

Assessing the impact of government size on economic growth: a varying coefficient approach

Deniz Baglan and Le Thi Nguyen

*Department of Economics, Howard University, Washington,
District of Columbia, USA*

Studies in
Economics and
Finance

937

Received 29 November 2024
Revised 24 May 2025
19 December 2025
Accepted 30 December 2025

Abstract

Purpose – This paper aims to investigate whether the effect of government consumption expenditure on economic growth is nonlinear and influenced by institutional and structural characteristics. Unlike most existing literature, which uses linear models, this study reexamines the relationship to determine if growth outcomes differ based on expenditure size, development level and institutional context.

Design/methodology/approach – The study analyzes data from 86 countries between 1980 and 2019, using linear, threshold and semiparametric panel data models to capture potential nonlinearities. Robustness checks include quadratic models, interactions with global crises, controls for financial development and different time aggregations.

Findings – The linear model indicates a statistically significant negative association between government consumption and economic growth. Threshold estimates identify a significant breakpoint at 10.26% of GDP, with positive growth effects below the threshold and negative, although statistically insignificant, effects above it. Semiparametric results show that the marginal effect of government consumption declines smoothly as its size increases and becomes negligible beyond a certain point, with substantial cross-country heterogeneity. Further analysis reveals that growth effects vary systematically with institutional quality, corruption and the sectoral composition of expenditure. Developed economies tend to experience negative returns to government consumption, while developing countries exhibit more moderate effects, often close to zero or weakly positive.

Originality/value – This study offers a flexible, multi-method assessment of the nonlinear relationship between government consumption and growth. By combining threshold and semiparametric methods and accounting for institutional differences, the study findings highlight the need to adapt fiscal policy to each country's institutional capacity, development level and expenditure structure.

Keywords Government spending, Economic growth, Semiparametric panel data, Threshold

Paper type Research paper

1. Introduction

The relationship between government spending and economic growth remains a highly debated issue in economics. While some argue that increased government expenditures can crowd out private sector activity and hinder growth, others emphasize the importance of public spending in fostering stability and addressing inequality, especially in contexts where more government investment is necessary. Empirical studies offer conflicting views on this topic. For example, [Kormendi and Meguire \(1986\)](#), [Ram \(1986\)](#), [Vedder and Galloway \(1998\)](#), [Schaltegger and Torgler \(2006\)](#), [Bose et al. \(2007\)](#) highlight the positive impact of government spending on growth. On the other hand, research by [Guseh \(1997\)](#), [Fölster and Henrekson \(2001\)](#) and [Dar and AmirKhalkhali \(2002\)](#) suggest that government consumption may have a detrimental effect on economic performance. This divergence points to the likelihood of a nonlinear relationship, where government spending contributes positively to growth up to a certain point, but beyond that, it becomes harmful.



Studies in Economics and Finance
Vol. 43 No. 4, 2026
pp. 937-979
© Emerald Publishing Limited
1086-7376
DOI 10.1108/SEF-11-2024-0834

Identifying the optimal level of government involvement is critical, particularly in developing and transition economies. In environments where the public sector is relatively small, increasing government spending can initially lead to higher returns and improved economic performance. [Barro \(1990\)](#) and [Devarajan *et al.* \(1996\)](#) claim that the effects of public spending vary depending on a country's stage of development and the type of expenditures. Investments in areas that enhance human and physical capital, for instance, can generate significant positive externalities and support long-term growth. In addition, government actions that promote political stability and correct market failures are often viewed as essential for economic progress. However, the benefits of increased government size are not limitless. As government spending continues to rise, diminishing returns may emerge. At a certain point, further expansion of the public sector can negatively impact economic performance through higher taxes, increased borrowing or inflationary pressures (e.g. [Asimakopoulou and Karavias, 2016](#)). Moreover, excessive government intervention can lead to inefficiencies, such as corruption, rent-seeking and distorted market dynamics, all of which reduce productivity (e.g. [Alesina and Angeletos, 2005](#); [Dzhumashev, 2014](#)). Such inefficiencies often stem from institutional weaknesses, which not only diminish the effectiveness of public spending but also shape the way resources are allocated. [d'Agostino *et al.* \(2016\)](#) show that corruption weakens the growth effects of public spending, particularly in the military sector, and argue that anti-corruption and limiting military expenditure can enhance growth.

