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Public Sector Efficiency: Implications for public debt, growth and productivity

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Public Sector Efficiency: Implications for public debt, growth and productivity•

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Abstract

This paper computes public sector efficiency scores in a group of 39 advanced and emerging market economies from 2000 to 2021. Next, it examines by means of the local projection method the short- to medium-term effects of public sector efficiency on the debt ratio, productivity, and private investment. We find that an increase in public sector efficiency lowers public debt and enhances its medium-term sustainability. It also significantly increases labor productivity, while yielding more moderate gains in terms of total-factor productivity. The impact on private investment is marginally positive over the medium term. The results remain valid after several robustness checks have been performed.

JEL: C14, E23, H11, H50, O49

Keywords: Public Spending Efficiency; DEA; Debt Sustainability; Productivity; Private Investment

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Αποτελεσματικότητα του Δημόσιου Τομέα: Επιπτώσεις στο δημόσιο χρέος, την ανάπτυξη και την παραγωγικότητα

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Περίληψη

Αυτό το άρθρο υπολογίζει δείκτες αποτελεσματικότητας του δημόσιου τομέα για μια ομάδα 39 προηγμένων και αναδυόμενων οικονομιών για την περίοδο 2000-2021. Στη συνέχεια, εξετάζει, μέσω της μεθόδου τοπικών προβολών, τις βραχυπρόθεσμες και μεσοπρόθεσμες επιπτώσεις της αποτελεσματικότητας του δημόσιου τομέα στον λόγο χρέους, την παραγωγικότητα και τις ιδιωτικές επενδύσεις. Βρίσκουμε ότι η αύξηση της αποτελεσματικότητας του δημόσιου τομέα μειώνει το δημόσιο χρέος και ενισχύει τη μεσοπρόθεσμη βιωσιμότητά του. Παράλληλα, αυξάνει σημαντικά την παραγωγικότητα της εργασίας, ενώ τα οφέλη ως προς την ολική παραγωγικότητα των συντελεστών είναι οριακά θετικά. Η επίδραση στις ιδιωτικές επενδύσεις είναι οριακά θετική σε μεσοπρόθεσμο ορίζοντα. Τα αποτελέσματα παραμένουν έγκυρα και μετά από πολλαπλούς ελέγχους ευρωστίας.

Λέξεις κλειδιά: Αποτελεσματικότητα δημοσίου τομέα, DEA, Βιωσιμότητα χρέους, Παραγωγικότητα, Ιδιωτικές επενδύσεις

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1 Introduction

Due to the COVID-19 pandemic and the subsequent energy crisis, many countries have increased their expenditures, resulting in rising deficit and debt levels in an effort to stimulate demand. Most countries have already started or are planning to implement fiscal consolidation programs to correct their fiscal positions. This will primarily be achieved through expenditure reductions and tax hikes. However, an effort must also be made to improve the targeting or efficiency of public expenditure in order to maximize its economic and social impact. At the same time, this approach will lead to cost savings. An important tool in this process is performance-based budgeting, which helps evaluate programs and actions.

Numerous studies have previously examined the relevance of public sector efficiency for economic performance (see Angelopoulos et al., 2008; Adam et al., 2011; Afonso et al., 2022; Afonso et al., 2024). The studies conclude that a more efficient public sector enhances citizens' trust in government (Afonso et al., 2024), bolsters market confidence (Afonso et al., 2022), and boosts economic growth (Angelopoulos et al., 2008). Moreover, enhanced public sector efficiency can lead to reduced public spending (Sutherland et al., 2007), higher firm productivity (Fadic et al., 2019), and improvements in education and GDP levels (Antonelli and De Bonis, 2019). However, less is known in the literature about the medium-term macroeconomic implications of public sector efficiency. This is the gap that this study aims to fill.

More specifically, our paper makes two key contributions. First, it fills a notable gap in the literature on public sector efficiency by examining its medium-term impact on fiscal sustainability, productivity, and private investment. Second, it offers valuable insights for policy makers, highlighting the need for an effective mix of public spending to

ensure the best use of resources so that public policies deliver the greatest possible social benefits.

Using a sample of 39 advanced and emerging market economies over the period 1990-2021 and following Afonso et al. (2024), we first compute the public sector efficiency via DEA with an input-oriented approach. Then, by means of the local projections methodology as pioneered by Jordà (2005), we examine the medium-term effects of public sector efficiency on debt-to-GDP ratios, total factor productivity, labor productivity and private investment as a % of GDP.

We find that a more efficient public sector contributes to expenditure saving by reducing the public debt ratio over the medium term. In addition, higher public sector efficiency leads to a significant increase in labor productivity, while its impact on total-factor productivity and private investment, though positive, is smaller. These results remain robust even after conducting several robustness checks, including the use of alternative definitions of public sector efficiency, addressing potential endogeneity between public sector efficiency and macroeconomic or fiscal conditions by means of IV techniques, and analyzing a smaller, more homogeneous sample.

The rest of the paper is organized as follows. Section 2 reviews empirical literature. Section 3 discusses data and methodological issues. Section 4 presents the empirical results. Section 5 presents some robustness checks, while Section 6 concludes.

2 Related Literature

The literature on public sector efficiency (PSE) frequently utilizes both parametric and non-parametric methodologies, with Data Envelopment Analysis (DEA) and Free Disposal Hull (FDH) being among the most widely employed non-parametric techniques for measuring efficiency. This literature typically yields two key outcomes: (i) the development of metrics for public sector efficiency, public sector performance, and public expenditure efficiency; and (ii) the identification of specific factors associated with public sector efficiency. Adam et al. (2011) estimated the PSE for 19 OECD countries, finding that individual countries could benefit from examining the efficiency of public service delivery in other countries.

One strand of the literature has examined the effects of PSE on growth, productivity and other macroeconomic variables. Public sector efficiency is closely linked to macroeconomic performance and economic growth (Angelopoulos et al., 2008). The authors examined how fiscal size affects economic growth, concluding that this relationship is contingent upon public sector efficiency. Using a sample of 64 countries, Angelopoulos et al. (2008) found that the heterogeneity in the relationship between fiscal size and economic growth depends crucially on the size-efficiency mix. In addition, other studies have explored how PSE influence productivity at regional levels. Beidas-Strom (2017) investigated PSE in England, using sub-regional data, and found that PSE improved following financial crises and government spending cuts, particularly in education. Furthermore, his study provided evidence that changes in labor productivity are linked to differences in PSE at the sub-regional level. In a similar vein, Fadic et al. (2019) examined the effect of public administration efficiency on firm-level productivity in Italy and concluded that an efficient public sector enhances firm productivity.

Another strand of the literature has focused on the link between the PSE, public finances, taxation and budgetary policies. Afonso et al. (2021) examined the effect of structural tax reforms on government spending efficiency for 18 OECD economies, finding that increased personal income tax rates harm public sector efficiency. However, other studies have provided different insights into tax policy. More specifically, efficient government spending fosters economic growth, with VAT further amplifying this effect, particularly when coupled with robust democratic and legislative institutions. Additionally, the effective use of resources is associated with more favorable taxpayer attitudes (Barone and Mocetti, 2011; Chan et al., 2017). Becker (2008) provided evidence suggesting that a smaller public sector tends to be more efficient, although the effect is not substantial. Rayp and Van De Sijpe (2007) evaluated the impact of budgetary policies and public spending efficiency on economic growth across 52 developing countries, demonstrating that structural country variables and governance indicators predominantly influence public expenditure efficiency. In addition, Afonso et al. (2022) investigated the effect of PSE on capital markets in 35 countries, revealing that higher PSE scores are associated with improved sovereign debt ratings.

A third strand of the literature has examined the link between PSE, fiscal rules, political and other factors. The effective management of public finances is of vital importance for the sustainability of an economy, making it essential to examine the efficiency of public spending and the instruments available to policymakers for its control. More specifically, fiscal rules, which serve as tools for policymakers in the conduct of fiscal policy, help prevent both large deficits and surpluses. More importantly, fiscal rules have been shown to reduce deficits even when their enforcement was not visible (Caselli and Wingender, 2021; Chrysanthakopoulos and Tagkalakis, 2024a).

Furthermore, strong fiscal councils have been found to mitigate the pro-cyclicality of fiscal policy and promote counter-cyclicality (Chrysanthakopoulos and Tagkalakis, 2024b), which is regarded as more effective in enhancing public sector efficiency. By adjusting government spending and taxation in response to economic fluctuations, counter-cyclical policies contribute to stabilizing the economy, enhance resource allocation, and prevent inefficiencies during periods of boom or recession. Bergman et al. (2016) found that fiscal rules effectively reduce structural primary deficits across various levels of government efficiency. Hence, fiscal rules, by effectively reducing structural primary deficits, contribute directly to the efficiency of the public sector. When deficits are constrained, governments are compelled to manage available resources more prudently and avoid unnecessary waste. This leads to a more optimal allocation of public expenditures, improves fiscal governance, and promotes transparency and accountability. As a result, the overall performance of the public sector is enhanced, ensuring a more efficient use of resources for the provision of public services. Apeti and Combes (2023) examined how fiscal rules influence public expenditure efficiency using data for 159 countries, providing strong evidence that fiscal rules enhance efficiency, although their impact varies depending on the type of rule, design, macroeconomic conditions, and the time elapsed since implementation. On the contrary, López-Herrera et al. (2023) found that fiscal rules negatively impact public sector efficiency scores. Adam et al. (2014) found a significant correlation between fiscal decentralization and PSE in a sample of 21 OECD nations. Moreover, Christl et al. (2020) further analyzed the effects of fiscal decentralization and fiscal rules on public sector efficiency in 23 EU countries, concluding that decentralization has positive but asymmetric effects, whereas fiscal rules generally do not enhance efficiency.

