brackets we report the robust standard errors. Obs. are the observations for each regression. Constant term was computed but for reasons of parsimony those results are not displayed.

Table E2. Relationship between growth rates of total public sector efficiency (input-oriented) and growth rates of government expenditure on public order and safety (dependent variable)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
θgr	-9.147***	-7.003**	-10.146***	-9.153***	-9.199***	-7.603***	-7.293***	-6.230*	-6.010*	-3.702	-3.390	-3.816	-3.366	-5.126	-3.389
	(2.910)	(2.971)	(3.519)	(2.922)	(2.934)	(2.828)	(2.634)	(3.560)	(3.465)	(4.148)	(3.815)	(4.334)	(3.731)	(4.743)	(3.835)
cycle		2.866						3.085	3.121	2.676	4.022	2.587	3.732	1.494	3.987
		(2.621)						(2.711)	(2.931)	(3.184)	(2.482)	(3.414)	(2.387)	(3.449)	(2.614)
HC			-9.984					-101.271	-95.408	-90.013	-35.663	-87.560	-44.078	-144.756*	-35.232
			(70.513)					(71.836)	(73.384)	(78.550)	(70.130)	(82.377)	(66.589)	(85.373)	(70.172)
young				-0.636*				-0.335				-0.192	-0.515		
				(0.380)				(0.775)				(1.321)	(0.765)		
elderly					-0.405				0.259					3.032*	0.072
					(0.409)				(0.688)					(1.789)	(0.640)
s8020						1.891				2.631		2.695		3.398	
						(2.634)				(3.428)		(3.467)		(3.371)	
red							-46.798				-42.338		-52.344		-41.594
							(40.659)				(41.226)		(41.916)		(41.800)
Obs.	159	115	132	159	159	109	153	95	95	63	90	63	90	63	90
R^2	0.449	0.461	0.499	0.456	0.451	0.454	0.468	0.540	0.539	0.633	0.577	0.633	0.580	0.660	0.577

Notes: * indicates the level of significance of 10%, ** a level of 5% and *** a level of 1%. In brackets we report the robust standard errors. Obs. are the observations for each regression. Constant term was computed but for reasons of parsimony those results are not displayed.

Table E3. Relationship between growth rates of total public sector efficiency (input-oriented) and growth rates of government expenditure on environmental protection (dependent variable)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
θgr	-12.864**	-9.189*	-11.234*	-12.832**	-12.656**	-8.796	-13.210**	-8.076	-6.664	2.846	-5.953	2.563	-5.864	3.361	-5.929
	(5.120)	(5.375)	(6.050)	(5.181)	(5.068)	(6.008)	(5.081)	(7.011)	(6.424)	(6.289)	(8.005)	(6.958)	(7.676)	(7.205)	(7.451)
cycle		4.554						4.302	3.777	5.496	4.855	5.274	3.760	5.924	3.474
		(5.746)						(6.309)	(6.160)	(5.652)	(5.687)	(5.809)	(5.897)	(5.971)	(5.677)
HC			39.624					-66.193	-30.659	-23.948	-4.499	-17.855	-36.189	-4.131	12.385
			(146.941)					(154.507)	(148.582)	(215.346)	(147.471)	(228.359)	(156.170)	(203.011)	(150.594)
young				-1.785*				-1.598				-0.476	-1.940		
				(0.913)				(1.956)				(2.138)	(2.059)		
elderly					1.520				2.681					-1.098	2.828
					(1.102)				(1.995)					(3.023)	(2.080)
s8020						0.469				-6.548		-6.389		-6.826*	
						(4.756)				(4.038)		(4.124)		(4.132)	
red							80.496				-17.824		-55.502		11.348
							(60.040)				(114.535)		(113.955)		(112.611)
Obs.	158	115	131	158	158	109	152	95	95	63	90	63	90	63	90
R^2	0.287	0.319	0.299	0.304	0.296	0.419	0.316	0.330	0.340	0.604	0.336	0.604	0.349	0.605	0.360

Notes: * indicates the level of significance of 10%, ** a level of 5% and *** a level of 1%. In brackets we report the robust standard errors. Obs. are the observations for each regression. Constant term was computed but for reasons of parsimony those results are not displayed.