Understanding the balance is essential, as exceeding a certain threshold of government spending can hinder growth or even lead to economic decline, making the determination of the optimal level of public expenditure that maximizes growth a critical question in this ongoing debate. Recent research has shifted toward nonlinear models to better understand the relationship between government spending and economic growth. For instance, [Chen and Lee \(2005\)](#) found that the effect of government size on growth in Taiwan from 1979 to 2003 depends on the level of spending, while [Ono \(2014\)](#) confirmed similar patterns for Japan between 1960 and 2010. [Asimakopoulou and Karavias \(2016\)](#) expanded this analysis to 129 countries, identifying an inverted U-shaped relationship where government spending initially boosts growth but becomes harmful beyond a certain point[1]. [Kim *et al.* \(2018\)](#), using panel smooth transition regression, found nonlinear interactions between government size, governance and economic growth. Their analysis revealed that while stronger governance amplified the productivity of public spending, excessive government size hindered growth – an effect that was particularly pronounced in resource-rich economies [2]. [Aydin and Esen \(2019\)](#) estimated spending thresholds of 11.67% of GDP for developing economies and 17.54% for developed economies, suggesting that while moderate spending supports growth, the optimal level varies depending on a country's stage of development. [Olaoye *et al.* \(2020\)](#), using a dynamic panel for economic community of West African states (ECOWAS) countries, identified an inverted U-shaped relationship with a threshold of 21.49% of GDP. [Akram and Rath \(2020\)](#) found that government size supported growth within state-specific bounds in Indian states, but its effect became insignificant beyond those thresholds, pointing to regional heterogeneity. [Buthlezi \(2023\)](#) reported regime-dependent adverse effects of fiscal expansion in South Africa, challenging the conventional assumption of uniformly positive public spending effects. Along related lines, [Nugraha and Safuan \(2025\)](#) use dynamic panel models to investigate the nonlinear relationships between information and communication technologies, financial inclusion and economic growth across high and low income countries, illustrating the importance of context-dependending modeling. Similar threshold effects have been identified in other domains, such as the link between corporate sustainability (ESG) performance and growth as discussed in [Mohd Daud](#)

et al. (2024). Together, these studies reinforce the idea of a nonlinear relationship between government expenditure and growth, raising important considerations for economic policy and development strategies.

However, a significant challenge in this area is the misspecification of functional forms, which can hinder effective policy formulation and obscure underlying economic relationships. As a result, nonparametric techniques have gained increasing traction in growth analyses, enabling the examination of nonlinearities inherent in empirical growth regressions. Notably, *Liu and Stengos* (1999) introduced an additive semiparametric model to explore the effects of initial output and schooling on growth rates. Following their work, *Durlauf et al.* (2001) adopted a varying coefficient model that allows parameters in growth regressions to vary according to a country's initial income level. Similarly, *Maasoumi et al.* (2007) applied robust nonparametric techniques to study the global distribution of growth rates, while *Kottaridi and Stengos* (2010) investigated the foreign direct investment-growth nexus. *Henderson et al.* (2015) and *Balcilar et al.* (2021) examine the potential nonlinearities in the relationship between inequality and growth, employing semiparametric methods. Lately, several studies have extended this line of inquiry by applying more flexible semiparametric and nonparametric techniques to examine diverse growth determinants. *Cai et al.* (2018) employed a semiparametric quantile panel model to show that foreign direct investment (FDI) disproportionately benefits faster-growing economies, highlighting distributional heterogeneity in the FDI-growth nexus. *Zouaoui et al.* (2018) adopted a semiparametric panel model to demonstrate that financial development affects growth volatility in a nonmonotonic manner, uncovering multi-threshold dynamics that challenge linear assumptions. In the context of infrastructure, *Zhang and Sun* (2019) used a semiparametric smooth coefficient model to analyze telecommunications infrastructure in China. *Matousek and Tzeremes* (2021) applied nonparametric and semiparametric approaches to a large cross-country panel and found that human capital has asymmetric effects on growth. Likewise, *Ren et al.* (2022) employed a nonparametric panel data model to capture the time-varying and region-specific effects of energy consumption on economic growth.

In this paper, we examine the impact of government consumption expenditure on economic growth across a panel of countries, recognizing the uncertainties surrounding the exact nature of this relationship. To address this complexity, we use a comprehensive empirical approach that includes linear, threshold and semiparametric varying coefficient models. The threshold model allows the slope of government consumption to vary across different regimes, producing distinct estimates. We further enhance this analysis by adopting a flexible specification in which the effect of government consumption on growth is represented as a smooth function. This methodology helps to reveal potential nonlinearities, offering a clearer understanding of how government consumption influences economic performance. Our modeling framework thus facilitates the estimation of spending effects across varying levels of government size, without imposing restrictive functional form assumptions. Building on this framework, our paper contributes to the literature by applying a semiparametric varying coefficient panel data estimator with fixed effects – a relatively recent development in semiparametric panel data models – to examine the government size–growth relationship. This approach enables us to capture cross-country heterogeneity while controlling for unobserved time-invariant characteristics, yielding a more nuanced depiction of the underlying dynamics. In addition, we apply this flexible methodology to an extensive panel of 86 countries spanning four decades, offering broadly generalizable insights across different stages of development.

Using data from 86 countries from 1980 to 2019, our analysis uncovers a nonlinear relationship between government consumption and economic growth. The linear model indicates a negative association, primarily influenced by a subset of countries with high government spending and weak growth performance. The threshold model identifies a critical point at 10.26% of GDP. Below this threshold, government consumption has a significant positive impact on growth, while above it, the effect turns negative and loses statistical significance. The semiparametric varying coefficient model supports these findings, showing that the marginal effect of government consumption gradually declines and becomes statistically insignificant beyond approximately 10.05% of GDP. A series of robustness checks -incorporating global crisis periods, financial development and alternative averaging windows - consistently support the presence of nonlinearities in the government size-growth nexus.