Borge et al. (2008) found that strong fiscal capacity and political fragmentation reduce efficiency, whereas democratic participation may enhance it. Hauner and Kyobe (2010) analyzed the public sector performance of 114 countries from 1980 to 2006, finding that institutional improvements benefit government efficiency, economic growth, and financial development. Giordano and Tommasino (2013) examined the role of citizens' political engagement in 103 Italian provinces, demonstrating that higher political involvement improves PSE. Montes et al. (2019) examined fiscal transparency's impact on government expenditure efficiency, using data from 82 countries, and found that fiscal transparency reduces public debt and enhances government efficiency. Herrera and Ouedraogo (2018) conducted an analysis of public spending efficiency using a large dataset encompassing 175 countries. Their findings indicated a negative relationship between public sector efficiency and both the overall levels of spending and the ratio of public to private financing in the provision of services. In addition, the efficiency of capital spending was found to be positively correlated with the quality of governance metrics, specifically regulatory quality, while being negatively associated with the perception of corruption.

Afonso et al. (2010) evaluated the impact of government expenditure on income inequality, with a particular focus on the quality of education and the role of public institutions within OECD countries. They found both input and output inefficiencies across various countries. These inefficiencies were specifically highlighted when examining the relationship between public social spending and income inequality.

Finally, another strand of literature has examined the link between socio-economic determinants such as trust in government, health and education and PSE. Afonso et al. (2024) estimated the link between PSE and public trust in government using data from 36 OECD countries, finding a positive correlation between higher PSE and increased

citizen trust in government. This study highlights the broader significance of PSE as a key determinant in interpreting macroeconomic and other variables. Moreover, Herrera and Pang (2005) investigated the efficiency of education and health spending using a large panel of 160 countries, concluding that higher spending often results in lower efficiency scores, and countries with higher public-to-private funding ratios and economic inequality tend to have lower efficiency scores. On the contrary, Antonelli and De Bonis (2019) found that higher efficiency is associated with higher education and GDP levels, smaller population sizes, lower selectivity in welfare systems, and reduced corruption. Dutu and Sicari (2020) used DEA to investigate welfare spending efficiency in areas such as healthcare, secondary education, and public services across OECD countries, revealing significant variations in efficiency measurements and potential improvements for both output and input efficiency.

Other studies have reinforced these findings. Sutherland et al. (2007) assessed the efficiency of public spending on education across OECD countries, suggesting that governments could achieve higher efficiency by reducing expenditure levels. Aubyn et al. (2009) analyzed the effectiveness of government spending on higher education in 26 countries, including Japan, the US, and EU countries, demonstrating that high-performing countries do not necessarily need to increase their spending but should prioritize spending efficiency. In a comparative study, Gupta and Verhoeven (2001) examined the efficiency of education and health spending in 38 African countries and compared them to Asian and Western Hemisphere countries, finding that African countries were less efficient in their spending. Eugène (2008) evaluated the effectiveness of Belgium's general government, focusing on public order, safety, healthcare, and education services. Fonchamnyo and Sama (2016) studied the efficiency of public spending in education and health in Cameroon, Chad, and the

Central African Republic, concluding that the budgetary quality and financial management positively affects efficiency, whereas corruption negatively impacts it.

However, despite the extensive literature examining the determinants influencing public sector efficiency in both advanced and developing economies, as well as its impact on indicators such as economic inequality and trust in government, there is a gap in the literature regarding public sector efficiency and its medium-term macroeconomic impacts. This study aims to bridge this gap.

3 Data and econometric framework

3.1 Data

We use a yearly unbalanced data set for a group of 39 advanced and emerging market economies from 2000 to 2021[1]. Our main explanatory variables include: [1] the debt-to-GDP ratio, serving as a proxy for fiscal sustainability (Chrysanthakopoulos and Tagkalakis, 2024a); [2] total factor productivity[2], which captures the impact of technological progress, innovation, and other efficiency-related factors not directly attributable to labor or capital inputs (Baier et al., 2006); [3] labor productivity[3], a key indicator of economic performance reflecting the efficiency of labor utilization (Baily et al., 2001); and [4] private investment as a percentage of GDP[4]. As control variables we use the inflation rate (based on GDP deflator), real GDP growth, the primary balance, real long-term interest rates and the natural logarithm of the terms of trade,

[1] Australia, Austria, Belgium, Bulgaria, China, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Georgia, Germany, Greece, Hungary, Iceland, Ireland, Israel, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Russia, Slovakia, Slovenia, South Africa, Spain, Sweden, Switzerland, Ukraine, United Kingdom, and United States of America.
[2] Data on total factor productivity is not available for the years 2020 - 2021.
[3] Data on labor productivity is not available for the years 2000 - 2004.
[4] Data on private investment as a percentage of GDP is not available for the following countries: Australia, China, Georgia, Iceland, Italy, Slovakia and Ukraine.

and the debt-to-GDP ratio. The macroeconomic variables are taken from the IMF World Economic Outlook (vintage April 2024), while data for the primary balance and the real long-term interest rates are taken from the IMF's "Public Finances in Modern History" database. In addition, data for the terms of trade are taken from the World Bank, while data for total factor productivity are taken from Feenstra et al. (2015), and for labor productivity are taken from the International Labour Organization. The political data were obtained from Döring's et al. (2022) website (ParlGov)[5], data on fiscal councils' and rules' characteristics are obtained from Chrysanthakopoulos and Tagkalakis (2023), while data for the exchange rate regime are taken from Reinhart et al. (2004) and Ilzetzki et al. (2019; 2022).

Turning to the variable of interest, we follow Afonso et al. (2024) to construct the PSE variable using the DEA method, which is explained in detail in the following subsection. Tables 1 and 2 report the variables that we used to construct the PSE scores with their sources.

[5] https://www.parlgov.org/

Table 1. DEA output components.

Sub Index	Variables	Source	Series
Opportunity Indicators			
Administrators	Red Tape	Quality of Government - Basic Dataset	The index measures economic freedom in five areas: government size, legal structure, property rights, sound money, trade, and regulation, ranging from 0 (least free) to 10 (most free).
	Independence of the Judiciary	Quality of Government - Basic Dataset	The 0-16 scale measures judicial independence, rule of law, protection from abuse, political control over police, peace, and equal treatment.
	Property Rights	World Economic Forum: The Global Competitiveness Report	The scale (0-1) measures the strength of private property rights.
	Shadow-Informal Economy	World Bank, Elgin et al. (2021)	DSGE-based estimates measure informal output as a percentage of official GDP.
	Control of corruption	World Bank - Worldwide Governance Indicators (WGI)	Captures perceptions of the extent to which public power is exercised for private gain, including both petty and grand forms of corruption, as well as "capture" of the state by elites and private interests. Ranging from approximately -2.5 (weaker control of corruption) to 2.5 (stronger control of corruption).
			z
Health	Mortality from CVD, cancer, diabetes or CRD	World Bank	Mortality rate (%), ages 30-70, from CVD, cancer, diabetes, or CRD.
	Life expectancy at birth, total (years)	World Bank	Life expectancy at birth is the average years a newborn is expected to live.
	Mortality rate, infant	World Bank	Infant mortality rate (per 1,000 live births) measures infant deaths.
Education	School enrollment, secondary (% gross)	World Bank	Ratio of total enrolment in secondary education.
	Quality of the education system	World Economic Forum: The Global competitiveness Report	Quality of the educational system is rated on a scale from 7 (very well) to 1 (not well at all).
Public Infrastructure	Infrastructure Quality	World Economic Forum: The Global competitiveness Report	Infrastructure quality on a scale from 7 (extensive and efficient) to 1 (extremely underdeveloped). Quality of road infrastructure from 7 to 1. Efficiency of train services from 7 to 1. Efficiency of air transport services from 7 to 1. Efficiency of seaport services from 7 to 1.
Musgravian indicators			
Distribution	Gini index	World Bank, Poverty and Inequality Platform	The Gini index ranges from 1 (perfect inequality) to 0 (perfect equality). Transformed 1-Gini.
Stabilization	Coefficient of variation of growth	IMF World Economic Outlook (WEO database)	The coefficient of variation is the standard deviation divided by the mean of 5-year GDP growth (percent change, constant prices). Its reciprocal is 1/x.
	Standard deviation of inflation	IMF World Economic Outlook (WEO database)	The standard deviation of inflation is based on 5-year consumer price data, and its reciprocal is 1/x.
Economic performance	GDP growth	IMF World Economic Outlook (WEO database)	GDP constant prices (% change).
	GDP per capita	IMF World Economic Outlook (WEO database)	GDP per capita based on PPP, current international dollar.
	Unemployment	IMF World Economic Outlook (WEO database)	Unemployment rate as % of total labor force.

Notes: Authors' calculations.

Table 2. DEA inputs components.

Sub Index	Variables	Source	Series
Opportunity Indicators			
Administrators	Government Consumption	World Bank	General government final consumption spending as % of GDP
	Education Spending	IMF Functional Expenditures (COFOG) database	Spending on education as % of GDP
	Health Spending	IMF Functional Expenditures (COFOG) database	Spending on health as % of GDP
	Public infrastructure	IMF Investment and Capital Stock Dataset	Public investment as % of GDP
Musgravian indicators			
Stabilization/Economic performance	Government Total Expenditures	IMF World Economic Outlook (WEO database)	Total spending as % of GDP

Notes: Authors' calculations.