Table E4. Relationship between growth rates of total public sector efficiency (input-oriented) and growth rates of government expenditure on community amenities (dependent variable)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
θgr	-1.887	-12.123	-4.437	-1.875	-1.816	-11.415	-0.932	-3.488	-4.130	-4.221	-4.051	-5.430	-4.050	-6.396	-4.054
	(11.727)	(7.522)	(11.561)	(11.779)	(11.767)	(9.685)	(12.962)	(8.955)	(9.023)	(9.967)	(9.630)	(10.412)	(9.759)	(10.859)	(9.728)
cycle		-2.041						-3.582	-4.455	9.849	-3.125	8.810	-2.535	8.282	-3.490
		(8.988)						(9.211)	(9.493)	(13.291)	(10.822)	(13.892)	(10.771)	(13.875)	(10.941)
HC			-122.134					-189.073	-207.199	-435.520*	-165.742	-409.362*	-142.644	-518.372*	-160.953
			(134.965)					(137.242)	(140.941)	(234.215)	(152.134)	(245.569)	(149.326)	(255.771)	(152.124)
young				0.439				1.569				-2.047	1.404		
				(1.224)				(1.826)				(5.187)	(1.999)		
elderly					0.619				0.616					4.593	0.806
					(1.411)				(2.069)					(4.643)	(2.105)
s8020						-3.166				9.689		10.378		10.843	
						(8.067)				(7.519)		(7.205)		(7.263)	
red							-134.341				19.746		47.988		27.921
							(155.713)				(153.106)		(163.653)		(156.249)
Obs.	158	114	131	158	158	108	152	94	94	62	89	62	89	62	89
R^2	0.321	0.276	0.436	0.321	0.322	0.326	0.347	0.346	0.342	0.457	0.356	0.460	0.360	0.469	0.357

Notes: * indicates the level of significance of 10%, ** a level of 5% and *** a level of 1%. In brackets we report the robust standard errors. Obs. are the observations for each regression. Constant term was computed but for reasons of parsimony those results are not displayed.

Table E5. Relationship between growth rates of total public sector efficiency (input-oriented) and growth rates of government expenditure on culture and religion (dependent variable)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
θgr	-6.207	-5.527	-6.114	-6.221	-6.082	-7.281	-7.131*	-6.315	-5.554	-3.835	-5.834	-4.453	-5.752	-3.918	-5.832
	(3.994)	(3.718)	(4.693)	(3.968)	(3.940)	(4.713)	(4.073)	(4.262)	(4.214)	(4.705)	(4.563)	(4.916)	(4.540)	(5.222)	(4.586)
cycle		2.862						2.838	3.566	4.777	5.030	4.293	4.021	4.708	4.952
		(3.850)						(4.159)	(3.972)	(5.018)	(4.203)	(4.774)	(4.540)	(5.445)	(4.117)
HC			23.366					-79.359	-57.529	-268.553***	2.097	-255.249**	-27.129	-271.732**	3.053
			(111.379)					(109.504)	(103.446)	(94.137)	(113.212)	(99.784)	(117.165)	(107.298)	(112.935)
young				-1.557**				-1.597				-1.040	-1.789		
				(0.737)				(1.304)				(2.885)	(1.371)		
elderly					0.973				0.073					0.176	0.160
					(0.779)				(1.697)					(2.317)	(1.838)
s8020						8.473***				1.674		2.023		1.719	
						(2.673)				(3.090)		(3.012)		(3.318)	
red							87.648*				32.047		-2.702		33.698
							(49.638)				(88.532)		(95.066)		(95.252)
Obs.	159	115	132	159	159	109	153	95	95	63	90	63	90	63	90
R^2	0.353	0.446	0.313	0.377	0.360	0.543	0.378	0.436	0.423	0.507	0.387	0.510	0.407	0.507	0.387

Notes: * indicates the level of significance of 10%, ** a level of 5% and *** a level of 1%. In brackets we report the robust standard errors. Obs. are the observations for each regression. Constant term was computed but for reasons of parsimony those results are not displayed.

Appendix F (online)

Table F1. Relationship between growth rates of total public sector efficiency (output-oriented) and growth rates of total government expenditure (dependent variable)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
θgr	-3.061	-2.234	-6.097**	-3.045	-3.243	-0.399	-2.979	-4.500	-5.369	-3.872	-5.030	-3.215	-4.433	-3.100	-5.032
	(2.794)	(3.108)	(2.991)	(2.774)	(2.729)	(3.333)	(2.843)	(3.089)	(3.389)	(4.607)	(3.345)	(4.759)	(3.239)	(4.610)	(3.356)
cycle		0.109						1.292	1.126	0.073	0.821	0.210	1.057	-0.005	0.822
		(3.072)						(3.046)	(3.233)	(3.795)	(3.232)	(3.754)	(3.142)	(3.762)	(3.267)
HC			79.950					6.449	45.421	-184.073**	82.672	-218.298**	43.497	-162.702*	82.407
			(55.577)					(78.107)	(63.317)	(90.370)	(72.910)	(90.918)	(83.876)	(84.185)	(64.904)
young				-0.643				-1.733				-1.220	-1.249		
				(0.807)				(1.142)				(1.311)	(1.107)		
elderly					-0.995				-0.199					1.218	-0.009
					(1.171)				(0.867)					(0.964)	(0.841)
s8020						4.855				8.295*		7.915*		9.505**	
						(4.012)				(4.455)		(4.259)		(4.449)	
red							42.247				112.978		87.808		112.896
							(57.493)				(84.760)		(84.505)		(83.840)
Obs.	270	199	216	270	270	166	260	160	160	86	152	86	152	86	152
R^2	0.147	0.157	0.202	0.150	0.154	0.186	0.152	0.204	0.188	0.422	0.213	0.430	0.222	0.433	0.213