We further investigate the sources of heterogeneity by analyzing how the growth effects of government consumption vary with institutional quality, corruption levels and the composition of public spending across sectors such as health and military. The results highlight the importance of institutional context. Stronger governance and lower corruption are generally linked to more favorable growth outcomes. However, the relationship is nonlinear and shaped by a country's development status. In developing economies, the growth effect of government consumption remains modest and relatively stable across institutional improvements. In contrast, developed countries experience substantially larger negative effects, which intensify at higher levels of institutional quality and corruption control. These findings suggest that institutions influence the direction of fiscal impacts and magnify cross-country differences in their magnitude. The allocation of public resources also plays a critical role. Health spending is positively associated with growth in developing countries but shows adverse effects in more advanced economies. Conversely, military expenditure tends to be growth-reducing across the board, with particularly pronounced adverse effects in developed nations. These patterns point to the broader conclusion that both the structure of spending and a country's stage of development are key determinants of the macroeconomic consequences of government consumption.

The rest of the paper is organized as follows. Section 2 discusses the methodological framework and estimation strategy. Section 3 presents the data and descriptive statistics. Section 4 reports the main empirical findings. Section 5 assesses the robustness of our results and explores how they vary with institutional quality, corruption and the composition of public spending. Section 6 discusses underlying mechanisms and offers policy implications. Finally, Section 7 concludes.

2. Empirical methodology

Our aim is to understand the influence of government consumption expenditure on the GDP growth of the panel of countries. Considering the uncertainty surrounding the precise nature of this relationship, we explore various empirical modeling approaches. We conduct a thorough analysis into the connection between government consumption and economic growth, utilizing linear, threshold and semiparametric panel data models.

2.1 Linear dynamic panel data model

One approach is to make the assumption that the true model is linear. The linear model is the most widely used regression model in the literature. Therefore, the dynamic panel data model of interest is given by:

$$y_{it} = \alpha_i + x'_{it}\beta_1 + Gov'_{it}\beta_2 + \varepsilon_{it}, i = 1, \dots, n, t = 1, \dots, T, \quad (1)$$

where y_{it} is real GDP growth per capita, x_{it} is vector of macroeconomic variables which include the lagged real GDP growth per capita (Δy_{it-1}), capital formation, inflation, population growth and openness; Gov_{it} denotes the size of the government consumption expenditure, α_i 's denote the country fixed effects, and ε_{it} is the error term[3]. Our model incorporates heterogeneity across countries through the fixed effects.

The existing literature sheds light on economic growth and underscores the importance of real GDP for comparing countries. However, real GDP per capita offers a more accurate assessment by factoring in population size when evaluating living standards across nations. Hence, we use the annual growth rate of real GDP per capita as a measure of living standards. In addition, we investigate the impact of government spending on economic growth by employing government consumption expenditure (Gov) as the independent variable. To align with the empirical growth literature, we incorporate gross capital formation as a proxy for investment, population growth, log-transformed inflation, lagged GDP growth, openness and life expectancy at birth as a proxy for human capital as control variables.

In our dynamic panel analysis, incorporating lagged GDP growth on the right-hand side introduces bias in the initial stage estimates. To mitigate this issue, several methods have been proposed for dynamic panel models. Kiviet (1995) and Bun and Kiviet (2003) recommend analytical approximation techniques designed to adjust the least squares dummy variable estimator. Bruno (2005) extends this approach by refining the bias correction formulas introduced in Bun and Kiviet (2003). Accordingly, we use the bias-corrected estimator developed by Bruno (2005) to address the distortion caused by the inclusion of the lagged dependent variable. Bruno (2005) also allows for the use of a generalized method of moments (GMM) estimator in the first stage and provides a method to correct its bias. Recognizing the widespread application of GMM techniques in the growth literature, we first estimate the model using the system GMM estimator of Blundell and Bond (1998) and use it as the initial estimate for Bruno's bias correction. This approach combines the strengths of GMM instrumentation with improved finite-sample properties. Applying both estimators enables a robustness check, and the consistency of the results supports the reliability of our findings. This linear specification serves as a baseline in our analysis, offering an estimate of the average change in GDP growth associated with changes in government size.

2.2 Threshold model

We are considering potential nonlinearities in how government consumption relates to GDP growth, as the true relationship might not be linear. Thus, our second alternative specification is a threshold model, which assumes a piecewise linear functional form for government consumption:

$$y_{it} = \alpha_i + x'_{it}\beta_1 + Gov'_{it}\mathbb{I}(Gov_{it} \leq \tau)\gamma_1 + Gov'_{it}\mathbb{I}(Gov_{it} > \tau)\gamma_2 + \varepsilon_{it} \quad (2)$$

where $\mathbb{I}(\cdot)$ is the indicator function and τ is the threshold parameter. This model assumes that the effect of government consumption below the threshold is γ_1 and above the threshold is γ_2 .