3.2 Measuring public sector efficiency

Following Afonso et al. (2024), we employ data envelopment analysis (DEA)[6] pioneered by Farrell's (1957) seminal work and was further developed by Charnes et al. (1978), which compares each observation with an ideal outcome, to measure the public sector efficiency scores. For each country i the following function is considered:

$$Y_i = f(X)_i, i = 1, \dots 39 \ (1)$$

where Y_i is the composite output performance measure and X is the is the composite input measure (public spending), i.e. public expenditure as a % of GDP. We compute the annual efficiency scores for 39 advanced and developing countries between 2000 and 2021. According to Afonso et al. (2024), the output composite indicator consists of two primary parts: Opportunity and Musgravian indicators (see Table 1).

The government's performance in the areas of infrastructure, education, health care, and administration are assessed by opportunity indicators. The Musgravian indicators are composed of three sub-indicators: distribution, stability, and economic performance.

[6] DEA is a non-parametric frontier methodology. See Thanassoulis (2001) for a comprehensive overview of DEA.

The composite output performance measure Y_i is the average between the Opportunity and Musgravian indicators (see Table 1). In addition, the Opportunity and Musgravian indicators are derived by calculating the average of the variables included in each category. For consistency in benchmarking, each variable is first normalized by dividing the value for a given country by the average of that variable across all countries in the sample.

The main input variable is the total spending as a % of GDP. However, as in Afonso et al. (2024), we develop two alternative input measures for the DEA model, which are subsequently employed in two distinct models to validate the baseline findings (see Table 2).

Musgravian input indicator is the average of the normalized variables of the social protection expenditure as a % of GDP and total expenditure as a % of GDP. Opportunity input indicator is the average of the normalized[7] indicators of general government final consumption spending as a % of GDP, health spending as a % of GDP, education spending as a % of GDP and public investment as a % of GDP.

Assuming variable-returns to scale (VRS) to account for the likelihood that a country may not function at its optimal scale, we employ an input-oriented approach to assess the proportionate increase in inputs while maintaining output constant. The efficiency scores are determined by solving the following linear programming problem:

$$\begin{gathered} min\theta_{\theta,\lambda} \\ s.t. - y_i + Y\lambda \geq 0 \\ \theta x_i - X\lambda \geq 0 \qquad (2) \\ I1'\lambda = 1 \end{gathered}$$

[7] As in Opportunity and Musgravian output indicators, each variable is first normalized by dividing the value for a given country by the average of that variable across all countries in the sample.

$$\lambda \geq 0$$

where y_i is a vector of outputs, x_i is a vector of inputs, 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. A country is inside the production frontier (i.e., inefficient) if $\theta < 1$, and at the frontier (i.e., efficient) if $\theta = 1$. Using DEA, we compute three alternative models. To compute our baseline PSE scores, we use only one input (total spending as % of GDP) and one output (the average of Musgravian and Opportunity indicators). As a robustness check, we compute a first set of alternative PSE scores, by using two inputs (the governments' spending on Opportunity and on Musgravian indicators) and one output (the total Musgravian output scores) and a second set of alternative PSE scores, by using one input (the normalized total spending indicator) and two outputs (the Opportunity and Musgravian indicators).

A summary of the baseline PSE scores for the period 2000–2021 is illustrated in Figure 1 using an input-oriented approach. The input-oriented assessment's aim is to determine how much input quantity can be lowered proportionately without affecting the amount of output that is generated[8]. As shown in Figure 1, the most efficient countries (in terms of public spending) located in the production possibility frontier for the baseline[9] model are: Bulgaria (2000-2006; 2008-2009), China (2000–2014; 2016-2019); Georgia (2013- 2016) and Ireland (2000; 2015-2021). Table 3 presents the summary statistics for the variables employed in our analysis.

[8] As an alternative, one can determine how much output quantities can be proportionately increased without changing the input quantities used by computing output-oriented DEA.

[9] For the first alternative model the countries that are the most efficient are: Bulgaria (2008), China (2000–2021); Georgia (2000- 2005; 2011-2012; 2018; 2020-2021), Ireland (2000; 2015; 2020-2021) and South Africa (2015-2017; 2019-2021). For the second alternative model the countries that are the most efficient are: Bulgaria (2000-2006; 2008-2009; 2011-2012), China (2000–2019); Georgia (2003; 2013-2016), Ireland (2000; 2015-2021), South Africa (2000-2021), Switzerland (2005-2008; 2010-2021) and United States (2000).

Figure 1. Public sector efficiency per country (with baseline definition).

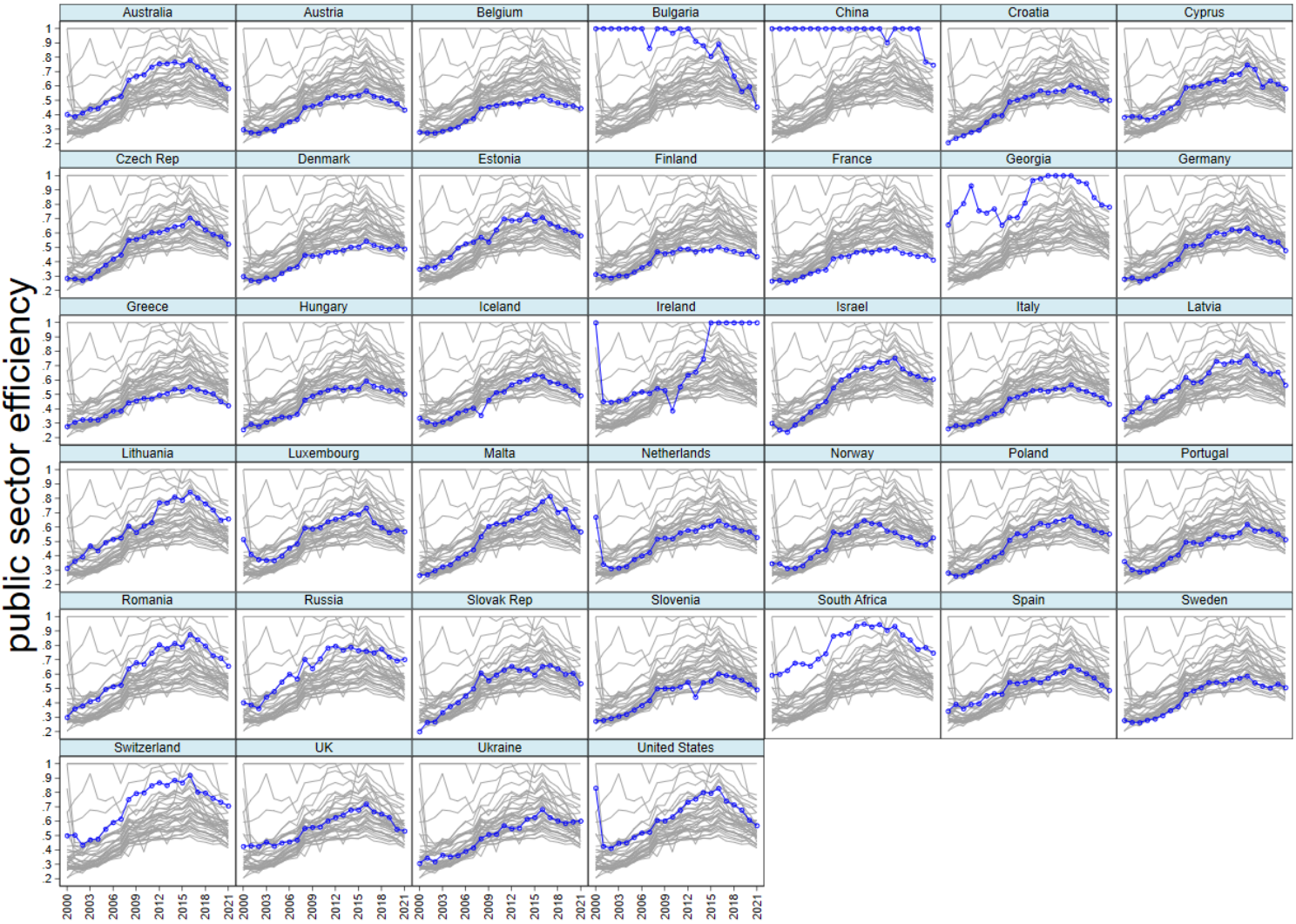


Table 3. Summary statistics

VARIABLES	(1) N	(2) Mean	(3) SD	(4) Min	(5) Max
Total factor productivity	761	0.968	0.0797	0.610	1.240
Labor productivity	663	0.489	0.256	0.0381	1.677
Debt to GDP	858	0.569	0.336	0.0377	2.132
Right	858	0.554	0.497	0	1
Power	858	0.263	0.441	0	1
Fiscal rules' characteristics	858	0.496	0.339	0	1
Fiscal councils' characteristics	858	0.306	0.367	0	1
Primary balance	858	0.0558	4.024	-28.17	20.57
Real long-term interest rate	792	1.587	2.882	-13.86	23.62
Real GDP growth	858	2.668	3.882	-15.10	24.48
Terms of trade	836	4.604	0.101	4.211	5.098
Fixed effective change regime	742	0.629	0.483	0	1
Public sector efficiency (baseline)	858	0.555	0.185	0.201	1
Public sector efficiency (alternative 1)	858	0.497	0.182	0.238	1
Public sector efficiency (alternative 2)	858	0.583	0.193	0.209	1
Private investment to GDP	704	0.0373	0.0105	0.0151	0.0769
Inflation	819	0.0292	0.0344	-0.156	0.322

Notes: This table presents the summary statistics.

