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Abstract

This paper provides a large dataset on public sector efficiency using a parametric approach, covering 158 countries of all income levels, over the period 1990-2017. The analysis includes four sectors: education, health, infrastructure, and public administration. We further consider three efficiency indicators regarding the 'Musgravian' tasks for government: allocation, distribution, and stabilization. After computing the efficiency scores for our sample countries, we examine the determinants of government efficiency using a wide range of economic and institutional factors. Our key findings are that trade globalization, factor productivity, and institutional quality seem to be important determinants of total public sector efficiency. The results remain robust to alternative specifications and methods. Finally, we provide additional evidence, by exploring the sensitivity of the main determinants to different country groups, considering the level of economic development, geographical regions, and fragile states.

JEL Classifications: C19, E02, E62

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1 Introduction

Typically associated by economists and political scientists with the size of the state in the economy, government spending helps influence economic conditions to achieve economic and social policy objectives such as stabilization, allocation, and resource redistribution (Musgrave, 1959; Desmarais-Tremblay, 2021). From the middle of the 20th century onwards, public spending in the first industrialized countries — especially social spending — rose sharply, while public revenues increased historically over the same period. Similarly, the structure of public spending in developing countries has changed significantly since the mid-1990s, with a growing focus on social sectors. Prevailing tax rates in industrialized countries today leave little scope for increased taxation, especially in countries with the greatest pressures from aging. Developing countries, on the other hand — generally characterized by strong unequal income distribution, macroeconomic instabilities, poor infrastructure, and high levels of poverty — are facing a huge development challenge, moving fiscal choices to the top of the political agenda for achieving the Sustainable Development Goals.

Governments in both industrialized and developing countries should adopt a much more ambitious fiscal policy, given their scope for maneuver, to better align public policies with their set objectives. In other words, governments need to do 'more' with 'less', especially in the post-Covid era of prolonged recession and monetary policy normalization, where economies around the world are facing budgetary and financing capacity constraints (Hallaert and Primus, 2022). Against this background, there is a growing literature focusing on the utility of public sector activities, with empirical assessments of government efficiency. Essential contributions include, among others, Tanzi and Schuknecht (1997, 2000); Gupta and Verhoeven (2001) or Afonso et al. (2005, 2010). Furthermore, Hauner and Kyobe (2010) compiled a cross-country panel data set on health and education expenditure efficiency, covering 114 countries over the 1980-2006 period, and examined some determinants of the computed scores.

Data are needed to determine the factors that influence and shape public sector efficiency, to help governments to improve their spending efficiency in order to ensure their economic and social role and thus limit the need for painful reforms with high political

costs, as currently illustrated by the French context with the pension reform, causing social unrest and protests (The Economist, 2023). In addition, data on public sector efficiency are useful for informing citizens about public sector management, comparing differences in performance between countries, and identifying areas where improvements can be made. In the literature, Afonso et al. (2005) are one of the first contributions that examine the question of PSE, providing crosssectional data on PSE for 23 industrialized countries over the period 1990–2000. Accordingly, the purpose of this paper is to take advantage of new methods to provide a panel database on public sector efficiency, including a country-year dimension. A secondary motivation is to analyze some robust determinants of efficiency, also exploring those that can explain the efficiency gap between developed and developing countries.

This paper contributes to the literature on public expenditure efficiency on two main grounds. First, while Afonso et al. (2005) compile efficiency scores for 23 industrialized countries over 1990-2000 using non-parametric methods, we provide the same indices using panel data over a longer period, 1990-2017, and include a large sample of 158 countries of all income levels. Furthermore, here efficiency scores are measured through a parametric approach — a Stochastic Frontier Analysis (SFA) following Kumbhakar et al. (2015) — in contrast to the existing literature which generally uses non-parametric approaches, namely the Data Envelopment Analysis (DEA) or the Free Disposal Hull (FDH) method.[1] Indeed, although non-parametric methods have the main advantage of not imposing any specific functional form on data distribution, they have two major limitations. On the one hand, they are very sensitive to random variations in the data and to measurement errors, sample variations, heterogeneity between units, the presence of outliers, and the degrees of freedom. On the other hand, as deterministic methods, they ignore measurement errors as well as any stochastic influence, considering any variation between units as inefficiency (Kumbhakar and Lovell, 2003). Thus, the SFA approach allows considering measurement errors as well as country-independent randomness to

[1]For example, Herrera and Pang (2005) use both the FDH and DEA approach to estimate health and education expenditure efficiency for a sample of 140 developing countries between 1996 and 2002. Afonso et al. (2005) analyze expenditure efficiency in 23 industrialized countries, using the DEA and FDH methods. Hauner and Kyobe (2010) compile a cross-country panel data set on education and health expenditure efficiency for 114 countries between 1980 and 2004, using the DEA approach. Finally, Wang and Alvi (2011) also use the DEA method, with an application to Asian countries.

disentangle inefficiency resulting from exogenous factors and that resulting from public sector mismanagement. This method is all the more relevant as public expenditure is affected by exogenous shocks such as commodity price shocks or environmental shocks, etc. A few studies using parametric methods are found in the literature. For example, Evans et al. (2000) use the SFA approach to assess health expenditure efficiency for a sample of 191 countries over the period 1993-1997. Likewise, estimating a stochastic frontier model, Grigoli and Kapsoli (2018) analyze health expenditure efficiency for 80 emerging and developing countries over 2001-2010.

Second, we provide some descriptive analyses and econometrically correlate the calculated scores with a series of economic and institutional determinants. On the descriptive side, advanced economies report a higher and statistically significant score (0.71) compared to developing countries (0.65). Furthermore, the 10 best-performing are advanced countries, while the 10 worst-performing are developing countries, and are mostly located in Africa. On the econometric side, a Tobit analysis suggests that trade globalization, factor productivity, and institutional quality tend to be associated with greater efficiency. Robustness was checked by controlling for some additional determinants and using alternative measures of expenditure efficiency. In addition, we address endogeneity issues, by re-estimating our baseline model using the system Generalized Method of Moments (GMM) estimator. Finally, we deepen the analysis, by examining our main determinants according to the level of economic development — distinguishing between advanced and developing countries — and geographical regions. First, our data suggest that trade globalization, factor productivity, and institutional quality seem to increase efficiency in both advanced and developing countries, while taxation seems to decrease efficiency in advanced countries. Second, trade globalization, factor productivity, and the level of democracy seem to reduce the efficiency gap between advanced and developing economies. Third, factor productivity and the level of democracy appear to be positively correlated with public expenditure efficiency in all the groups considered (Africa, Asia, Latin America, and Europe), while the positive impact of trade globalization on efficiency seems to be driven by Asian and European countries. Likewise, the negative effect of taxation on efficiency seems to be mainly driven by Latin American and European countries. Finally, government durability seems to promote efficiency in

European countries, while it seems to reduce efficiency in fragile states.

We organize the document as follows. The following section defines the conceptual framework for measuring efficiency. Section 3 describes the methodology for calculating the scores. Some stylized facts are then reported in Section 4. Section 5 examines some potential determinants of the calculated scores. Sections 6 and 7 analyze the robustness and heterogeneity of our main results. The last section concludes.

2 Conceptual Framework

Government deficits, particularly in developing and emerging market economies, have grown significantly in recent years (Gnimassoun and Do Santos, 2021). Public finances deteriorated further in the context of the Covid-19 crisis, including in advanced economies, where a number of measures have been introduced to support social policies, leading to a substantial increase in public debt. That said, governments should promote sound fiscal management, given their room for maneuver, to better achieve the targets set. Furthermore, as long argued by the public choice school, given the lack of competition in public services, waste is likely to occur in the public sector, leading to inefficiency (Jackson and McLeod, 1982). Against this background, firstly used to assess firm performance, the concept of efficiency has been progressively extended to the public sector, in order to judge to what extent government spending contributes to the objectives set, in the quest for better public sector management. Indeed, researchers argue that attempts to measure public sector efficiency are not entirely new (Pollitt and Bouckaert, 2011). This literature has expanded considerably in recent years, with major contributions from, among others, Tanzi and Schuknecht, 1997, 2000; Gupta and Verhoeven, 2001; Afonso et al., 2005, 2010 or Hauner and Kyobe, 2010).[2] Conceptually, efficiency implies achieving an objective in an economy of means, i.e., the relationship between the results obtained, and the resources used to achieve them. In other words, greater efficiency is essential to ensure that governments deliver high-quality services to their citizens while using public resources responsibly. Empirically, efficiency scores are

[2]Other contributions assess efficiency at the local level (e.g., see Eeckaut et al., 1993; Worthington, 2000; Afonso and Fernandes, 2008).

derived based on the relative distances of inefficient observations from an ideal frontier, made up of the best-performing units in the sample (see Farrell, 1957). The literature distinguishes between technical and allocative efficiency. The first is defined as the ability of a unit to produce a given set of outputs with minimal inputs, regardless of input prices. The latter measures the ability of a unit to use inputs in optimal proportions given their prices. In this study, we choose the first approach, as estimating allocative efficiency requires information on the price structure of inputs (which, in our context, would be difficult to obtain), while the former requires only quantity data (Lovell, 2000; Afonso and Fernandes, 2008).