The threshold model allows us to investigate whether there is a tipping point at which the effect of government spending on economic growth shifts from beneficial to detrimental, or vice versa. The two states can be interpreted as a system comprising low and high government spending. Hansen (1999) introduced threshold regression methods for static panel data models with fixed effects. These methods necessitate the covariates to be strongly exogenous for the estimator to remain consistent. However, such strong exogeneity

requirements can be restrictive in many real-world applications. [Seo and Shin \(2016\)](#) improved upon [Hansen \(1999\)](#) by allowing for lagged dependent variables and including cases in which the covariates and threshold variables may be endogenous. They use a GMM approach based on the first difference transformation, and estimate the threshold and the model parameters after a grid search[4]. In this paper, we adopt the estimator proposed by [Seo and Shin \(2016\)](#)[5].

Asymptotic distributions of the threshold estimates are not nuisance parameter free. Moreover, under the null of linearity, i.e. $H_0 : \gamma_1 = \gamma_2$, the threshold parameter is not identified. So, it is not possible to test for coefficient equality across regimes using typical inference methods. Therefore, we use the bootstrap procedure in [Seo and Shin \(2016\)](#) to conduct inference on the threshold model.

2.3 Varying coefficient model

In the threshold model, the slope of government consumption is allowed to differ across regimes, resulting in two estimates. However, in this section, we do not impose further constraints and assume that the effect (slope) of government consumption on growth follows a smooth function. This flexible specification has the potential to provide valuable insights into nonlinearities in the relationship between government consumption and growth.

We estimate the following partially linear varying coefficient model:

$$y_{it} = \alpha_i + x'_{it}\beta_1 + Gov'_{it}\theta(Gov_{it}) + \varepsilon_{it} \quad (3)$$

where $\theta(\cdot)$ is the unknown varying coefficient function, and other variables are defined in section 2.1. The varying coefficient, $\theta(\cdot)$, represents the marginal effect of government consumption, evaluated across all observed values of government consumption in the sample. In a linear model, this effect remains constant. By contrast, the threshold model allows for shifts in the effect between distinct regimes, while the varying coefficient model reflects a smooth change in the effect with varying levels of government consumption.

To perform estimation, we first difference the data to eliminate the unobserved heterogeneity, α_i . This yields:

$$y_{it} - y_{it-1} = (x'_{it} - x'_{it-1})\beta_1 + (Gov'_{it}\theta(Gov_{it}) - Gov'_{it-1}\theta(Gov_{it-1})) + \varepsilon_{it} - \varepsilon_{it-1} \quad (4)$$

[Yonghong et al. \(2016\)](#) proposed estimating the model with the series method. They approximate the varying coefficient function $\theta(\cdot)$ by a linear combination of basis functions. They use K basis functions, i.e. $p^K(z) = (p_1(z), \dots, p_K(z))$, to approximate the unknown function $\theta(z)$ [6].

The following format allows us to further reduce the model to matrix form:

$$Y = X\beta_1 + G + U \quad (5)$$

where Y is $NT \times 1$ with typical element $(y_{it} - y_{it-1})$, X , G and U are constructed similarly, and a typical element of G is $(Gov'_{it}\theta(Gov_{it}) - Gov'_{it-1}\theta(Gov_{it-1}))$. Let P be $NT \times 1$ matrix that approximates G and define $M = (P'P)^{-1}P'$ [7]. Premultiplying all variables in [equation \(5\)](#) with M and subtracting from the original equation yields:

$$Y - \tilde{Y} = (X - \tilde{X})\beta_1 + (G - \tilde{G}) + (U - \tilde{U}) \quad (6)$$

where $\tilde{Y} = MY$, $\tilde{X}$ and $\tilde{G}$ are similarly defined. Having lagged GDP growth on the right-hand side variables introduces endogeneity due to the fixed effects. Following [Yonghong et al. \(2016\)](#), assuming there exists an instrumental variable matrix Q which is uncorrelated with the error term and correlated with X , we can consistently estimate β_1 by running the instrumental variable regression of $(Y - \tilde{Y})$ on $(X - \tilde{X})$. This yields:

$$\hat{\beta}_1^{IV} = \left[(Q - \tilde{Q})' (X - \tilde{X}) \right]^{-1} (Q - \tilde{Q})' (Y - \tilde{Y}). \quad (7)$$

Then the varying coefficient $\theta(z)$ can be estimated by $\hat{\theta}_{IV}(z) = p^K(z) \hat{\delta}_{IV}$ where $\hat{\delta}_{IV} = (P'P)^{-1}P' \left(Y - X\hat{\beta}_1^{IV} \right)$. In summary, we start by removing the nonparametric component through projection and differencing. Next, we estimate the parametric component and move it to the left-hand side. Finally, we estimate the nonparametric component using the series method [\[8\]](#).