3.3 Direct effects of public sector efficiency

Next, we examine the medium-term effects of PSE on several key macroeconomic variables (i.e., debt to GDP ratio ["Debt"], total factor productivity ["TFP"], labor productivity ["Labor"] and private investment to GDP ratio ["GFCF"]) which are used by academics and policymakers, to assess the soundness, efficiency, and the potential growth of an economy. A more efficient public sector leads to reduced public expenditure waste, lowers public debt by boosting economic growth and fiscal positions, leading to improved well-being. Furthermore, a more effective public sector provides enhanced services to citizens in areas such as healthcare, education, and infrastructure, thereby increasing their productivity. In addition, it can foster the growth of private enterprises by providing a more business friendly economic environment, e.g., by cutting red tape, which can stimulate business investment.

In line with Auerbach and Gorodnichenko (2012, 2013), Klein (2017), Ramey and Zubairy (2018), and Chrysanthakopoulos and Tagkalakis (2024a), we employ the Local Projection (LP) method, as introduced by Jordà (2005). The LP method offers several advantages over Vector Auto-Regressions (VARs): it can be estimated by using simple regression techniques, provides greater robustness to model misspecification, and facilitates the straightforward implementation of both joint and point-wise analytical inference (see e.g., Klein, 2017; Ramey and Zubairy, 2018). Consequently, the LP method offers a natural and more robust alternative for deriving impulse responses, rather than relying on VARs (Jordà and Taylor, 2025).

Hence, we estimate the following equations:

$$Debt_{it+h} - Debt_{it-1} = a^h + a_1^h(Debt_{it-1} - Debt_{it-2}) + a_2^h X_{it-1} + a_3^h PSE_{it} + \eta_{i+h} + \lambda_{t+h} + \varepsilon_{it+h} \quad (3)$$

$$TFP_{it+h} - TFP_{it-1} = a^h + a_1^h(TFP_{it-1} - TFP_{it-2}) + a_2^h X_{it-1} + a_3^h PSE_{it} + \eta_{i+h} + \lambda_{t+h} + \varepsilon_{it+h} \quad (4)$$

$$Labor_{it+h} - Labor_{it-1} = a^h + a_1^h(Labor_{it-1} - Labor_{it-2}) + a_2^h X_{it-1} + a_3^h PSE_{it} + \eta_{i+h} + \lambda_{t+h} + \varepsilon_{it+h} \quad (5)$$

$$GFCF_{it+h} - GFCF_{it-1} = a^h + a_1^h(GFCF_{it-1} - GFCF_{it-2}) + a_2^h X_{it-1} + a_3^h PSE_{it} + \eta_{i+h} + \lambda_{t+h} + \varepsilon_{it+h} \quad (6)$$

The dependent variables $Debt_{it+h} - Debt_{it-1}$, $TFP_{it+h} - TFP_{it-1}$, $Labor_{it+h} - Labor_{it-1}$ and $GFCF_{it+h} - GFCF_{it-1}$ are the cumulative changes in debt-to-GDP ratio

(equation 3), total factor productivity (equation 4), labor productivity (equation 5) and private investment as a % of GDP (equation 6). The forecast horizon h takes values from 0 up to 6 years ahead. a^h is a vector of constants, η_{i+h} are country effects to control for the unobserved effects between countries, λ_{t+h} are time effects that account for global factors and ε_{t+h} is the error-term, which is assumed to have a mean of zero and a strictly positive variance.

The variable PSE_{it} (public sector efficiency) is the variable of interest. In each equation, we account for the lagged value of the dependent variable. In addition, equation (3) includes as control variables (X_{it-1}) the lagged values of the inflation rate (based on GDP deflator), real GDP growth, the primary balance, real long-term interest rates and the natural logarithm of the terms of trade, while equations (4) – (6) incorporate the same variables[10], with the addition of the debt-to-GDP ratio. Equations (3) - (6), are estimated by means of an OLS technique with country and time fixed effects.

4 Empirical findings

Figure 2 reports the results based on equations (3) - (6). The solid line depicts the cumulative response of debt-to-GDP ratio, total factor productivity, labor productivity and private investment from year t=0 to year t+6, in response to an increase in public sector efficiency. The pink-shaded area corresponds to the 90% confidence bands.

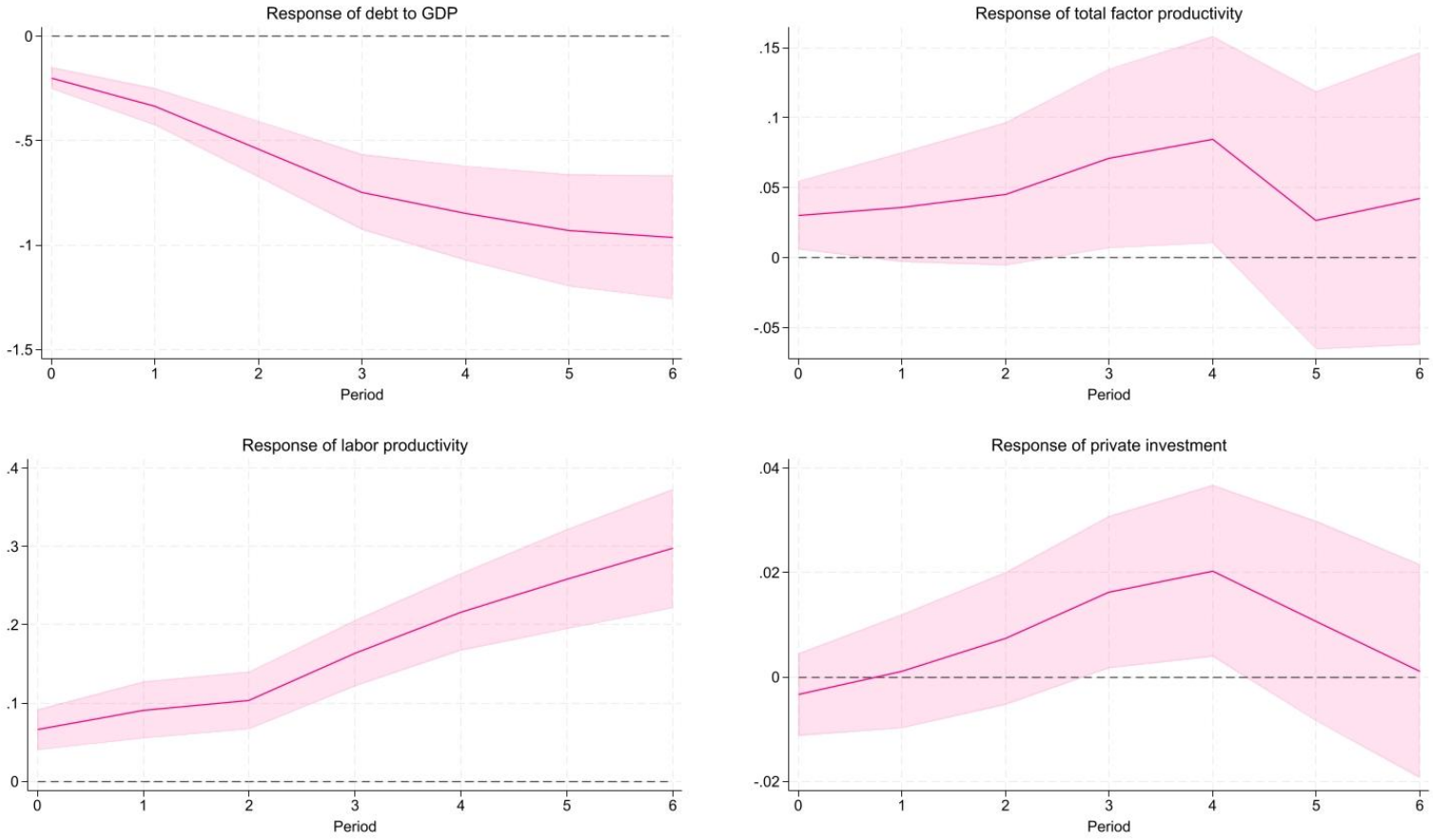
We find that a 1% increase in public spending efficiency reduces public debt by about 1.0% at the end of the forecast horizon. In addition, a 1% increase in public spending efficiency leads to a rise in total factor and labor productivity by 0.04% and 0.29%, respectively. Finally, a 1% increase in public spending efficiency leads to a marginal rise in private investment by 0.001%. However, in this case the peak response of private

[10] Real GDP growth enter as independent variable only in equation (6).

investment (of 0.02%) occurs 4 years after the more efficient allocation of public spending.

Our findings demonstrate that an efficient public sector can yield substantial economic benefits. These take the form of improved fiscal positions and lower debt ratio and increased total factor and labor productivity. Moreover, a more efficient public sector, in the spirit of complementarity between the public and private sector, can have a positive effect on business investment. When public expenditures are allocated efficiently, expenditure saving improves fiscal positions and lowers the debt ratio. Overall, a well-functioning public sector improves fiscal soundness and promotes sustainable development and prosperity.

Figure 2. The medium-term response of various macroeconomic indicators.



Notes: Figure 2 reports the cumulative response of various macroeconomic variables to an increase in public spending efficiency. Estimator: OLS with country and time fixed effects. Shaded area indicates the 90% bands.