Measuring efficiency in organizational units such as the public sector is challenging, as public objectives are usually poorly defined, complex, and multidimensional (M. Lewis, 2015). In other words, public sector performance is a multidimensional concept, sometimes involving hybrid public sector organizations that combine elements of the public and private sectors, thus generating complexity in public management (Jackson, 2011; De Waele et al., 2021). Therefore, the dimensions of the economy that are likely to be really affected by public sector activities need to be rigorously grounded in the literature, to avoid ad hoc indicators that could bias the analysis. Such an exercise is not straightforward, as internationally comparable, relevant, valid, and reliable data are not always available, coupled with measurement difficulties and the potential effects of many external factors. The existing literature has often examined government efficiency in sectors such as education, health, and infrastructure, as public spending in these sectors has been shown to have a significant impact on economic growth, human capital, poverty or inequality, and business conditions (see, among others, Aschauer, 1989; Barro, 1990; Baffes and Shah, 1998; Jung and Thorbecke, 2003; Wilhelm and Fiestas, 2005; Chauvet and Ferry, 2021). In the same vein, the study by Afonso et al. (2005), which we follow in this paper, has attempted to approach the public sector through several dimensions, considering two categories of performance indicators. The opportunity performance includes the following sectors: education, health, infrastructure, and public administration. The Musgravian indicators allow for taking into account the traditional tasks of government, including three dimensions: distribution, stability, and economic performance. We further discuss the relevance of the selected indicators in subsection

3.1.

3 Methodology

As mentioned above, Public Sector Efficiency (PSE) refers to the relationship between the socio-economic indicators targeted by the government and the public resources used to achieve them. Subsection 3.1 describes the socio-economic indicators used in the study (Public Sector Performance —PSP— indices). Next, subsection 3.2 discusses the methodology for calculating the efficiency scores.

3.1 Public Sector Performance (PSP) Indices

We compute sectoral performance indices from a series of social indicators. For a given country i and j areas of government activity, the PSP is defined as follows: [3]

$$PSP_i = \sum_{j=1}^{n} PSP_{i,j} \tag{1}$$

with $PSP_{i,j} = f(I_k)$. Therefore, an improvement in PSP depends on improving the values of the relevant socio-economic indicators:

$$\Delta PSP_{ij} = \sum_{i=k}^{n} \frac{\delta f}{\delta I_k} * \Delta I_k. \tag{2}$$

As mentioned earlier, this study follows Afonso et al. (2005), who attempted to approach the public sector through several dimensions, considering two categories of performance indicators.[4] The first, described as opportunity performance, includes the following sectors: education, health, infrastructure, and public administration. Education and health spending have direct and indirect impacts on both economic growth and poverty or inequality. Health is fundamental to improving population productivity and well-being. Education, in turn, provides skills that increase employment opportunities

[3] See Afonso et al. (2005).

[4] Appendix C discusses the limitations of our measure of public sector efficiency and some possible extensions.

and incomes, while helping to protect populations from socioeconomic risks (Wilhelm and Fiestas, 2005). Public investment in infrastructure improves business conditions and can affect positively both domestic and foreign investment, which raises employment and growth (Arrow and Kurz, 1969; Aschauer, 1989; Barro, 1990; Baffes and Shah, 1998; Carboni and Medda, 2011). Last but not least, good quality of public administration, characterized by a good judicial system, efficient property rights, and well-functioning markets, can be seen as preconditions for a level playing field in the organization of a society (Afonso et al., 2005), and helps to build conditions for strong and sustained economic growth. The second category, described as 'Musgravian' performance, includes the traditional tasks for government: allocation, distribution, and stabilization. Indeed, the countercyclical role of fiscal policy is to promote macroeconomic stabilization and reduce economic fluctuations. Moreover, redistributive policies in favor of the poorest households also contribute to reducing poverty and inequality (Lindbeck, 1985; Ravallion, 1997; Cornia and Reddy, 1999). Finally, government spending, especially in social sectors, helps make households resilient to external shocks and can prevent them from falling into a poverty trap.

Outcome indicators were selected based on data availability and previous work (e.g., see Afonso et al., 2005; Herrera and Pang, 2005; Hauner and Kyobe, 2010). The education sector outcome index includes three sub-indicators: public primary enrollment, public secondary enrollment, and expected years of schooling.[5] The output indicators in health are life expectancy at birth and infant mortality rate (per 1000 live births). Following Donaubauer et al. (2016), we calculate an infrastructure sector outcome index using six infrastructure sub-indices, classified into three main groups: transport, communication, and energy. The output indicators in transport are the total length of roads in kilometers, normalized by the country's area, and the number of paved roads as a percentage of total roads. The outcome index for communication includes fixed telephone subscriptions (per 100 people), fixed broadband subscriptions (per 100 people), and faults for 100 fixed telephone lines per year. Three sub-indicators are also considered for the energy sector: the proportion of households with electricity, electric

[5]Qualitative indicators such as PISA (Programme for International Student Assessment) measures could have been considered, but these data are partly available only for OECD countries. Here we do not include them due to our sample size.

power consumption (in kWh per capita), and electric power transmission and distribution losses (as a percentage of production). Following Afonso et al. (2005), we retain four sub-indicators for public administration: the independence of the judiciary, the quality of property rights, the quality of government, and the level of the shadow economy. On the input side, we consider public expenditure on education (as a percentage of GDP) for the educational sector, public expenditure on health (as a percentage of GDP) for the health sector, public capital stock (as a percentage of GDP) and public-private partnership stock (as a percentage of GDP) for infrastructure, and government final consumption expenditure (as a percentage of GDP) for administration.

As mentioned earlier, we also consider Musgravian indicators, including three sub-indicators: distribution, stability, and economic performance. The outcome indicator for distribution performance is proxied by the Gini index. For the stability sub-indicators, we use the standard deviation of the three-year moving average of GDP growth and inflation. To measure economic performance, we include GDP per capita, GDP growth (10-year average), and unemployment rate (10-year average). We use total public expenditure (as a percentage of GDP) as input for economic stability and performance, and social protection expenditure (as a percentage of GDP) as input for distribution.

Finally, to capture the common features of the performance sub-indicators used, we compute a composite outcome index for each sector, following Anderson (2008). This method applies generalized least squares estimators that account for variables with missing data, giving them less weight compared to the principal component analysis (PCA) method, which, moreover, is particularly sensitive to the presence of outliers.[6]

Appendix G describes the set of variables used to compute the efficiency scores and their sources.

[6] We use the Stata procedure proposed by Schwab et al. (2020). Nevertheless, for robustness purposes, we compare the composite indicators obtained following Anderson (2008) with those obtained using the PCA method. Overall, in our case, the two approaches lead to very similar results. For example, for the four sectors — education, health, infrastructure, and administration — the Pearson correlations are 95%, 100%, 18%, and 96%, respectively.

3.2 Measuring Public Sector Efficiency

Both parametric and non-parametric approaches are used in the literature to estimate efficiency scores. Non-parametric techniques include Free Disposal Hull (FDH) analysis and Data Envelopment Analysis (DEA). These methods impose no restrictions on the distribution of inefficiency and no behavioral hypothesis (profit maximization objective), in contrast to parametric methods which are based on econometric estimation techniques. However, non-parametric approaches, as deterministic methods, ignore measurement errors as well as any stochastic influence, considering any variation between units as inefficiency (Kumbhakar and Lovell, 2000; Kumbhakar and Lovell, 2003). Such an assumption can lead to major estimation biases, as public expenditure is impacted by exogenous shocks (e.g., commodity price shocks, environmental shocks, etc.), which in turn affect public sector performance, irrespective of the resulting efficiency (or inefficiency). Moreover, these methods are very sensitive to random variations in data, measurement errors, sample variations, heterogeneity between units, and the presence of outliers (Fiorentino et al., 2006). Among the non-parametric methods, the DEA approach is commonly used in the literature. A few other studies use the FDH approach (e.g., see some pioneering work: Tulkens and Eeckaut, 1995; Tulkens, 2006). In contrast to the DEA analysis, the latter imposes only slight restrictions on the production technology, while allowing for a comparison of efficiency between units (see Bauer, 1990 and Seiford and Thrall, 1990 for further discussion on the merits of these methods). However, as it remains a non-parametric approach, it does not allow for random factors unrelated to efficiency to be considered.[7]

Given the limitations of non-parametric methods, parametric techniques are often used in the literature. The latter use a stochastic production function — a Stochastic Frontier Analysis (SFA) — and allow the error term to have two components: a negative term which measures inefficiency and an idiosyncratic error which captures idiosyncratic shocks (Aigner et al., 1977; Meeusen and van Den Broeck, 1977). However,

[7]Establishing the relative efficiency of municipal spending in Belgium, Eeckaut et al. (1993) compare results of the FDH analysis with those of the DEA, and conclude that the assumption of convexity imposed by the DEA distorts the results of the efficiency analysis. Furthermore, in a study on public expenditure efficiency in developing countries, Gupta and Verhoeven (2001) found that the FDH analysis is strongly influenced by changes in the number of output indicators, highlighting the sensitivity of the results of this method to variations in the dataset.

these methods require strong hypotheses on data distribution. The most commonly used distributions are semi-normal, exponential, and truncated normal.