Notes: * indicates the level of significance of 10%, ** a level of 5% and *** a level of 1%. In brackets we report the robust standard errors. Obs. are the observations for each regression. Constant term was computed but for reasons of parsimony those results are not displayed.

Table F2. Relationship between growth rates of total public sector efficiency (output-oriented) and growth rates of government expenditure on public order and safety (dependent variable)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
θgr	-4.840**	-3.767*	-6.510**	-4.821**	-4.832**	-3.177*	-4.730**	-3.836*	-5.042**	-0.559	-4.331*	0.497	-3.152	-0.888	-4.361*
	(2.249)	(2.121)	(2.693)	(2.205)	(2.241)	(1.769)	(2.296)	(2.087)	(2.536)	(3.189)	(2.533)	(2.953)	(2.172)	(3.308)	(2.527)
cycle		2.300						2.982*	2.747	-0.796	1.910	-0.576	2.376	-0.763	1.922
		(1.832)						(1.717)	(1.934)	(1.924)	(1.997)	(1.675)	(1.755)	(1.882)	(1.999)
HC			26.529					-96.243**	-40.325	-59.646	-16.058	-114.600**	-93.380*	-68.758	-19.679
			(42.041)					(44.539)	(41.775)	(45.421)	(52.329)	(47.192)	(49.546)	(43.135)	(50.322)
young				-0.761				-2.429***				-1.959**	-2.465***		
				(0.528)				(0.867)				(0.787)	(0.840)		
elderly					0.041				-0.228					-0.519	-0.125
					(0.425)				(0.522)					(0.673)	(0.517)
s8020						2.778				4.963**		4.353**		4.447*	
						(1.991)				(2.238)		(1.774)		(2.333)	
red							15.336				38.795		-10.884		37.677
							(40.602)				(54.940)		(44.757)		(55.638)
Obs.	270	199	216	270	270	166	260	160	160	86	152	86	152	86	152
R^2	0.231	0.228	0.269	0.236	0.231	0.359	0.235	0.334	0.255	0.482	0.259	0.544	0.342	0.488	0.259

Notes: * indicates the level of significance of 10%, ** a level of 5% and *** a level of 1%. In brackets we report the robust standard errors. Obs. are the observations for each regression. Constant term was computed but for reasons of parsimony those results are not displayed.

Table F3. Relationship between growth rates of total public sector efficiency (output-oriented) and growth rates of government expenditure on environmental protection (dependent variable)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
θgr	-7.313***	-4.591*	-8.806**	-7.259***	-7.252***	-4.933	-7.274***	-6.027*	-6.188*	-5.593	-6.037*	-5.532	-5.528	-4.802	-5.888
	(2.785)	(2.790)	(3.767)	(2.761)	(2.775)	(3.340)	(2.771)	(3.571)	(3.677)	(5.530)	(3.650)	(5.658)	(3.551)	(5.626)	(3.687)
cycle		2.697						3.414	3.296	3.139	3.017	3.152	3.218	3.059	2.957
		(3.254)						(3.202)	(3.238)	(4.535)	(3.147)	(4.518)	(3.029)	(4.562)	(3.160)
HC			45.624					18.346	57.132	-37.327	-15.620	-40.512	-40.000	-15.431	2.319
			(57.147)					(55.137)	(58.745)	(68.119)	(58.760)	(80.111)	(62.624)	(68.090)	(61.236)
young				-1.824**				-0.705				-0.114	-1.064		
				(0.771)				(1.183)				(1.884)	(1.221)		
elderly					0.329				0.813					1.248	0.617
					(0.599)				(0.789)					(1.042)	(0.777)
s8020						3.901				6.391		6.356		7.631*	
						(3.897)				(4.272)		(4.384)		(4.365)	
red							67.885				-77.772		-99.218		-72.233
							(45.552)				(64.144)		(66.801)		(63.530)
Obs.	268	199	214	268	268	166	258	160	160	86	152	86	152	86	152
R^2	0.111	0.143	0.123	0.139	0.112	0.199	0.141	0.173	0.175	0.354	0.209	0.354	0.215	0.363	0.212

Notes: * indicates the level of significance of 10%, ** a level of 5% and *** a level of 1%. In brackets we report the robust standard errors. Obs. are the observations for each regression. Constant term was computed but for reasons of parsimony those results are not displayed.