The optimal number and choice of instruments remains a topic of ongoing debate in the literature on nonparametric and semiparametric dynamic panel data models, particularly due to concerns about weak instruments. Notably, [Newey and Windmeijer \(2009\)](#) and [Okui \(2009\)](#) provide theoretical guidance on instrument selection in such settings. Building on these contributions, [Zhang and Zhou \(2021\)](#) offer methodological recommendations specifically tailored to dynamic varying coefficient models, which we adopt in our empirical strategy. In our application, we use the second lag of GDP growth as the primary instrument [\[9\]](#).

To implement the semiparametric estimation procedure, we need to determine the number of basis functions (K). This number plays a similar role to the smoothing parameter (bandwidth) in kernel-based nonparametric analysis. We use cubic splines as the basis functions and select the number of knots using the leave-one-out cross-validation method.

It is well known that inference of semiparametric and nonparametric models based on its asymptotic normal distribution may perform poorly in finite samples. Therefore, we use a bootstrap method to obtain the standard errors for our partially linear varying coefficient model. Specifically, we find it convenient to implement the fixed design wild bootstrap technique proposed by [Hansen \(2000\)](#).

3. Data and descriptive statistics

In our empirical analysis, we use a panel data set spanning 86 countries over the period from 1980 to 2019 [\[10\]](#). Following the empirical growth literature, we aggregate our variables into nonoverlapping five-year averages, yielding eight time-series observations ($T = 8$) for each country [\[11\]](#). The data set includes the growth rate of real GDP per capita, government size, gross capital formation, inflation, population growth, openness, human capital, private credit, institutional quality, control of corruption, military expenditure and government health expenditure. Government size is measured by general government final consumption expenditure, while openness is defined as the sum of exports and imports. Human capital is proxied by life expectancy at birth. Financial development is captured by private credit, measured as domestic credit to the private sector by banks. Institutional quality is constructed as the simple average of six governance indicators: rule of law, control of corruption, regulatory quality, political stability and absence of violence/terrorism, voice and accountability and government effectiveness. Government size, gross capital formation, openness, private credit, military expenditure and government health expenditure are expressed as percentages of GDP. Institutional quality and control of corruption are

measured as percentile ranks. All variables are obtained from the World Development Indicators database.

Table 1 presents the summary statistics for the data. When the entire sample is examined, the average GDP growth rate is 1.658%, with a standard deviation of 2.456%, capturing broad variation in national outcomes. Similarly, government size and capital formation display notable variation, with averages of 15.591% and 23.414%, respectively, and standard deviations of 5.414% and 7.354%. The inflation rate displays substantial variability, with a

Table 1. Summary statistics

Variable	Obs.	Mean	SD	Min.	Max.
<i>Full sample</i>					
GDP growth	688	1.658	2.456	-11.703	12.771
Government size	688	15.591	5.414	1.150	42.097
Capital formation	688	23.414	7.354	3.575	77.504
Inflation	688	18.928	133.657	-3.016	2414.346
Population growth	688	1.638	1.098	-1.180	6.945
Openness	688	79.399	58.939	12.876	425.158
Human capital	688	68.936	9.920	39.107	84.637
Private credit	552	41.615	36.546	1.919	182.415
Institutional quality	425	56.858	26.912	4.927	99.643
Control of corruption	425	58.329	28.738	2.497	100.000
Military expenditure	618	2.249	1.801	0.156	15.915
Health expenditure	340	3.558	2.278	0.326	9.170
<i>Developing countries</i>					
GDP growth	416	1.543	2.636	-11.703	12.771
Government size	416	13.946	4.896	1.150	37.855
Capital formation	416	22.993	8.408	3.575	77.504
Inflation	416	28.391	171.195	-3.016	2414.346
Population growth	416	2.102	0.944	-1.180	5.126
Openness	416	65.531	33.643	12.876	205.539
Human capital	416	63.509	8.928	39.107	79.367
Private credit	416	30.353	23.675	1.919	146.545
Institutional quality	255	38.848	16.836	4.927	75.902
Control of corruption	255	39.449	19.617	2.497	88.810
Military expenditure	336	2.154	1.558	0.156	9.932
Health expenditure	208	2.284	1.238	0.326	5.582
<i>Developed countries</i>					
GDP growth	272	1.834	2.146	-11.147	9.108
Government size	272	18.106	5.204	6.542	42.097
Capital formation	272	24.059	5.305	11.200	53.913
Inflation	272	4.455	7.635	-2.255	76.359
Population growth	272	0.928	0.925	-0.390	6.945
Openness	272	100.609	79.537	17.379	425.158
Human capital	272	77.235	3.613	64.243	84.637
Private credit	136	76.062	46.284	6.980	182.415
Institutional quality	170	83.873	12.940	41.730	99.643
Control of corruption	170	86.650	12.207	50.090	100.000
Military expenditure	248	2.498	2.164	0.310	15.915
Health expenditure	132	5.565	2.089	1.065	9.170