3.3 Computation of the efficiency scores

Among the parametric methods, those of Kumbhakar (1991), Lee and Schmidt (1993), and Battese and Coelli (1992) have been widely used in the literature, especially on panel data. Here we adopt a more recent method, that of Kumbhakar et al. (2015), for two main reasons. First, the latter approach allows distinguishing unobserved heterogeneity across units from inefficiency, unlike older methods, notably those mentioned above. This, therefore, improves the analysis, by capturing countries' heterogeneous characteristics such as their level of development, structural or institutional features, etc. Second, unlike Greene (2005) and Kumbhakar and Wang (2005) who merely separate individual heterogeneity from stochastic noise, Kumbhakar et al. (2015) propose a further decomposition of inefficiency by distinguishing between persistent (long-run) and transitory or variant (short-run) inefficiency. This makes it possible to take into account inefficiency resulting from structural characteristics that persist over time and those resulting from short-term features.

We now describe the conceptual framework described in Kumbhakar et al. (2015) to compute the efficiency scores. The econometric model is specified as follows:

$$Y_{it} = \alpha_0^* + f(x_{it};\beta) + v_{it} - u_{it}^* - \eta_i^* \tag{3}$$

with:

$$\alpha_0^* = \alpha_0 - E(\eta_i) - E(u_{it}) \tag{3.a}$$

$$u_{it}^* = u_{it} - E(u_{it}) \tag{3.b}$$

$$\eta_i^* = \eta_i - E(\eta_i) \tag{3.c}$$

where Y_{it} is a measure of government performance, proxied by the public sector performance index, in country i in year t. X_{it} is the vector of inputs. The model consists of three steps. First, we estimate Equation 3 using a standard random effect regression.

We thus obtain consistent measure of β and predicted values of η_i^* and u_{it}^*. Second, persistent technical inefficiency is computed using the predicted values of η_i^*. Then, persistent technical inefficiency can be obtained from:

$$\eta_i = Max(\eta_i^*) - \eta_i^* \tag{4}$$

Finally, persistent technical efficiency (PTE) is calculated from exp(-η_i), then residual technical efficiency (RTE) is computed in the last step. To do so, we go back to the first step and obtain the residues (i. e, $Y_{it} - f(x_{it};\beta) + \eta_i = \alpha_0 + v_{it} - u_{it}$). Assuming that v_{it} is iid, i.e., $v_{it} \sim$ N(0, σ_v^2), and u_{it} is iid, i.e., $u_{it} \sim N(0, \sigma^2)$, we can maximize the log-likelihood function for the next standard normal stochastic frontier model for the grouped data:

$$r_{it} = \alpha_0 + v_{it} - u_{it} \tag{5}$$

where $r_{it} = y_{it} - f(x_{it};\beta) + \eta_i$. In practice, we use the estimated values of β and η_i to define r_{it}. In other words, the sampling variability associated with β and η_i is ignored. Using the standard boundary model on Equation 4, we obtain estimates of α_0, σ_v^2 and σ^2. Following Jondrow et al. (1982), we estimate residual technical inefficiency, $\hat{u}_{it}$, based on the estimated residues, $(v_{it} - u_{it})$. Thus, we can use $\hat{u}_{it}$ to calculate residual time-varying technical inefficiency defined as RTE = exp(-$\hat{u}_{it}$), and then estimate the overall technical efficiency (OTE) defined as the product of PTE and RTE (OTE = PTE * RTE).

4 Stylized facts

This section reports some stylized facts and descriptive statistics of the calculated scores, for 158 countries, over the period 1990-2017. By construction, the calculated scores can range from 0 to 1 (best performance). We report an average score of 0.66 over the sample and the period considered. Figure 1 displays the average scores, distinguishing between advanced, emerging, and low-income countries. On average, advanced countries are the closest to their efficiency frontier, with a score of 0.71, while the average efficiency

scores reported for emerging and low-income countries are 0.67 and 0.64, respectively.[8] Furthermore, statistical tests suggest that the differences in efficiency between country groups are statistically significant. Last, Appendix F presents country rankings based on average efficiency scores. On the one hand, the 10 best-performing countries report scores ranging from 0.80 to 0.72 and are all advanced economies. On the other hand, the bottom 10 ranked countries report scores between 0.48 and 0.60, and most of them are African economies. Finally, Figure 2 provides some highlights. Indeed, we observe a high concentration of the worst-performing countries in Africa, i.e., those with an average score below the sample average, while the best-performing countries are almost exclusively located in North America, Europe, and the South Pacific.

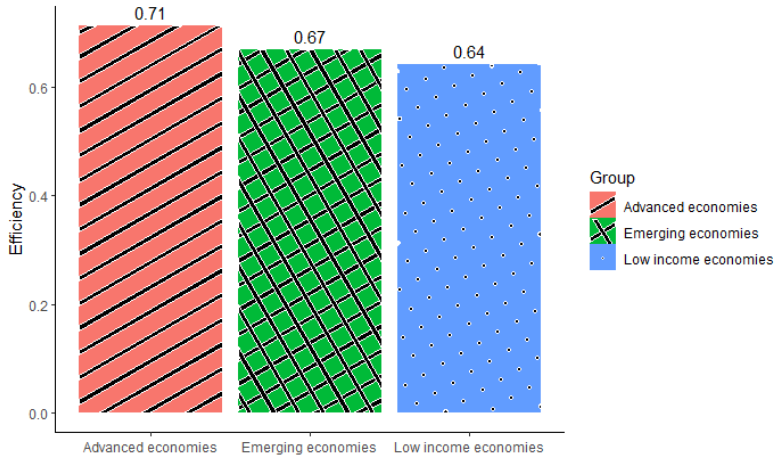

Figure 1: Average government efficiency scores (1990-2017)

Source: Authors' calculations. **Notes:** The statistics cover 158 countries over 1990-2017, including 35 advanced, 37 emerging, and 86 low-income economies.

5 Determinants of Public Sector Efficiency

5.1 Theoretical predictions

This section examines the influence of some factors on government expenditure efficiency, notably: trade globalization, factor productivity, tax revenues, institutional quality, and

[8]For instance, a score of 0.66 for a given country means that the latter could, on average, increase its efficiency by 34%, for the same level of resources used to achieve the objectives set.

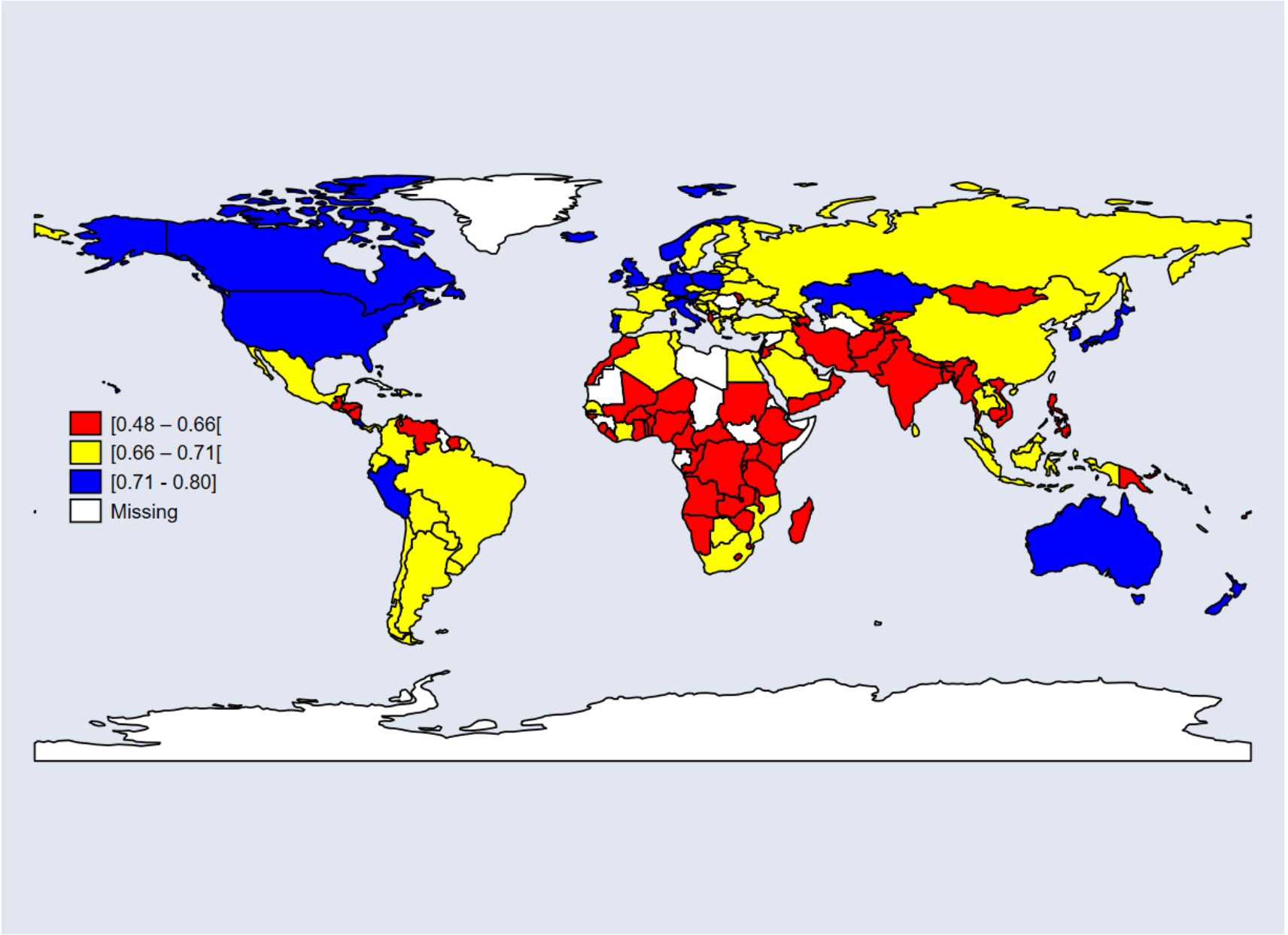

Figure 2: Average efficiency scores around the world (1990-2017)

Source: Authors' calculations. **Notes:** This map displays the distribution of the average efficiency scores in the sample. The statistics cover 158 countries of all income levels over 1990-2017. The distribution ranges have been harmonized with the mean scores in the sample to improve the readability of the map. Countries in red register an average score below the sample average (0.66). Those in the yellow report a score above the sample average, but below the average for advanced countries (0.71). Finally, those in blue have a score above or equal to the average for developed countries.

population density. We further discuss the expected sign of the considered variables before providing some empirical evidence in the next subsection.