Table F4. Relationship between growth rates of total public sector efficiency (output-oriented) and growth rates of government expenditure on community amenities (dependent variable)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
θgr	-3.633	-0.071	-2.309	-3.635	-3.631	-7.106	-3.916	2.466	3.183	-2.068	3.953	-2.571	3.150	-3.941	3.638
	(5.865)	(5.908)	(6.756)	(5.872)	(5.872)	(5.966)	(5.867)	(5.389)	(5.287)	(7.510)	(5.414)	(7.414)	(5.570)	(7.118)	(5.359)
cycle		5.855						4.699	5.205	1.906	6.141	1.427	5.428	1.961	6.223
		(5.300)						(4.873)	(4.910)	(7.151)	(5.382)	(7.118)	(5.396)	(6.946)	(5.283)
HC			-10.608					-49.117	-143.778*	-106.288	-143.641*	-61.628	-76.005	-162.103**	-186.390**
			(71.474)					(76.543)	(74.326)	(70.735)	(83.836)	(100.972)	(88.275)	(73.723)	(84.573)
young				-0.370				2.413**				1.550	2.125*		
				(0.973)				(1.215)				(2.111)	(1.312)		
elderly					0.012				-1.296					-3.215**	-1.477
					(0.950)				(0.979)					(1.244)	(0.999)
s8020						-3.694				3.833		4.158		0.562	
						(7.005)				(4.734)		(4.986)		(5.086)	
red							-99.112				-103.603		-57.979		-116.315
							(110.082)				(98.295)		(102.838)		(98.660)
Obs.	269	198	215	269	269	165	259	159	159	85	151	85	151	85	151
R^2	0.158	0.142	0.231	0.158	0.158	0.205	0.164	0.244	0.232	0.302	0.232	0.309	0.246	0.349	0.242

Notes: * indicates the level of significance of 10%, ** a level of 5% and *** a level of 1%. In brackets we report the robust standard errors. Obs. are the observations for each regression. Constant term was computed but for reasons of parsimony those results are not displayed.

Table F5. Relationship between growth rates of total public sector efficiency (output-oriented) and growth rates of government expenditure on culture and religion (dependent variable)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
θgr	-7.379***	-6.830***	-10.914***	-7.360***	-7.302***	-3.339	-7.503***	-8.874***	-9.307***	-8.779***	-9.130***	-8.264**	-8.515***	-9.158***	-8.972***
	(2.267)	(2.271)	(2.698)	(2.252)	(2.270)	(2.550)	(2.316)	(2.614)	(2.694)	(3.184)	(2.760)	(3.198)	(2.689)	(3.144)	(2.784)
cycle		-0.244						0.465	0.310	1.226	-0.296	1.334	-0.053	1.265	-0.359
		(2.168)						(2.139)	(2.182)	(2.458)	(2.397)	(2.472)	(2.317)	(2.457)	(2.373)
HC			14.027					-6.772	38.837	-8.621	29.082	-35.431	-11.230	-19.110	48.066
			(35.681)					(37.160)	(37.500)	(44.695)	(39.870)	(51.420)	(43.814)	(47.246)	(43.647)
young				-0.768				-1.182				-0.956	-1.285*		
				(0.633)				(0.750)				(0.873)	(0.733)		
elderly					0.426				0.606					-0.598	0.653
					(0.437)				(0.560)					(0.687)	(0.572)
s8020						4.315				1.376		1.079		0.782	
						(2.745)				(2.138)		(2.067)		(2.327)	
red							52.250				-0.736		-26.637		5.125
							(37.449)				(50.953)		(51.352)		(52.060)
Obs.	270	199	216	270	270	166	260	160	160	86	152	86	152	86	152
R^2	0.237	0.283	0.272	0.244	0.239	0.374	0.255	0.356	0.347	0.494	0.335	0.505	0.351	0.500	0.341

Notes: * indicates the level of significance of 10%, ** a level of 5% and *** a level of 1%. In brackets we report the robust standard errors. Obs. are the observations for each regression. Constant term was computed but for reasons of parsimony those results are not displayed.