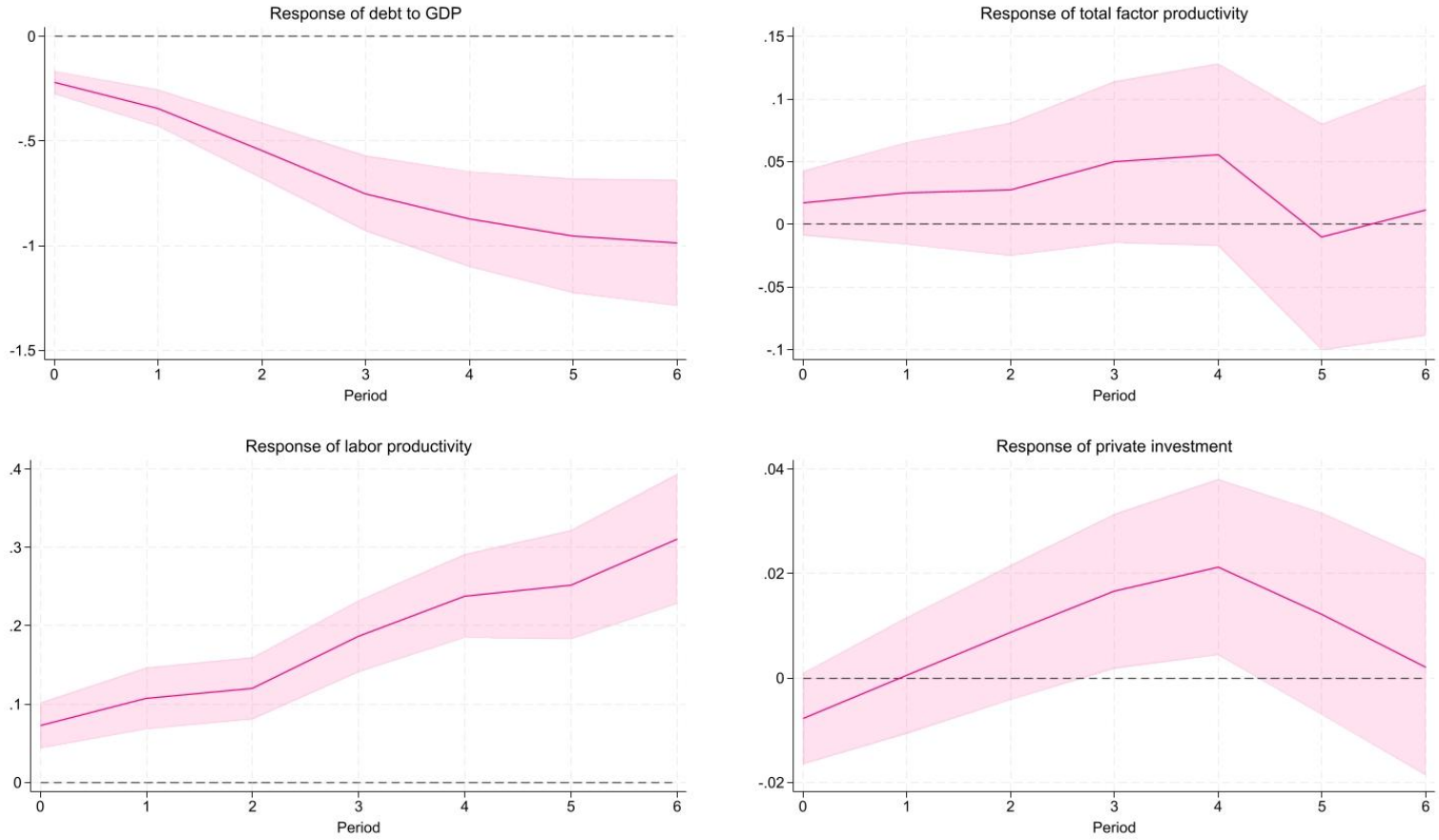
5 Robustness checks

5.1 Additional control variables and alternative definitions of PSE

To verify the validity of our baseline findings, we perform several robustness checks. First, we re-estimate equations (3) - (6), but we also include additional control variables. Specifically, following Afonso et al. (2024), we include two political variables to control for the political orientation and the strength of the government, since Hauner and Kyobe (2010) found that institutional improvements benefit government efficiency and financial development. In addition, we include indices for the specific characteristics of fiscal rules and fiscal councils (Chrysanthakopoulos and Tagkalakis, 2023), because fiscal institutions can improve fiscal transparency and accountability (Beetsma et al., 2019) and the overall fiscal performance. Furthermore, we include a dummy variable that captures the exchange rate regime, since as outlined in a standard macroeconomic textbook (e.g., Gartner, 2016), fiscal policy effects are more significant under fixed exchange rate regimes vis-à-vis to flexible ones.

The new impulse responses, that are reported in Figure 3, indicate that the baseline findings still hold.

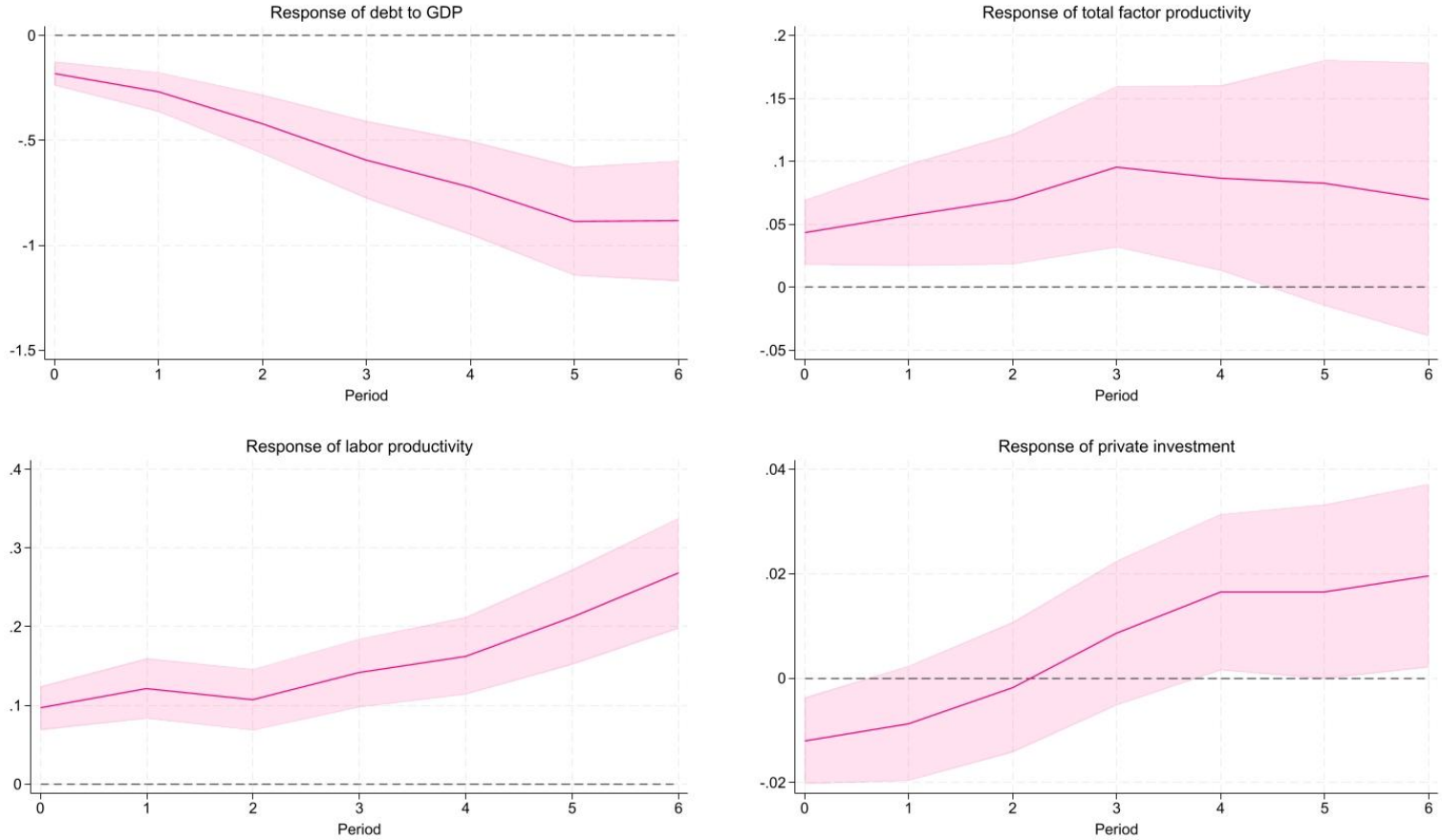
Figure 3. The medium-term response of various macroeconomic indicators. Adding more control variables.



Notes: Figure 3 reports the cumulative response of various macroeconomic variables to an increase in public spending efficiency. Estimator: OLS with country and time fixed effects. Shaded area indicates the 90% bands.