The effects of trade globalization on public sector efficiency may be ambiguous. On the one hand, globalization can increase the overall performance of the economy, by promoting the transfer of skills, knowledge, and technologies (Hauner and Kyobe, 2010). Technology transfer in turn may foster technological progress and the adoption of more efficient production techniques and systems that can promote efficient public sector management. In addition, knowledge diffusion resulting from trade globalization — including in the public sector — can contribute to strengthening domestic knowledge and public administration capacities. On the other hand, globalization could indirectly affect government efficiency through taxation, with ambiguous effects. For instance, Schulze and Ursprung (1999) document the literature on the link between globalization and fiscal policy, distinguishing two effects. The efficiency effect refers to the fact that in the context of liberalization, countries wishing to attract more international capital may have an incentive to reduce their domestic tax, thereby lowering their capacity to provide public goods. The compensation effect assumes that globalization, being likely to increase income inequalities, may raise the demand for social insurance programs, which in turn causes an upward shift in taxation and spending levels.[9] That said, whether globalization affects domestic tax revenues positively or negatively, the effect of taxation on expenditure efficiency is itself ambiguous (the next paragraph details this point).

Tax revenue mobilization is a critical issue for both advanced and developing economies. Indeed, population aging faced by advanced economies imposes public spending to be more and more oriented towards social sectors, sometimes raising the fear of a situation of fiscal stress (Leeper and Walker, 2011). On the other hand, developing countries — which are heavily dependent on external financial flows — are implementing reforms to improve tax revenue mobilization, in a context of increasing trade liberalization over the past decades that has led to a loss of tariff revenues. Last, domestic taxation allows these countries to finance their development and depend less on external financing, to support the core functions of an effective state, create the conditions for economic growth, and

[9] See also Dreher et al. (2008).

encourage governments to be more responsive and accountable for their decisions. From a theoretical point of view, Barro (1990) highlights a non-linear relationship between government spending and economic growth, conditioned by the level of taxation. In this model, an increase in taxes allows for the financing of productive public spending, whereas taxation generates distortions in the economy beyond a certain threshold — in the spirit of Laffer — resulting in a decline in the productivity of private capital. Therefore, in light of this analysis, the effect of taxation on government efficiency may be ambiguous, and potentially driven by a threshold effect. Empirically, for a panel of over 100 countries, Chan et al. (2017) find that value-added taxes enhance the effect of government spending efficiency on economic growth, while for OECD countries over the period 2003-2017, Afonso et al. (2021) show that expenditure efficiency is negatively associated with taxation.

Better factor productivity may reflect technical progress, greater organizational, and technological innovation, or more efficient use of factors of production. As discussed earlier, factors such as technological innovation or technical progress can encourage the adoption of techniques and systems aimed at improving efficiency in the economy, including in public sector management. In addition, productivity gains from improved factors of production can generate additional resources for the government, which may be reallocated to the most productive sectors. Finally, as productivity gains are important components of the growth process (Bosworth and Collins, 2003), increasing factor productivity can help create a more dynamic economy and improve household welfare, especially if the resulting productivity gains are pro-poor.

Institutional quality (approximated here by the level of democracy and government durability) is an important determinant of public sector management. A better institutional framework — such as good governance or stronger democracy — encourages governments to justify their control of the state machinery, promotes greater transparency in the budget approval process and budget regulation, and provides a comprehensive overview of public sector activity. This in turn helps to limit the risk of fraud or misappropriation of public funds. On the other hand, government durability, i.e., the ability of a government to provide consistent policies and services to its citizens over a long period of time, may also be an important determinant of expenditure efficiency, since

political volatility is likely to complicate coherent budget planning and undermine efficiency (Hauner and Kyobe, 2010). However, this argument needs to be nuanced as government durability in autocratic or less democratic regimes may reflect poor institutions, with potentially adverse effects on efficiency, especially as it has been observed that countries with poorer governmental and institutional performance are often those with poor economic performance (Acemoglu et al., 2008).

Last, Hauner and Kyobe (2010) argued that a higher population, by reducing the cost of public service provision through economies of scale, may improve public sector efficiency. Our reading is that other channels may play a role, making the relationship complex. On the one hand, higher population density can also contribute to pressure on natural resources or public infrastructure such as public services and housing. For instance, in areas where public infrastructures or socio-economic opportunities are limited, this, in turn, can lead to social tensions or conflicts among communities. On the other hand, population density could play an indirect role through the taxation channel, as income or sales taxes may be more difficult to administer in sparsely populated areas (Riezman and Slemrod, 1987). But, as discussed earlier, the link between taxation and expenditure efficiency is itself not clear-cut.

Trade globalization is measured by the KOF index (Dreher, 2006; Gygli et al., 2019), and ranges from 1 to 100 (higher degree of globalization). Total factor productivity measures the share of output that is not explained by the quantity of inputs used in production, and is from the Penn World Table (PWT). Tax revenues — excluding social contributions and natural resources — are from the UNU-WIDER Government Revenue Dataset. The level of democracy is captured by an index varying between 0 (least democratic) and 10 (most democratic), extracted from the Freedom House database. Government durability measures the number of years since the last change in the political regime and comes from the Polity IV dataset. Population density is the mid-year population divided by the area in square kilometers and comes from the World Bank's WDI (World Development Indicators) database.

5.2 Empirical results

We conduct econometric estimations through a Tobit analysis, as our dependent variable is censored, i.e., it only takes values between 0 and 1 (the choice of this model is based on previous studies, e.g., Afonso et al., 2010; Afonso and Aubyn, 2006). We regress the expenditure efficiency scores, δ, on the set of potential drivers, Z, as follows:

$$\delta_{i,t} = f(Z_{i,t}) + \varepsilon_{i,t} \tag{6}$$

The main estimates are reported in Column [1] of Table 1. We find a positive and statistically significant effect of trade globalization, factor productivity, the level of democracy, and government durability on government efficiency, while there is a negative and statistically significant influence of tax revenues on the efficiency scores.

6 Robustness

6.1 Additional variables

In Columns [2]-[9] of Table 1, we augment our baseline model by adding some additional controls. This allows us, on the one hand, to test the robustness of the previous results and, on the other hand, to examine some other potential determinants. In Column [2], instead of the trade globalization index used in the main model, we rely on an alternative measure, that is, the sum of exports and imports as a percentage of GDP. In Columns [3]-[10], we include the following variables: financial development, inflation, government fragmentation, corruption control, ethnic fractionalization, fiscal rules, fiscal councils, and fiscal responsibility law, respectively.[10] Overall, the new estimates support our main findings: there is a positive and statistically significant influence of trade globalization, factor productivity, and institutional quality on expenditure efficiency. However, the negative effect of tax revenues on expenditure efficiency does not appear to be robust. Finally, regarding the additional controls, our data suggest a positive

[10] In Appendix A.1, we discuss the theoretical relationship between public expenditure efficiency and the additional controls.

Table 1: Public Sector Efficiency (PSE) and Determinants

Dependent: PSE	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]	[10]
Trade globalization	0.0010***		0.0008***	0.0009***	0.0011***	0.0005**	0.0011***	0.0008***	0.0009***	0.0010***
	(0.0002)		(0.0002)	(0.0002)	(0.0002)	(0.0002)	(0.0002)	(0.0002)	(0.0002)	(0.0002)
Factor productivity	0.1168***	0.1228***	0.1055***	0.1321***	0.1274***	0.1063***	0.1245***	0.1099***	0.1174***	0.1169***
	(0.0115)	(0.0119)	(0.0118)	(0.0124)	(0.0127)	(0.0145)	(0.0123)	(0.0115)	(0.0115)	(0.0115
Tax revenues (Log.)	-0.0125**	-0.0098	-0.0226***	-0.0109	-0.0141**	-0.0068	-0.0042	-0.0140**	-0.0131**	-0.0126**
	(0.0064)	(0.0065)	(0.0072)	(0.0072)	(0.0070)	(0.0070)	(0.0065)	(0.0063)	(0.0064)	(0.0064)
Democracy	0.0080***	0.0091***	0.0079***	0.0079***	0.0067***	0.0093***	0.0062***	0.0071***	0.0079***	0.0080***
	(0.0012)	(0.0013)	(0.0012)	(0.0013)	(0.0013)	(0.0016)	(0.0013)	(0.0012)	(0.0012)	(0.0012)
Government durability	0.0004***	0.0006***	0.0001	0.0005***	0.0003***	0.0001	0.0004***	0.0003**	0.0003***	0.0004***
	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)
Population density (Log.)	-0.0036	-0.0003	-0.0062*	-0.0020	-0.0040	-0.0023	-0.0028	-0.0039	-0.0038	-0.0036
	(0.0031)	(0.0030)	(0.0033)	(0.0033)	(0.0032)	(0.0033)	(0.0033)	(0.0030)	(0.0031)	(0.0031)
Trade openness (Log.)		0.0139**								
		(0.0057)								
Financial development			0.0646***							
			(0.0185)							
Inflation				0.0004						
				(0.0004)						
Government fragmentation					0.0143**					
					(0.0070)					
Corruption control						0.0003**				
						(0.0002)				
Ethnic fractionalization							-0.0042			
							(0.0177)			
Fiscal rules								0.0216***		
								(0.0040)		
Fiscal councils									0.0125*	
									(0.0070)	
Fiscal Responsibility Law										-0.0001
										(0.0054)
Observations	2101	2062	2031	1961	2023	1519	1737	2101	2101	2101