Note(s): This table reports mean, standard deviation, minimum and maximum for the variables used in the analyses

Source(s): Authors' own work

mean of 18.928% and extremes ranging from -3.016% to 2414.346%. These wide fluctuations point to the coexistence of both macroeconomic stability and episodes of severe price instability across the sample. Population growth rates are highly variable, with a mean of 1.638% and a standard deviation of 1.098%, reflecting variations in demographic trends and population dynamics. There exists considerable disparity in trade openness among nations. With a standard deviation of 58.939% and an average openness level of 79.399%, the data set stresses diverse levels of integration into the global economy. Human capital, measured by life expectancy at birth, exhibits moderate variation, with an average of 68.936 years and a standard deviation of 9.920 years. Values range from 39.107–84.637, underscoring significant disparities in health outcomes and development levels across countries. Private credit, used as a proxy for financial development, also displays considerable dispersion, averaging 41.615% of GDP with a standard deviation of 36.546%. The wide range - from 1.919% to 182.415% - suggests stark contrasts in access to credit and financial sector depth. Institutional quality, constructed as the average of six governance indicators, has a mean value of 56.858 and a standard deviation of 26.912, indicating marked cross-country variation in institutional strength. Control of corruption presents a similar pattern, with an average of 58.329 and a standard deviation of 28.738, reflecting differing degrees of governance quality and regulatory integrity. Military expenditure remains relatively low on average (2.249% of GDP), although the range extends from 0.156% to 15.915%, signaling divergent defense priorities. Finally, government health expenditure averages 3.558% of GDP, with a standard deviation of 2.278%, highlighting uneven public investment in health across the sample.

Upon categorizing the data into developing and developed countries, further insights emerge. Developing countries demonstrate a lower average GDP growth rate of 1.543% compared to developed countries, with a mean of 1.834%. Likewise, economic variables such as government size and capital formation appear lower in developing countries than developed countries. Inflation rates, however, are generally higher in developing countries, with a mean of 28.391% compared to 4.455% in developed countries. This suggests greater macroeconomic volatility and challenges in managing inflation in developing economies. Population growth rates also tend to be higher in developing countries, reflecting youthful demographics and fertility rates. There is a notable disparity in openness between developed and developing nations. Developed countries showcase a markedly higher average level of openness, standing at 100.609% of GDP, in contrast to developing countries, which exhibit a lower average of 65.531% of GDP. The standard deviation further underlines this distinction. Developed nations display a considerably wider dispersion in openness, recorded at 79.537%, compared to the more concentrated distribution observed in developing countries, which have a standard deviation of 33.643%. This discrepancy highlights a significant variation in the level of integration into the global economy between developed and developing nations, with developed countries presenting a distinctly higher degree of openness on average. Disparities between the two groups are further evident in human capital, financial development, institutional quality and public spending. Human capital averages 63.509 years in developing countries, compared to 77.235 years in developed countries, highlighting persistent health and living standards gaps. Private credit also reveals a pronounced difference, with developing countries averaging 30.353% of GDP while developed countries reach 76.062%, indicating significantly deeper financial systems in the latter. Institutional quality scores are markedly higher in developed countries (mean of 83.873) than in developing ones (mean of 38.848), and control of corruption follows a similar pattern, averaging 86.650 and 39.449, respectively. These differences underscore the institutional and governance challenges facing lower-income economies. Government

military and health expenditures also reflect divergent policy priorities and capacities. While military expenditure is relatively close in average terms - 2.154% of GDP in developing and 2.498% in developed countries - health spending diverges sharply. Government health expenditure stands at only 2.284% of GDP in developing economies, compared to 5.565% in developed countries, pointing to significant inequalities in public investment in health infrastructure and services.

Table 2 displays the correlation between the variables. GDP growth exhibits various correlations with different economic indicators. It is positively correlated with lagged GDP growth, with a coefficient of 0.286, and with capital formation, a proxy for investment, at 0.298. Conversely, it shows negative correlations with government consumption expenditure at -0.193, inflation at -0.186 and population growth at -0.203. Its correlation with openness is weak, at 0.093. Notably, while there is a negative correlation between GDP growth and government consumption expenditure, numerous studies indicate that this relationship turns positive up to a certain threshold of government consumption; beyond this threshold, the relationship becomes negative. We are interested in exploring the relationship between GDP growth and the size of government consumption through the varying coefficient approach, as it could offer valuable insights into this dynamic.

Further correlations reveal additional patterns. Human capital is positively associated with GDP growth, with a coefficient of 0.127. Private credit also shows a weak positive correlation, measured at 0.060, implying a limited direct link between financial deepening and short-term growth in this data set. Institutional quality and control of corruption exhibit slightly negative correlations with growth, at -0.069 and -0.057, respectively. Military expenditure is weakly and positively correlated with GDP growth, with a coefficient of 0.097, although this relationship is likely context-dependent. Finally, government health expenditure shows a moderate negative correlation with GDP growth, measured at -0.195, which may reflect the fiscal burden of health spending in lower-income countries or the lagged nature of its benefits.