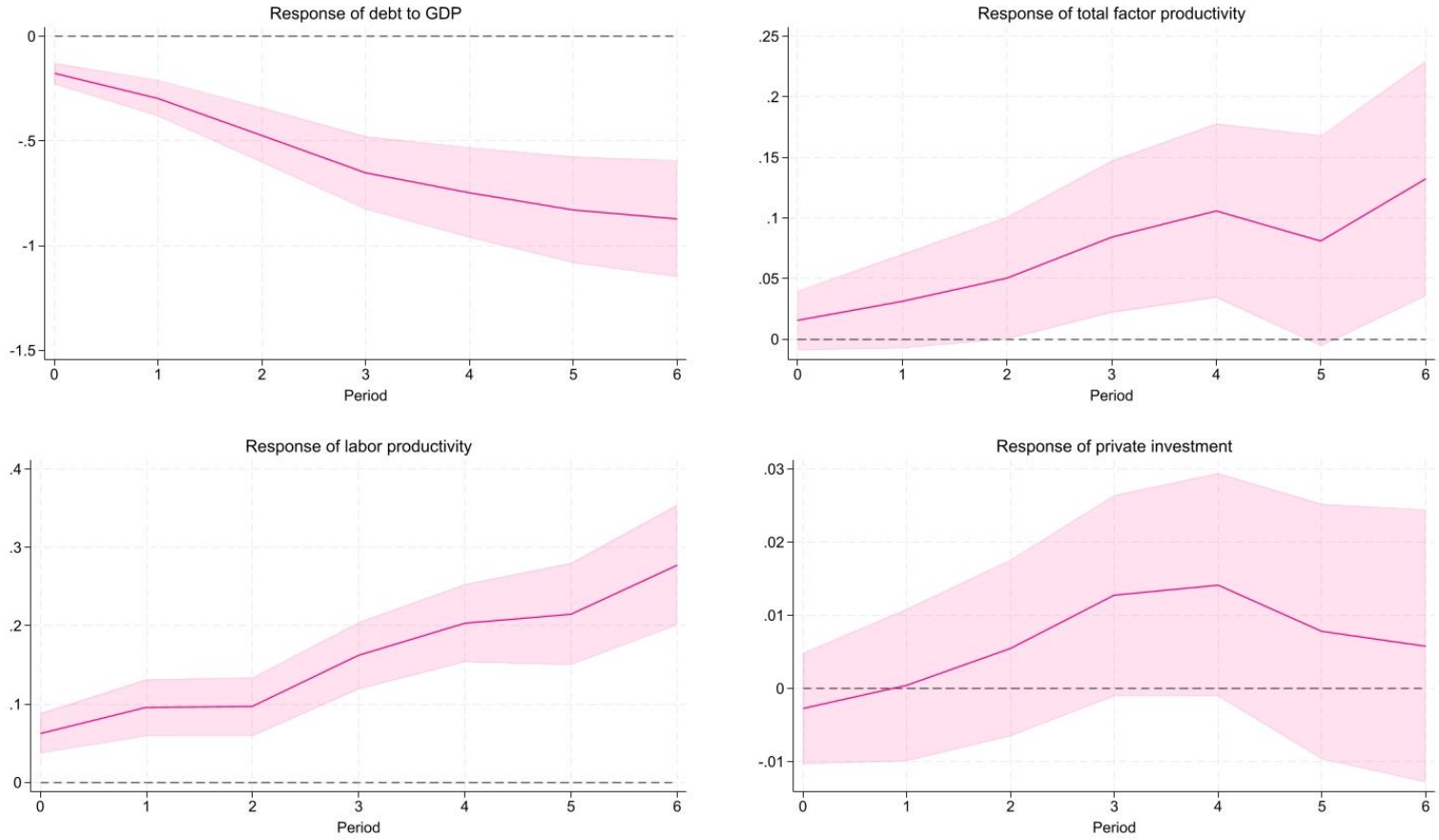
Second, in order to avoid any potential bias in our results, we re-estimate equations (3) – (6), by replacing the public sector efficiency variable with the two alternative definitions derived using the DEA method that were described in subsection 3.2. The impulse responses that are reported in Figures 4 and 5 are qualitatively similar with the baseline evidence.

Figure 4. The medium-term response of various macroeconomic indicators. With the first alternative public spending efficiency variable.



Notes: Figure 4 reports the cumulative response of various macroeconomic variables to an increase in public spending efficiency. Estimator: OLS with country and time fixed effects. Shaded area indicates the 90% bands.

Figure 5. The medium-term response of various macroeconomic indicators. With the second alternative public spending efficiency variable.



Notes: Figure 5 reports the cumulative response of various macroeconomic variables to an increase in public spending efficiency. Estimator: OLS with country and time fixed effects. Shaded area indicates the 90% bands.

5.2 Further robustness checks to address endogeneity

To ensure the validity of our baseline findings, it is essential to account for any potential endogeneity between public sector efficiency and the macroeconomic or fiscal variables under examination. This concern arises from the possibility that a country with a high PSE may already exhibit high productivity, or, due to the efficient allocation of public sector resources, may already implement prudent fiscal policies and have low debt ratio.

To this end, we re-estimate equations (3) – (6) by means of the 2-Stage Least Squares method with instrumental variables (IV), where the shock variable (i.e., the baseline PSE variable) is instrumented by the first lag of the change of government effectiveness

index obtained from the World Bank and the first lag of the PSE variable. Table 4 presents some diagnostics related to the estimation of equations (3) – (6).

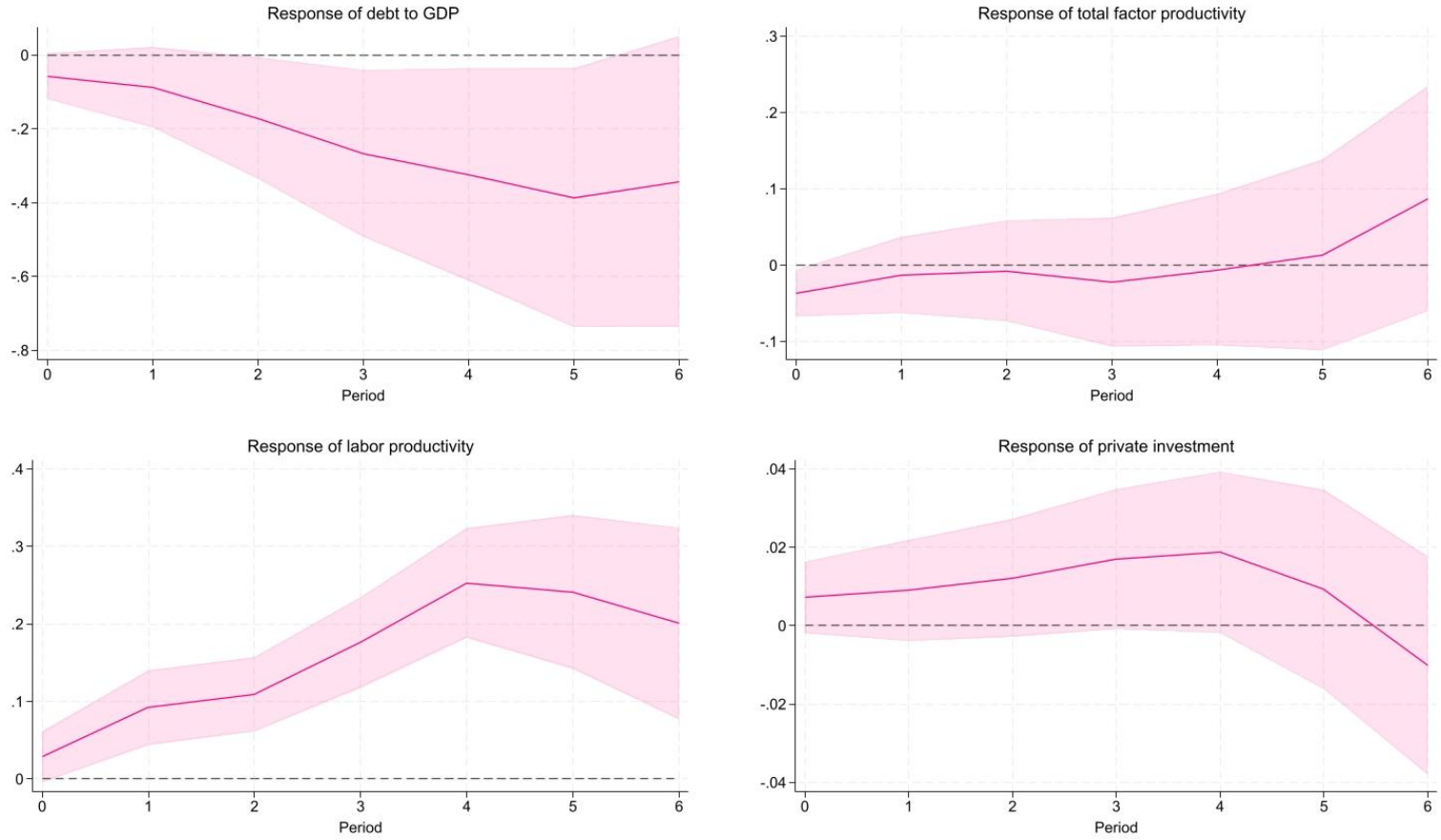
Table 4: Diagnostics results.

DIAGNOSTICS	(1) Year 0	(2) Year 1	(3) Year 2	(4) Year 3	(5) Year 4	(6) Year 5	(7) Year 6
Debt-to-GDP ratio							
R^2	0.53	0.54	0.53	0.58	0.62	0.66	0.69
Kleibergen-Paap rk LM statistic	37.099	35.637	34.835	38.691	40.390	42.750	38.014
Cragg-Donald Wald F statistic	871.486	698.699	676.992	541.271	449.882	350.080	297.771
Hansen J statistic	3.238	3.491	1.860	0.917	0.764	1.718	0.752
Total factor productivity							
R^2	0.37	0.47	0.53	0.58	0.62	0.64	0.62
Kleibergen-Paap rk LM statistic	33.343	36.417	37.746	38.975	37.014	35.847	35.655
Cragg-Donald Wald F statistic	801.982	646.218	540.999	430.013	359.317	318.798	233.349
Hansen J statistic	3.862	1.615	0.025	0.046	0.612	2.499	3.197
Labor productivity							
R^2	0.13	0.17	0.20	0.29	0.32	0.35	0.38
Kleibergen-Paap rk LM statistic	30.963	29.213	27.275	28.412	27.401	29.125	25.130
Cragg-Donald Wald F statistic	462.151	357.761	365.104	265.548	201.860	142.370	102.380
Hansen J statistic	0.184	0.299	0.121	0.355	0.112	0.212	0.554
Private investment as % of GDP							
R^2	0.32	0.45	0.54	0.59	0.63	0.65	0.66
Kleibergen-Paap rk LM statistic	25.551	26.088	23.712	25.120	25.129	28.423	24.257
Cragg-Donald Wald F statistic	789.788	719.761	580.428	446.047	360.406	250.510	208.110
Hansen J statistic	0.686	0.358	1.942	0.401	0.750	0.102	0.234

Notes: This table presents diagnostics regarding equations (3) – (6) which are estimated by means of a 2-SLS with IV instruments. The null hypothesis of the LM statistic states that the equation is under identified. As shown in the Table, rejecting the LM statistic posits that the instruments are valid. The Cragg-Donald Wald F-statistic tests for the weak instruments used. By rejecting the null, as shown in the Table, the instruments are strong, i.e. they are sufficiently correlated with the endogenous regressors and can provide reliable IV estimates. Finally, the null hypothesis of the Hansen J test states that the instruments are valid (i.e., uncorrelated with the error term) and failing to reject the null as shown in Table suggests that the instruments are valid and exogenous.