Notes: This table reports the correlations between the calculated scores and the main potential determinants, from a Tobit analysis. Results from the main model are reported in Column [1]. Columns [2]-[10] include some additional variables. Standard errors are in parentheses. All regressions include the constant, not reported in the table. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

and statistically significant effect of financial development, government fragmentation, corruption control, and fiscal institutions — notably fiscal rules and fiscal councils — on expenditure efficiency.

Appendix A.2 provides some additional robustness by considering alternative measures of public expenditure efficiency. The results remain stable.

6.2 Endogeneity concerns

Our main results are estimated from a Tobit regression, without taking into account endogeneity issues. For instance, there may be a reverse causality between factor productivity and efficiency, as the least efficient governments may implement policies aimed at better organizational or technological innovation, or more efficient use of factors of production for greater efficiency. Likewise, greater efficiency may lead to a reallocation of expenditure to other sectors of the economy, which could indirectly affect the tax system, given the close relationship between public expenditure and tax revenues. Finally, institutional factors can be correlated with aspects such as culture, customs, and ideological or religious orientation, leading to an omission bias. To deal with potential endogeneity in the determinants examined, we re-estimate our main model using the Blundell and Bond (1998) two-step system-GMM estimator. This method allows for addressing endogeneity, using lagged differences and levels of explanatory variables as instruments while accounting for the persistence of government efficiency and controlling for the Nickell bias (Nickell, 1981) that arises in a dynamic panel model. The new results are reported in Column [2] of Table 2.[11] We find robust evidence of the positive and significant effect of trade globalization, productivity, and institutional quality on efficiency. In addition, the Hansen test does not reject the hypothesis of instrument validity. Likewise, the AR (1) test for the absence of autocorrelation of the first-order error term and the AR (2) test for the absence of autocorrelation of the second-order error term do not raise concerns about the validity of our estimates.

[11] See also Ullah et al. (2018) for GMM advantages.

7 Heterogeneity

Table 3 expands the analysis by replicating the main model (Column [1] of Table 1) for advanced (Column [2]) and developing countries (Column [3]). Evidence suggests a positive and statistically significant influence of trade globalization, factor productivity, and the quality of institutions on efficiency for both advanced and developing countries. Moreover, estimates suggest a negative and statistically significant effect of taxation on efficiency in advanced countries — in line with Afonso et al. (2021) — while this factor does not seem to matter for developing economies. Finally, in the last column (Table 3), we deepen the analysis by examining, among the determinants of the main model, those that could explain the efficiency gaps between advanced and developing economies. The efficiency gap is calculated as the difference between the average efficiency in advanced countries and the annual efficiency in developing ones. Thus, an increase in this variable reflects a higher efficiency gap in favor of advanced countries. Results suggest that trade globalization, factor productivity, and the level of democracy seem to reduce the efficiency gap between advanced and developing economies. Finally, Appendix B examines the main determinants according to geographical regions and fragile states. We find that factor productivity and the level of democracy seem to be positively correlated with public expenditure efficiency in all the groups considered (Africa, Asia, Latin America, and Europe), while the positive impact of trade globalization on efficiency seems to be driven by Asian and European countries. Likewise, the negative effect of taxation on efficiency seems to be mainly driven by Latin American and European countries. Finally, while government durability seems to promote efficiency in European countries, the opposite effect is observed in fragile states.

Table 2: Robustness: GMM estimator

Dependent: PSE	Tobit estimates	GMM estimates
	[1]	[2]
Trade globalization	0.0010***	0.0002**
	(0.0002)	(0.0001)
Factor productivity	0.1168***	0.0191**
	(0.0115)	(0.0091)
Tax revenues (Log.)	-0.0125**	-0.0019
	(0.0064)	(0.0033)
Democracy	0.0080***	0.0020**
	(0.0012)	(0.0008)
Government durability	0.0004***	0.0001*
	(0.0001)	(0.0001)
Population density (Log.)	-0.0036	0.0003
	(0.0031)	(0.0011)
Lagged Expenditure efficiency (PSE)		0.7190***
		(0.0482)
Observations	2101	2019
Number of groups/instruments		89/78
AR(1) /AR(2) p-values		0.000/0.116
Hansen overidentification test p-value		0.297

Notes: This table examines the robustness of our main determinants, using a two-step system-GMM (Column [2]). The results of the main model, estimated from a Tobit analysis, are reported in Column [1]. Standard errors are in parentheses. All regressions include the constant, not reported in the table. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table 3: Heterogeneity: Advanced versus developing countries

Dependent: PSE	Total sample	Advanced	Developing	Efficiency gap
	[1]	[2]	[3]	[4]
Trade globalization	0.0010***	0.0028***	0.0007***	-0.0008***
	(0.0002)	(0.0004)	(0.0002)	(0.0002)
Factor productivity	0.1168***	0.2520***	0.1019***	-0.1077***
	(0.0115)	(0.0324)	(0.0127)	(0.0136)
Tax revenues (Log.)	-0.0125**	-0.0919***	-0.0063	0.0077
	(0.0064)	(0.0255)	(0.0066)	(0.0070)
Democracy	0.0080***	0.0102	0.0079***	-0.0081***
	(0.0012)	(0.0077)	(0.0013)	(0.0014)
Government durability	0.0004***	0.0013***	-0.0001	0.0001
	(0.0001)	(0.0002)	(0.0002)	(0.0002)
Population density (Log.)	-0.0036	0.0005	-0.0055	0.0053
	(0.0031)	(0.0078)	(0.0040)	(0.0042)
Observations	2101	626	1475	1475

Notes: This table reports the correlations between the calculated scores and the main potential determinants, from a Tobit analysis, and distinguishes between advanced (Column [2]) and developing countries (Column [3]). Results from the full sample are reported in Column [1]. The last column re-estimates the main model, using the efficiency gap between advanced and developing countries as the dependent variable. An increase in the dependent variable reflects an efficiency gap in favor of advanced countries. Standard errors are in parentheses. All regressions include the constant, not reported in the table. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

8 Conclusion

A large body of literature has examined public sector efficiency. Unlike most of the contributions, we provide a large panel dataset on government efficiency using a parametric approach, referring to Kumbhakar et al. (2015). That is, for a panel of 158 countries of all income levels over 1990-2017, we compute efficiency scores for four sectors: education, health, infrastructure, and public administration. We also include three efficiency indicators for the Musgravian tasks for government: allocation, distribution, and stabilization. Next, the study empirically examines some determinants of the scores obtained, considering economic and institutional factors. A Tobit analysis suggests that trade globalization, factor productivity, and institutional quality seem to be positively associated with public sector efficiency. Robustness was checked by using alternative measures of government efficiency, additional controls, and the system-Generalized Method of Moments (GMM) estimator. Furthermore, we examine heterogeneity according to the level of economic development and geographical regions, drawing some conclusions. First, estimates suggest that the positive effect of trade globalization, factor productivity, and institutional quality on efficiency appears to hold in both advanced and developing economies, while tax revenues seem to be negatively associated with government efficiency in advanced economies, but do not seem to count for developing countries. Second, trade globalization, factor productivity, and the level of democracy seem to reduce the efficiency gap between advanced and developing economies. Third, regarding geographical areas, our data suggest that factor productivity and the level of democracy appear to be positively correlated with public expenditure efficiency in all the groups considered (Africa, Asia, Latin America, and Europe), while the positive impact of trade globalization on efficiency seems to be driven by Asian and European countries. Likewise, the negative effect of taxation on efficiency seems to be mainly driven by Latin American and European countries. Finally, government durability seems to increase efficiency in European countries, while it seems to play negatively in fragile states.

Some policy implications can be drawn from our main findings. First, governments should better grasp the benefits of trade globalization, by promoting better transfer of skills, knowledge, and technology into the domestic economy, as these factors appear

to be important for public sector efficiency. Similarly, policies aimed at promoting factor productivity, such as technological innovation or human capital formation, may lead to more efficient public sector management. Third, governments should further mobilize their efforts to improve the quality of their institutions and promote better fiscal governance and transparency in the management of public funds, through, among others, better supervision of budget execution, better control of financial and accounting reports, and better monitoring of public expenditure. Finally, some important questions remain for future research. For instance, it would be interesting to examine the spillover effects of government efficiency in neighboring countries — using for example a spatial econometric approach — or to conduct an in-depth analysis on the impact of fiscal reforms and frameworks on government efficiency.