4. Empirical results

Table 3 reports estimates from the linear dynamic panel data model, using System GMM and bias-corrected methods to examine the relationship between government consumption and GDP growth. The relationship between government consumption and GDP growth is consistently negative and statistically significant across estimation methods and country groups. Under the bias-corrected estimator, a 10-percentage point increase in government consumption is associated with a 1.89 percentage point decline in GDP growth for the entire sample. The effect is slightly smaller in developing countries (1.48 percentage points) and considerably larger in developed economies, where the same increase corresponds to a 3.42 percentage point reduction. The System GMM estimates yield a similar pattern: the effect of government consumption on growth remains negative and statistically significant across all subsamples, with the magnitude of the impact more pronounced in developed countries. These findings confirm that the adverse growth effects of government size are robust to alternative estimation strategies.

The control variables exhibit patterns largely consistent with prior growth literature. Lagged GDP growth enters positively but remains statistically insignificant in most specifications, except in the developed country subsample under the System GMM model, where it is weakly negative. Inflation, measured in natural logarithms, exhibits a robust negative association with GDP growth in the full sample and developing countries. Bias-corrected estimates reveal a coefficient of -0.438 for the full sample and -0.506 for developing economies, both statistically significant. This implies that proportional increases

Table 2. Correlation matrix

Variables	GDP growth	Lagged growth	Government size	Capital formation	Inflation	Population	Openness	Human capital	Private credit	Institutional quality	Corruption	Military expenditure	Health expenditure
GDP growth	1	0	0	0	0	0	0	0	0	0	0	0	0
Lagged growth	0.286	1	0	0	0	0	0	0	0	0	0	0	0
Government size	-0.193	-0.088	1	0	0	0	0	0	0	0	0	0	0
Capital formation	0.298	0.337	0.011	1	0	0	0	0	0	0	0	0	0
Inflation	-0.186	-0.085	-0.094	-0.113	1	0	0	0	0	0	0	0	0
Population	-0.203	-0.107	-0.210	-0.067	0.065	1	0	0	0	0	0	0	0
Openness	0.093	0.132	0.129	0.172	-0.061	-0.081	1	0	0	0	0	0	0
Human capital	0.127	0.202	0.308	0.242	-0.085	-0.557	0.342	1	0	0	0	0	0
Private credit	0.060	0.179	0.198	0.215	-0.052	-0.437	0.307	0.672	1	0	0	0	0
Institutional quality	-0.069	0.039	0.484	0.051	-0.442	-0.541	0.391	0.753	0.643	1	0	0	0
Corruption	-0.057	0.049	0.522	0.096	-0.414	-0.510	0.387	0.704	0.589	0.963	1	0	0
Military expenditure	0.097	0.119	0.231	0.070	0.009	0.306	0.050	0.059	0.008	-0.034	0.057	1	0
Health expenditure	-0.195	-0.161	0.662	-0.064	-0.381	-0.512	0.091	0.697	0.502	0.689	0.673	-0.059	1

Note(s): This table presents the correlation coefficient among the variables
Source(s): Authors' own work

Table 3. Linear dynamic panel data model

Variables	Full sample			Developing			Developed		
	System GMM	Bias corrected		System GMM	Bias corrected		System GMM	Bias corrected	
Lagged growth	0.071 (0.054)	0.070* (0.042)		0.064 (0.044)	0.045 (0.058)		-0.160* (0.090)	-0.073 (0.069)	
Government size	-0.255*** (0.064)	-0.189*** (0.042)		-0.195* (0.102)	-0.148** (0.058)		-0.363*** (0.079)	-0.342*** (0.066)	
log(Inflation)	-0.577*** (0.176)	-0.438*** (0.122)		-0.736*** (0.204)	-0.506*** (0.164)		0.030 (0.315)	-0.107 (0.172)	
Capital formation	0.090* (0.054)	0.094*** (0.020)		0.053 (0.062)	0.078*** (0.027)		0.094 (0.061)	0.031 (0.035)	
Population	0.119 (0.752)	-0.238 (0.160)		1.092 (0.946)	0.276 (0.239)		-0.831*** (0.263)	-0.529** (0.215)	
Openness	0.010 (0.011)	0.001 (0.005)		0.028 (0.019)	0.012 (0.010)		0.013 (0.010)	0.005 (0.005)	
Human capital	-0.087* (0.045)	0.093** (0.044)		-0.118** (0.057)	0.047 (0.053)		-0.625*** (0.188)	-0.434*** (0.164)	
Time dummies	Yes	Yes		Yes	Yes		Yes	Yes	
Number of countries	86	86		52	52		34	34	
T	8	8		8	8		8	8	