The new impulse responses are reported in Figure 6 and are nearly identical to those presented in Figure 2. Consequently, after accounting for potential endogeneity between the PSE variable and the dependent variables in equations (3)-(6), we find robust evidence that a more efficient public sector can indeed lead to a reduction in public debt over the medium-term, an increase in productivity, as well as contribute to a marginal short-term increase in private investment.

Figure 6. The medium-term response of various macroeconomic indicators.

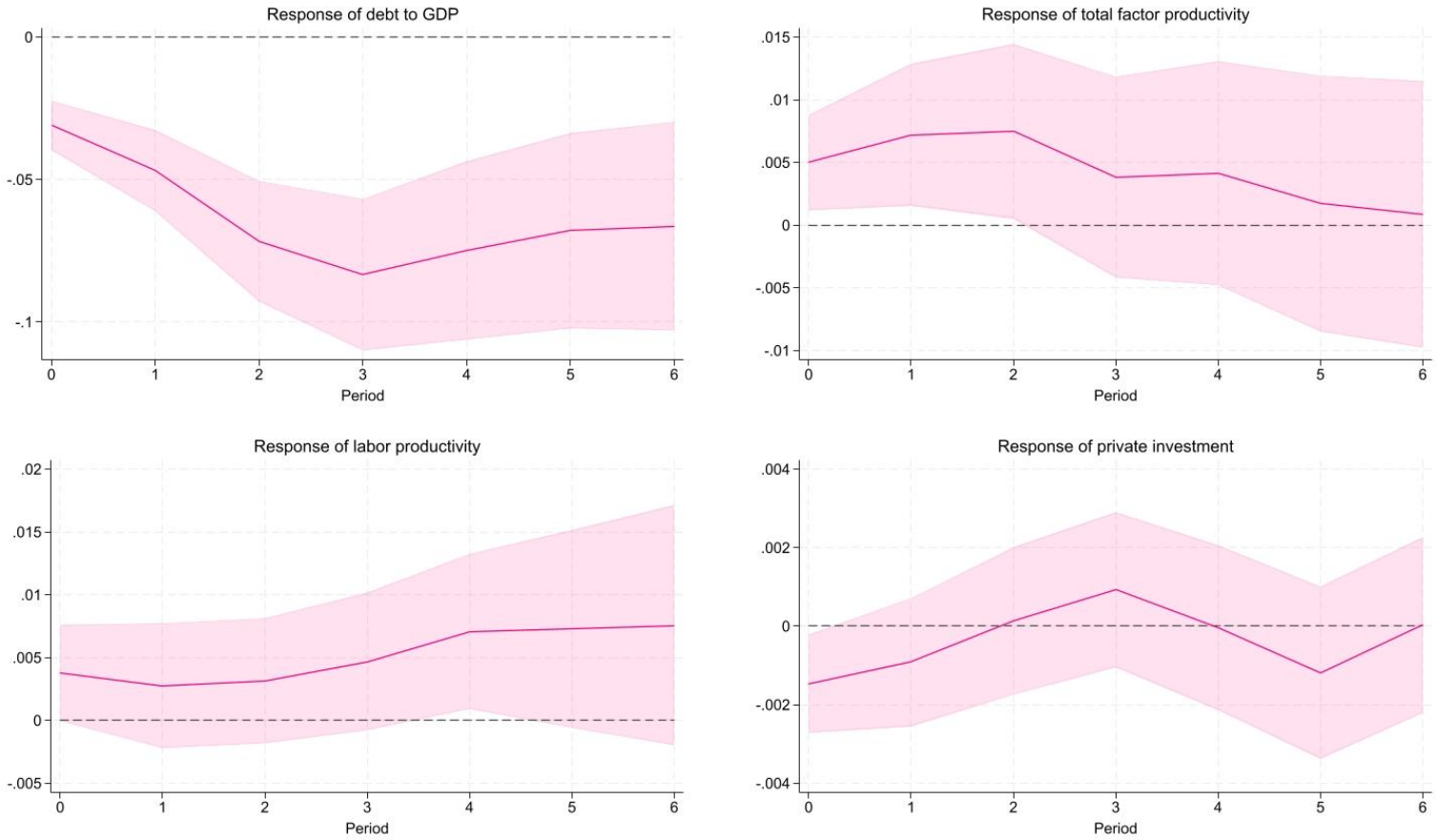


Notes: Figure 6 reports the cumulative response of various macroeconomic variables to an increase in public spending efficiency. Estimator: 2 SLS with IV instruments and country and time fixed effects. Instrumented variable: PSE. Instruments: the first lag of the change in government effectiveness indicator and the first lag of PSE. Shaded area indicates the 90% bands.

As a further robustness check we replace the PSE variable with a dummy variable. In more detail, we create a dummy variable (D1) that takes the value of 1 when the change in public sector efficiency is positive, and 0 otherwise. Then, we re-estimate equations (3) – (6) by means of an OLS with fixed effects technique, incorporating this new dummy variable (D1) as shock variable. In this case we take into account only the effect of the improvements in the public sector efficiency. As shown in Figure 7, the results obtained are qualitatively consistent with the baseline findings, though quantitatively slightly smaller. This occurs because the dummy variables do not account for the size effects, but this approach is an additional effort to mitigate the potential endogeneity

between PSE and the dependent variables. The only discernible difference is that the private investment impulse response is insignificant and on average zero.

Figure 7. The medium-term response of various macroeconomic indicators. With D1 as shock variable.



Notes: Figure 7 reports the cumulative response of various macroeconomic variables. Estimator: OLS with country and time fixed effects. Shaded area indicates the 90% bands.

5.3 Consider a smaller more homogeneous sample of countries in DEA

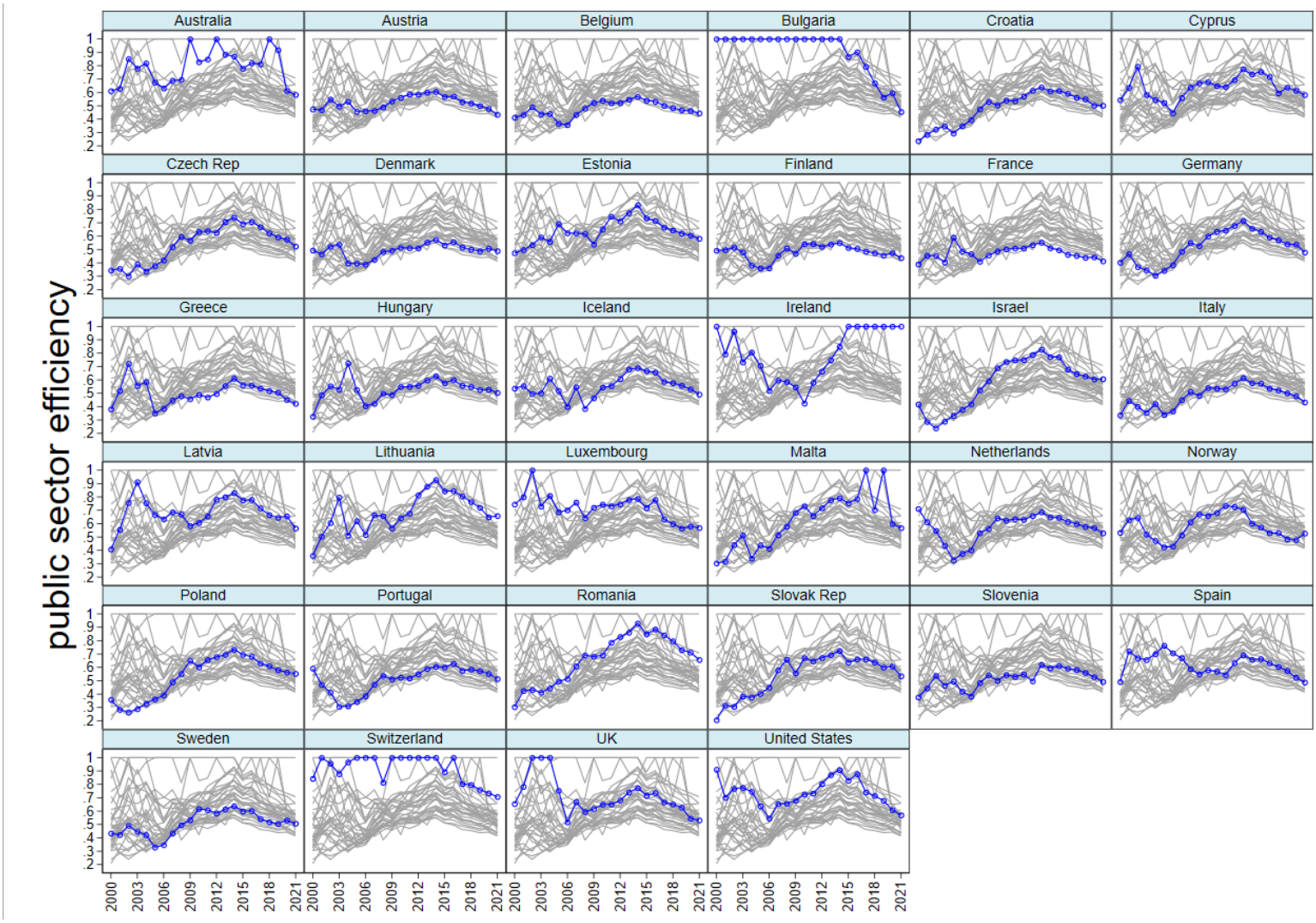
To ensure that our results are not influenced by countries with distinct political, cultural, and economic factors, we exclude China, Ukraine, South Africa, Russia, and Georgia from our sample. Excluding these countries when assessing public sector efficiency is prudent due to several factors. These countries often experience political instability and high levels of corruption, which can distort the true performance of their public sectors. In addition, their political and economic systems, particularly in countries like China