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Appendix A Robustness

A.1 Additional variables

In this section, we discuss the theoretical relationship between public expenditure efficiency and the additional controls included in Columns [3]-[10] of Table 1 of the main manuscript: financial development, inflation, government fragmentation, corruption control, ethnic fractionalization, and fiscal institutions (fiscal rules, fiscal councils, and fiscal responsibility law).[12]

A strong financial system promotes financial inclusion and better mobilization of tax revenues (Oz-Yalaman, 2019; Gnangnon, 2021; Santoro et al., 2022; Apeti and Edoh, 2023; Bambe, 2023), allowing countries, especially those in the developing world, to finance their economies and be less dependent on external sources of financing. Additionally, by promoting access to credit and investment by households and firms, financial development can be an important determinant of economic growth (e.g., see De De Gregorio and Guidotti, 1995; Khan and Senhadji, 2000).

By reducing the predictability of the business cycle, inflation can discourage investment, or by generating a loss of purchasing power for households, worsening their conditions (Bambe et al., 2022). On the other hand, an inflation surprise can help support economic activity.

Institutional factors such as the control of corruption can be an important determinant of government budget management, as corruption leads to the misuse of public funds. Government fragmentation may also influence public sector management. For instance, Kontopoulos and Perotti (1999) find that fragmentation tends to be associated

[12]The Financial Development Index measures the level of development of financial institutions and markets in terms of depth, access, and efficiency and is from the IMF Financial Development Index Database. Government fragmentation measures the probability that two deputies picked at random among from the government parties will be of different parties, and is from the Database of Political Institutions (DPI). Corruption control ranges from 0 to 100, where higher values are better, and is from the Worldwide Governance Indicators database. Ethnic fragmentation is taken from Drazanova (2019) and ranges from 0 (total homogeneity) to 1 (total heterogeneity). Data related to fiscal rules are extracted from the IMF Fiscal Rules Dataset. The fiscal rules variable is measured by a dummy equal to 1 when a country i has adopted a fiscal rule in year t, and zero otherwise. Fiscal councils and fiscal responsibility law which come from Fiscal Council Dataset and IMF Fiscal Rules Dataset respectively are measured in the same way.

with larger expenditures in OECD countries, since the most important representatives of individual spending interests in European governments are spending ministers. Similar results were found in other studies (e.g., see Edin and Ohlsson, 1991; Borrelli and Royed, 1995; Franzese, 2000; Volkerink and De Haan, 2001; Balassone and Giordano, 2001; Artés and Jurado, 2018). However, other scholars fail to find any statistically significant effect from government fragmentation (De Haan and Sturm 1994, 1997; Harrinvirta and Mattila, 2001; Ricciuti, 2004).

Substantial literature, early examples being Canning and Fay (1993) and Mauro (1995), considers ethnic fragmentation to have a significant impact on governmental activities and institutional quality. For example, according to Easterly and Levine (1997), Africa's strong ethnic fragmentation explains much of its characteristics such as economic growth, political instability, or poor infrastructure. La Porta et al. (1999) argued that ethnic fragmentation may reduce the quality of government by increasing the cost of public services and benefits, especially due to communication problems.[13] Therefore, one may expect a negative effect of ethnic fragmentation on efficiency.

Last, fiscal institutions such as fiscal rules or fiscal councils are aspects that might matter for public expenditure efficiency. Since the 1990s, fiscal rules have spread considerably around the world and are increasingly shaping fiscal choices. Several studies examining the effects of fiscal rules suggest that they promote fiscal discipline (Debrun et al., 2008; Combes et al., 2018; Asatryan et al., 2018; Caselli and Reynaud, 2020; Caselli and Wingender, 2021) economic growth (Afonso and Jalles, 2013), mitigate the pro-cyclicality of fiscal policy (Combes et al., 2017), improve the credibility of countries in international markets (Thornton and Vasilakis, 2018), or allow constraining political budget cycles (Gootjes et al., 2021). Fiscal discipline, through deficit or debt reduction, can be achieved by better tax revenue mobilization or by reducing public expenditure. Governments that choose the first option — as accountability and willingness to pay taxes are linked to the quality of public goods provided to taxpayers — should be more concerned with managing public resources to achieve the highest possible outcomes. However, as shown by Asatryan et al. (2018), the disciplining effect of fiscal rules is

[13] A large literature on U.S. localities also documents a negative correlation between ethnic fragmentation and the provision of public goods, participation in social activities, trust, and economic success (e.g., see Alesina et al. 1996; 1999; 2000; 2002).

more likely to stem from the reduction in public spending, as the taxation channel is not statistically significant. Fiscal austerity can affect the composition of expenditure, leading either to a greater reduction in current expenditure or a greater reduction in public investment. The literature on the composition effect of fiscal rules suggests that they tend to protect productive or growth-enhancing spending, in particular public investment (e.g., see Ardanaz et al., 2021). Furthermore, Castro (2011) and Afonso and Jalles (2013) provide evidence that fiscal rules foster economic growth, suggesting that better outcomes could be achieved with the same or fewer public resources. More specifically, the reduction in resources, by limiting the possibilities of debt financing within the framework of fiscal rules, leads governments to reallocate expenditure to productive sectors, i.e., to use less public resources efficiently to achieve better outcomes. Finally, institutions such as independent fiscal councils or fiscal responsibility laws — aimed at strengthening commitments to sustainable public finances or monitoring fiscal aggregates — are also an important factor in public sector management.

A.2 Alternative measures of public sector efficiency

In this section, we check the robustness of our main results in three ways. In Column [2] of Table A1, we re-estimate our efficiency scores following Greene (2005). Indeed, the model proposed by Kumbhakar et al. (2015) that we use to estimate our efficiency scores has the advantage, in addition to taking into account unobserved heterogeneity across countries, of breaking down inefficiency into persistent (long-term) and transient (short-term) inefficiency, which requires a two-stage estimation procedure. Although Greene (2005)'s approach does not allow for this decomposition of inefficiency, it does allow for unobserved heterogeneity across countries and offers a one-step specification model, allowing greater flexibility in the econometric procedure. In Column [3] (Table A1), we further exploit a 'subjective' approach of well-being for robustness purposes. More specifically, among the outcome indicators for economic performance, we replace GDP per capita with a happiness measure. Economic performance, therefore, includes happiness, GDP growth (10-year average), and unemployment rate (10-year average). The happiness index is based on how respondents feel about their well-being, the best

possible life for them being a score of 10 and the worst, 0.[14] Finally, a number of studies in the literature on public expenditure efficiency consider only education, health, and public infrastructure (see, among others, Gupta and Verhoeven, 2001; Hauner and Kyobe, 2010; Grigoli and Kapsoli, 2018). As discussed earlier, our approach follows Afonso et al. (2005) and tries to assess the overall efficiency of the public sector, considering not only the three sectors mentioned above but also public administration and the Musgravian tasks of the government. Nevertheless, for robustness, In Column [4] (Table A1) we re-estimate the efficiency scores only from the three sectors (education, health, and public infrastructure), considering the same inputs as in the main model. New estimates suggest a positive, statistically significant, and robust effect of trade globalization, factor productivity, and institutional quality on expenditure efficiency. Similarly, the effect of tax revenues on expenditure efficiency remains negative, statistically significant, and robust.

Appendix B Heterogeneity

Some countries may have some degree of geographical, cultural, economic, or institutional similarities. Since these factors can lead to cross-sectional dependencies in government efficiency, one might ask whether our main determinants are sensitive to geographical regions. Hence, in Columns [2]-[5] of Table B1, we examine the main determinants by considering different geographical areas. Furthermore, our full sample includes 20 fragile states, i.e., countries classified by the IMF as having characteristics that significantly undermine their economic and social performance, with weak governance, limited administrative capacity, chronic humanitarian crises, persistent social tensions, and, often, violence or the legacy of armed conflict or civil war. In Column [6] (Table B1) we examine whether the determinants of the main model also matter for public expenditure efficiency in these countries. The results reveal some characteristics of heterogeneity in the main determinants considered. First, factor productivity and the level of democracy appear to be positively correlated with public expenditure efficiency

[14]Data publisher's source: Gallup World Poll surveys (life evaluation question): https://ourworldindata.org/happiness-and-life-satisfaction.