with its centralized, state-controlled model, differ significantly from the Western world, complicating direct comparisons. Furthermore, unreliable data, especially from authoritarian regimes, along with ongoing transitions in countries like Russia, Ukraine and Georgia, can further compromise the integrity of the analysis. Removing these countries allows for more accurate and meaningful comparisons between countries with similar institutional frameworks and stages of development.

To this end, we re-estimate equations (1) and (2) using the DEA method to calculate the baseline PSE scores[11], as in section 3.

[11] Figure 8 shows the public sector efficiency for the smaller more homogeneous sample of countries.

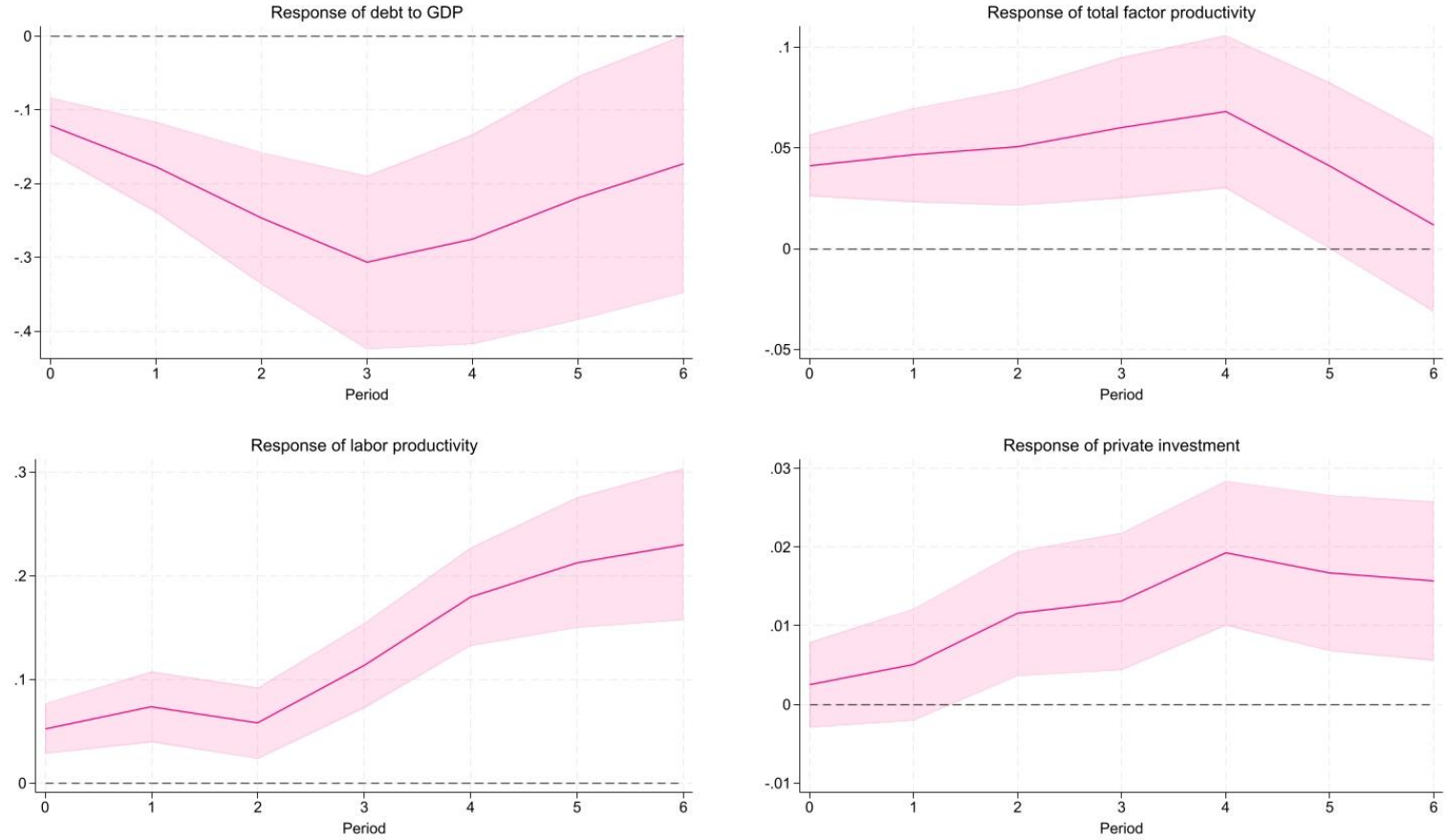
Figure 8. Public sector efficiency for the smaller more homogeneous sample of countries (with baseline definition).



We then re-estimate equations (3) - (6) using the OLS with fixed effects method to assess whether our results have changed. As shown in Figure 9, our key findings hold, even after excluding these countries, providing strong evidence that a more efficient public sector leads to public debt sustainability and leads to higher productivity. Moreover, we observe that a more efficient public sector significantly boosts private investment. The strong positive effect of public sector efficiency on investment in

Western countries highlights the importance of respect for the rule of law and democratic values as a prerequisite for attracting investment.[12]

Figure 9. The medium-term response of various macroeconomic indicators. Excluding China, Georgia, Russia, South Africa and Ukraine.



Notes: Figure 9 reports the cumulative response of various macroeconomic variables. Estimator: OLS with country and time fixed effects. Shaded area indicates the 90% bands.

[12] More democratic regimes encourage private investment for several reasons: [1] enhanced legal security and transparency, ensuring the protection of investor rights and contract enforcement, [2] provide political stability and predictable regulatory frameworks, reducing the risk of sudden policy shifts that could negatively impact businesses, [3] lower levels of corruption and a commitment to market freedom foster a more favorable environment for private sector initiatives, making democratic countries more attractive to investors.

6. Conclusions

To address the COVID-19 pandemic and the energy crisis many governments around the globe implemented large-scale fiscal stimulus packages. These measures involved substantial increases in public expenditure, primarily directed towards healthcare, social welfare programs, and financial support for businesses and households. This unprecedented fiscal expansion contributed to avoiding a prolonged recession and facilitated economic recovery. Several economies have gradually begun to withdraw support measures for businesses and households and are implementing fiscal consolidation programmes, in order to restore fiscal sustainability.

Beyond fiscal stabilization efforts through spending cuts and revenue growth, the question arises whether better economic outcomes for the public sector (and the economy in general) could be achieved through better targeting of public spending. A more efficient public sector can lead to expenditure savings, sound public finances and better public services that improve citizens' quality of life and business development through a more business-friendly economic environment.

Various studies have examined the very important role of public sector efficiency on various fiscal and economic variables (e.g., Angelopoulos et al., 2008; Adam et al., 2011; Afonso et al., 2022; 2024). Several of these studies have shown that greater public sector efficiency boosts citizens' trust in government (Afonso et al., 2024), strengthens market confidence (Afonso et al., 2022), and supports economic growth (Angelopoulos et al., 2008). Building on these studies, this paper's key contribution to literature is to examine the medium-term effect of improvements in public sector efficiency on key economic indicators such as the debt ratio, productivity, and private investment.

In more detail, using a sample of 39 advanced and developing countries over the 2000-2021 period, we first measure the public sector efficiency by means of the DEA method.

Next, we assess the medium-term benefits of enhanced public sector efficiency on debt ratios, total factor productivity, labor productivity, and private investment.

Our findings reveal that increased efficiency in public expenditure significantly reduces public debt and enhances its medium-term sustainability. It also leads to substantial improvements in labor productivity, with more modest gains in total factor productivity. Although the initial impact on private investment is marginal positive, the full effect materializes a few years after the efficiency gains, contributing to increased private investment over time.

Various robustness checks have been conducted, involving additional control variables, different PSE variables, alternative estimation techniques to control for likely endogeneity between public sector efficiency and macroeconomic and fiscal conditions and a smaller more homogenous sample of countries. The robustness checks verified the validity of the baseline results.

Our findings have significant policy implications. This is due to the fact that efficient public spending is crucial for a country as it ensures the optimal use of limited resources, promoting sustainable economic growth without exacerbating fiscal imbalances. By improving the allocation of expenditures, governments can achieve higher productivity, support long-term investment, and enhance the overall economic well-being of citizens. Efficient spending also reduces the burden of public debt, allowing for greater fiscal flexibility in addressing future economic challenges. Finally, it strengthens the resilience of public finances, fosters investor confidence, and contributes to a more stable and prosperous economy.

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