Table A1: Robustness: Alternative PSE measures

Dependent: PSE	Baseline	Alternative PSE		
	[1]	[2]	[3]	[4]
Trade globalization	0.0010***	0.0008***	0.0009***	0.0010***
	(0.0002)	(0.0002)	(0.0002)	(0.0002)
Factor productivity	0.1168***	0.1425***	0.0751***	0.0267**
	(0.0115)	(0.0128)	(0.0112)	(0.0129)
Tax revenues (Log.)	-0.0125**	-0.0223***	-0.0193***	-0.0214***
	(0.0064)	(0.0074)	(0.0064)	(0.0080)
Democracy	0.0080***	0.0083***	0.0071***	0.0044***
	(0.0012)	(0.0014)	(0.0012)	(0.0014)
Government durability	0.0004***	0.0005***	0.0004***	0.0005***
	(0.0001)	(0.0001)	(0.0001)	(0.0002)
Population density (Log.)	-0.0036	-0.0006	-0.0052*	-0.0009
	(0.0031)	(0.0038)	(0.0031)	(0.0062)
Observations	2101	2239	2101	2107

Notes: This table reports the correlations between the calculated scores and the main potential determinants, from a Tobit analysis, and considering alternative measures of public sector efficiency. Results from the main model are reported in Column [1]. Column [2] re-estimates the main model using the scores obtained following Greene (2005). In Column [3], we include a «subjective» measure of well-being in the economic performance indices. Column [4] re-estimates the efficiency scores, only from the three sectors: education, health, and public infrastructure. Standard errors are in parentheses. All regressions include the constant, not reported in the table. * p < 0.1, ** p < 0.05, *** p < 0.01

in all the groups considered. Second, the positive impact of trade globalization on efficiency seems to be driven in particular by Asian and European countries. Third, the negative effect of taxation on efficiency seems to be mainly driven by Latin American and European countries. Fourth, while government durability seems to favor efficiency in European countries, the opposite effect is observed in fragile states.

Appendix C Limitations and possible extensions

This section briefly discusses the merits and shortcomings of the indicators used in our study. As mentioned in Section 2 of the main manuscript, measuring efficiency in organizational units such as the public sector is challenging, as government objectives are usually poorly defined, complex, and multidimensional. The choice of indicators and

dimensions of public sector performance in this study is based on existing literature, notably Afonso et al. (2005), who attempt to approach the public sector through several dimensions, by considering two categories of performance indicators. The opportunity performance includes the following sectors: education, health, infrastructure, and public administration. The Musgravian indicators allow for taking into account the traditional tasks of government, including three dimensions: distribution, stability, and economic performance. As discussed in subsection 3.1 (main manuscript), education, health, and infrastructure are dimensions affected by the size of government, as public spending in these sectors has been shown to have a significant impact on economic growth, the reduction of poverty and inequality, and business conditions (see, among others, Aschauer, 1989; Barro, 1990; Wilhelm and Fiestas, 2005; Chauvet and Ferry, 2021). Although the education indicators used in this study only take into account public schools, it can be assumed that country-specific characteristics may also be relevant. We believe that these factors are to some extent taken into account in our approach to calculating efficiency scores, which is based on Kumbhakar et al. (2015), as the latter allows distinguishing unobserved heterogeneity across units from inefficiency. Another limitation of the analysis is that the information we have does not allow for taking into account the amount of infrastructure or hospitals built by private companies. Next, regarding public administration, there may be other agencies, institutions, or authorities which, although in the public domain, operate with an independent budget and autonomous management. In the same vein, factors such as the independence of the judiciary, the quality of the government, or the size of the shadow economy are strongly correlated to long-term institutional factors or to the overall performance of the economy. Given these limitations, and the potential shortcomings of the Musgravian indicators, for robustness purposes, we have re-estimated the efficiency scores only from three sectors (education, health, and public infrastructure) and considering the same inputs as in the main model. The results reported in Column [4] of Table A1 support our baseline model, which includes administration and the Musgravian indicators. In other words, the results of the baseline model scores do not seem to be very sensitive to changes in the measurement of certain outcome indicators. Nevertheless, we expect that over time, the overall measures of government performance will be refined, by taking into account factors not included in this analysis, to better address the shortcomings of this study.

Table B1: Heterogeneity: Geographical regions

Dependent: PSE	Total sample	Africa	Asia	Latin America	Europe	Fragile States
	[1]	[2]	[3]	[4]	[5]	[6]
Trade globalization	0.0010***	0.0001	0.0020***	-0.0006	0.0026***	-0.0007
	(0.0002)	(0.0004)	(0.0004)	(0.0005)	(0.0005)	(0.0010)
Factor productivity	0.1168***	0.1047***	0.1285***	0.1317***	0.1375***	0.0836**
	(0.0115)	(0.0194)	(0.0197)	(0.0432)	(0.0315)	(0.0377)
Tax revenues (Log.)	-0.0125**	-0.0010	0.0141	-0.0568***	-0.0896***	-2.540E-5
	(0.0064)	(0.0109)	(0.0113)	(0.0220)	(0.0310)	(0.0129)
Democracy	0.0080***	0.0078***	0.0147***	0.0103*	0.0314***	0.0113***
	(0.0012)	(0.0018)	(0.0028)	(0.0059)	(0.0108)	(0.0043)
Government durability	0.0004***	0.0006	-0.0002	0.0003	0.0011***	-0.0027**
	(0.0001)	(0.0004)	(0.0003)	(0.0004)	(0.0004)	(0.0010)
Population density (Log.)	-0.0036	0.0044	-0.0126	-0.0105	-0.0233	-0.0092
	(0.0031)	(0.0047)	(0.0081)	(0.0068)	(0.0146)	(0.0086)
Observations	2101	483	446	405	604	135

Notes: This table reports the correlations between the calculated scores and the main potential determinants, from a Tobit analysis, and considering different geographical regions. Results from the full sample are reported in Column [1]. Column [2] includes Sub-Saharan African countries. Column [4] includes Latin American and Caribbean countries. Column [6] includes 20 fragile states. Standard errors are in parentheses. All regressions include the constant, not reported in the table. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Appendix D Sample and correlational evidence

Table D1: Countries in the sample

Panel A: Advanced economies			
Australia	Austria	Belgium	Canada
Switzerland	Cyprus	Czech Republic	Germany
Denmark	Spain	Estonia	Finland
France	United Kingdom	Greece	Ireland
Iceland	Israel	Italy	Japan
Korea, Rep.	Lithuania	Luxembourg	Latvia
Malta	Netherlands	Norway	New Zealand
Portugal	Singapore	Slovak Republic	Slovenia
Sweden	United States		
Panel B: Developing economies			
Afghanistan	Angola	Albania	Argentina
Armenia	Azerbaijan	Burundi	Benin
Burkina Faso	Bangladesh	Bulgaria	Bahrain
Bahamas, The	Bosnia and Herzegovina	Belarus	Belize
Bolivia	Brazil	Barbados	Bhutan
Botswana	Central African Republic	Chile	China
Cote d'Ivoire	Cameroon	Congo, Dem Rep	Congo, Rep
Colombia	Cabo Verde	Costa Rica	Dominica
Dominican Republic	Algeria	Ecuador	Egypt, Arab Rep.
Ethiopia	Fiji	Georgia	Ghana
Guinea-Bissau	Equatorial Guinea	Grenada	Guatemala
Honduras	Croatia	Hungary	Indonesia
India	Iran, Islamic Rep.	Iraq	Jamaica
Jordan	Kazakhstan	Kenya	Kyrgyz Republic
Cambodia	Kiribati	Kuwait	Laos
Lebanon	Liberia	Sri Lanka	Lesotho
Morocco	Moldova	Madagascar	Maldives
Mexico	Mali	Myanmar	Mongolia
Mozambique	Mauritius	Malawi	Malaysia
Namibia	Niger	Nigeria	Nicaragua
Nepal	Oman	Pakistan	Panama
Peru	Philippines	Papua New Guinea	Poland
Paraguay	Qatar	Russian Federation	Rwanda
Saudi Arabia	Sudan	Senegal	Solomon Islands
Sierra Leone	El Salvador	Serbia	Suriname
Swaziland	Seychelles	Togo	Thailand
Tajikistan	Timor-Leste	Tonga	Trinidad and Tobago
Tunisia	Turkey	Tanzania	Uganda
Ukraine	Uruguay	Uzbekistan	St Vincent and the Grenadines
Venezuela, RB	Vietnam	Vanuatu	Samoa
Yemen, Rep.	South Africa	Zambia	Zimbabwe

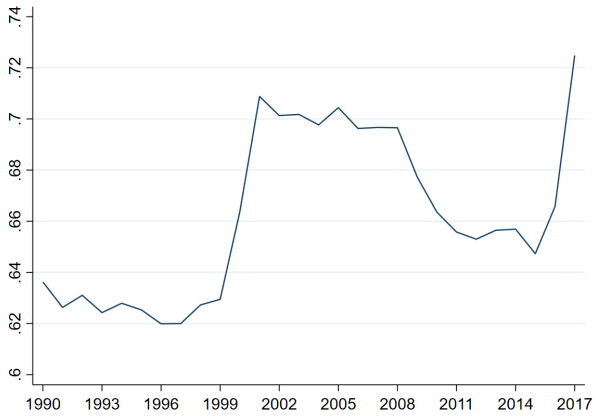
Table D2: Pearson's correlations of the main variables

	PSE	PSE	PSE	PSE	PSE
Trade globalization	0.3088***				
Factor productivity		0.1478***			
Tax revenues			0.2570***		
Democracy				0.2728***	
Government durability					0.2741***
Population density					

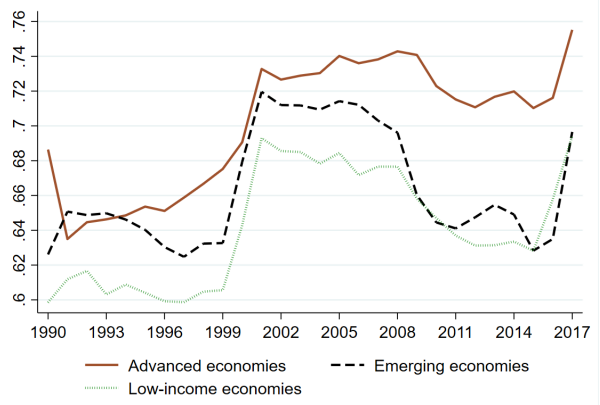
	0.0671***

Notes: This table reports the Pearson correlations of the main variables and the public sector efficiency (PSE) scores. *** indicates significance at the 1% threshold.

Appendix E Government efficiency trends from 1990 to 2017



(a) Overall public sector efficiency



(b) Public sector efficiency by income group

Figure E 1: Government efficiency trends from 1990 to 2017

Appendix F Country rankings

Table F1: Country rankings by average efficiency scores: 1990-2017

Country	Score	Rank	Country	Score	Rank	Country	Score	Rank	Country	Score	Rank
United States	0.8011	1	Tunisia	0.688	41	Chile	0.6632	81	Mali	0.6356	121
United Kingdom	0.7733	2	Tonga	0.6873	42	Ivory Coast	0.6623	82	Cameroon	0.6338	122
Australia	0.7468	3	Barbados	0.6849	43	Jamaica	0.6622	83	Mongolia	0.6325	123
Japan	0.7416	4	Laos	0.6849	44	Luxembourg	0.6622	84	Malawi	0.6323	124
New Zealand	0.7359	5	Mauritius	0.6821	45	Trinidad and Tobago	0.6618	85	Lesotho	0.6318	125
Israel	0.7279	6	Argentina	0.6814	46	Algeria	0.6617	86	India	0.6317	126
Germany	0.7259	7	Finland	0.681	47	Armenia	0.6601	87	Ghana	0.6309	127
Netherlands	0.7257	8	Grenada	0.6804	48	Botswana	0.6599	88	Bahamas, The	0.6293	128
Norway	0.7254	9	Latvia	0.6795	49	Paraguay	0.6597	89	Honduras	0.629	129
Ireland	0.7242	10	Thailand	0.6776	50	Sweden	0.6597	90	Central African Republic	0.6285	130
Italy	0.7224	11	Panama	0.6774	51	Saudi Arabia	0.6596	91	Zimbabwe	0.6264	131
Korea, Rep.	0.7223	12	Greece	0.6774	52	Mozambique	0.659	92	Namibia	0.6259	132
Austria	0.7194	13	Mexico	0.6769	53	South Africa	0.6588	93	Liberia	0.6251	133
Iceland	0.7184	14	Seychelles	0.6768	54	Iraq	0.658	94	Benin	0.6245	134
Costa Rica	0.718	15	Egypt, Arab Rep.	0.6767	55	Vanuatu	0.6566	95	Bangladesh	0.6232	135
Denmark	0.7166	16	Hungary	0.6764	56	Nepal	0.6549	96	Iran, Islamic Rep.	0.6222	136
Slovenia	0.7152	17	Republic of Serbia	0.6763	57	Moldova	0.6545	97	Sudan	0.6218	137
Canada	0.7139	18	Samoa	0.6741	58	Tajikistan	0.6543	98	Madagascar	0.6218	138
Malta	0.7133	19	Bosnia and Herzegovina	0.674	59	Fiji	0.654	99	Pakistan	0.6211	139
Singapore	0.7112	20	Uzbekistan	0.6737	60	Philippines	0.6539	100	Afghanistan	0.6191	140
Kazakhstan	0.7098	21	Timor-Leste	0.6726	61	Maldives	0.6539	101	Eswatini	0.6191	141
Peru	0.7092	22	Ecuador	0.6725	62	Qatar	0.6534	102	Nicaragua	0.6171	142
Portugal	0.7083	23	Colombia	0.6722	63	Kyrgyz Republic	0.6531	103	Bhutan	0.6163	143
Poland	0.708	24	Dominica	0.6715	64	Burkina Faso	0.651	104	Kenya	0.6079	144
Brazil	0.7038	25	Belize	0.6713	65	Rwanda	0.649	105	Zambia	0.6072	145
Switzerland	0.7031	26	Georgia	0.6713	66	Jordan	0.6483	106	Myanmar	0.6057	146
China	0.7027	27	Estonia	0.671	67	Morocco	0.6483	107	Equatorial Guinea	0.6042	147
Czechia	0.7014	28	St Vincent and the Grenadines	0.6706	68	Solomon Islands	0.6481	108	Uganda	0.5996	148
France	0.7012	29	Indonesia	0.6689	69	Oman	0.648	109	Burundi	0.5961	149
Lithuania	0.6994	30	Bahrain	0.6688	70	Kuwait	0.6476	110	Republic of the Congo	0.5931	150
Belarus	0.697	31	Ukraine	0.6681	71	Guatemala	0.6461	111	Angola	0.5907	151
Belgium	0.6965	32	Kiribati	0.668	72	Niger	0.6458	112	Papua New Guinea	0.5688	152
Slovak Republic	0.6949	33	Russian Federation	0.6676	73	Vietnam	0.6456	113	Togo	0.5612	153
Lebanon	0.6944	34	Dominican Republic	0.6672	74	Sierra Leone	0.6433	114	Ethiopia	0.5604	154
Cabo Verde	0.6935	35	Bulgaria	0.667	75	Cambodia	0.6429	115	Nigeria	0.5543	155
Cyprus	0.6919	36	Senegal	0.6659	76	Venezuela, RB	0.6415	116	United Republic of Tanzania	0.5467	156
Spain	0.691	37	Bolivia	0.6657	77	Albania	0.6402	117	Yemen, Rep.	0.5429	157
Turkey	0.691	38	Malaysia	0.6654	78	Suriname	0.6379	118	Democratic Republic of the Congo	0.4826	158
Sri Lanka	0.6898	39	El Salvador	0.6651	79	Guinea-Bissau	0.637	119			
Uruguay	0.6897	40	Croatia	0.664	80	Azerbaijan	0.6368	120			

Appendix G VARIABLES AND THEIR SOURCES

Table G1: Variables for calculating public expenditure efficiency

Variables	Nature	Sources
1. Public expenditure (inputs)		
Education expenditure (%GDP)	Continuous	Public Expenditures for Economic Development (SPEED)
Infrastructure expenditure (%GDP)	Continuous	SPEED
Health expenditure (%GDP)	Continuous	SPEED
Government final consumption (%GDP)	Continuous	World Economic Outlook (WEO)
2. Sectoral performance indices (outcomes)		
Education		
— Primary enrollment	Continuous	World Development Indicators (WDI)
— Secondary enrollment	Continuous	WDI
— Expected years of schooling	Continuous	WDI
Health		
— Life expectancy at birth	Continuous	World Development Indicators (WDI)
— Infant mortality rate (per 1000 live births)	Continuous	WDI
Infrastructure		
— Total length of roads in kilometers	Continuous	World Telecommunication/ICT Indicators Database
— Number of paved roads (% total roads	Continuous	World Telecommunication/ICT Indicators Database
— Fixed telephone subscriptions (per 100 people)	Continuous	World Telecommunication/ICT Indicators Database
— Fixed broadband subscriptions (per 100 people)	Continuous	World Telecommunication/ICT Indicators Database
— Faults for 100 fixed telephone lines per year	Continuous	World Telecommunication/ICT Indicators Database
— Proportion of households with electricity	Continuous	World Telecommunication/ICT Indicators Database
— Electric power consumption (in kWh per capita)	Continuous	World Telecommunication/ICT Indicators Database
— Electric power transmission and distribution losses (%production)	Continuous	World Telecommunication/ICT Indicators Database
Administration		
— Independence of the judiciary	Continuous	Teorell et al. (2018)
— teorell2018quality of property rights	Continuous	Teorell et al. (2018)
— Quality of government	Continuous	Teorell et al. (2018)
— Level of the shadow economy	Continuous	Teorell et al. (2018)
Stability		
— Standard deviation of the three-year moving average of GDP growth	Continuous	Authors, from WDI
— Standard deviation of the three-year moving of inflation	Continuous	Authors, from WDI
Distribution		
— Gini index	Continuous	Standardized World Income Inequality Database (SWIID)
Economic performance		
— GDP per capita	Continuous	WDI
— GDP growth (10-year average)	Continuous	WDI
— Unemployment rate (10-year average)	Continuous	WDI
3. Main determinants		
Trade globalization	Index ranging from 0 to 100	KOF (Dreher, 2006; Gygli et al., 2019)
Total factor productivity	Continuous	Penn World Table (PWT)
Tax revenues	Continuous	UNU-WIDER Government Revenue Dataset
Democracy Index	Index ranging from 0 to 10	Freedom House database
Government durability	Continuous	Polity IV
Population density	Continuous	WDI, World Bank

Table G2: Main determinants of public expenditure efficiency

Trade globalization is measured by the KOF index (Dreher, 2006; Gygli et al., 2019), and ranges from 1 to 100 (higher degree of globalization).
Total factor productivity measures the share of output that is not explained by the quantity of inputs used in production, and is from the Penn World Table (PWT).
Tax revenues — excluding social contributions and natural resources — are from the UNU-WIDER Government Revenue Dataset.
Democracy is captured by an index varying between 0 (least democratic) and 10 (most democratic), extracted from the Freedom House database.
Government durability measures the number of years since the last change in the political regime and comes from the Polity IV dataset.
Population density is the mid-year population divided by the area in square kilometers and comes from the World Bank's WDI (World Development Indicators) database.