Note(s): This table reports point estimates and standard errors for the linear dynamic panel data model. Standard errors are in parentheses below each estimate. The System GMM estimator follows [Blundell and Bond \(1998\)](#). The Bias Corrected estimator, proposed by [Bruno \(2005\)](#), refines the System GMM approach to mitigate the finite-sample bias. Full sample includes all countries; developing includes only developing countries; developed includes only developed countries. Dependent variable: GDP growth. Sample period: 1980–2019. ***Significance at 1% level, **Significance at 5% level, *Significance at 10% level

Source(s): Authors' own work

in inflation (e.g. doubling inflation from 5% to 10% or from 20% to 40%) correspond to proportionally greater declines in growth, with developing economies exhibiting somewhat greater sensitivity (-0.506 vs -0.438). For developed countries, the relationship is not statistically significant from zero, consistent with institutional or policy frameworks mitigating inflationary costs. Similarly, System GMM estimates reinforce these findings, exhibiting similar signs, magnitudes and patterns of statistical significance across the country groups. Capital formation, a proxy for investment activity, shows a positive and statistically significant impact on growth in the full sample and among developing countries, with a 10-percentage point increase translating into approximately a 0.94 and 0.78 percentage point gain in GDP growth, respectively. However, the coefficient is not statistically significant for developed countries, highlighting a potentially diminishing return to investment in more capital-abundant contexts. Population growth only exerts a statistically significant negative effect on GDP growth in developed countries while remaining insignificant for the full sample and developing countries. Openness is positive but statistically insignificant in all specifications, indicating limited average effects of trade exposure once other controls are included. Human capital, interestingly, displays a divergent pattern: while its coefficient is negative in the System GMM specification, it becomes positive and statistically significant in the bias-corrected estimates for the full sample, suggesting sensitivity to the estimation approach and potential nonlinearities in the effect of human capital on growth. [12]

Table 4 summarizes the estimation and inference results for the two-regime case. The dynamic threshold regression model posits that government consumption operates within two distinct regimes: high and low. As a result, we proceed to estimate the regression model accordingly. The estimated threshold for the entire sample is 10.26%, a figure of significant importance as it provides a critical benchmark for analysis. The point estimate for the government consumption threshold, in particular, is relatively low, indicating a nuanced aspect of the data. Moreover, the threshold estimate is statistically significant. Government consumption's influence on GDP growth is positive and statistically significant below the

Table 4. Nonlinear dynamic panel data-threshold model

Variables	Full sample	Developing	Developed
Threshold	10.260*** (0.254)	5.784*** (0.158)	18.370*** (1.088)
<i>Government size</i>			
Below threshold	1.053*** (0.129)	3.792*** (0.296)	-1.014*** (0.077)
Above threshold	-0.437 (0.268)	0.023 (0.593)	-0.397** (0.171)
Lagged growth	-0.090*** (0.020)	-0.116*** (0.012)	-0.211*** (0.013)
log(Inflation)	-0.531*** (0.055)	-1.294*** (0.102)	-0.374*** (0.065)
Capital formation	0.097*** (0.011)	0.179*** (0.011)	0.094*** (0.013)
Population	-0.234*** (0.081)	0.036 (0.126)	-1.682*** (0.116)
Openness	0.026*** (0.003)	0.043*** (0.004)	0.017*** (0.003)
Human capital	-0.013 (0.013)	-0.044** (0.018)	-0.501*** (0.039)
Time dummies	Yes	Yes	Yes
Number of countries	86	52	34
T	8	8	8

Note(s): This table reports point estimates and standard errors for the dynamic panel threshold regression. Bootstrap standard errors are in parentheses below each estimate. Full sample includes all countries; developing includes only developing countries; developed includes only developed countries. Dependent variable: GDP growth. Sample period: 1980–2019. ***Significance at 1% level, **Significance at 5% level

Source(s): Authors' own work

threshold of 10.26%. However, beyond this threshold, the impact becomes negative, although not statistically significant. More specifically, a one-percentage-point increase in government consumption boosts GDP growth by 1.15 percentage points below the threshold, while above the threshold, it reduces growth by 0.44 points, although the latter effect is not statistically significant. These results highlight the importance of understanding the nonlinear effect of government consumption level on GDP growth.

When examining developing countries, the estimated threshold is 5.78%, notably lower than that found when all countries are considered. Importantly, below this threshold, as government consumption rises, GDP growth also increases, indicating a positive relationship. A one-percentage-point increase in government consumption below the threshold results in a substantial 3.79 percentage points increase in GDP growth. However, above the threshold, a one-percentage-point increase in government consumption has no statistically significant effect on growth, with an estimated change of 0.023 percentage points.

For developed countries, the estimated threshold is notably higher at 18.37%, which is 12.59 percentage points above the corresponding threshold identified for developing countries. This finding is consistent with [Asimakopoulos and Karavias \(2016\)](#) and [Aydin and Esen \(2019\)](#). Below the threshold, government consumption has a negative and statistically significant effect on growth -1.014 , while above the threshold, the effect remains negative -0.397 and significant at the 5% level, albeit with a smaller magnitude. The remaining control variables generally behave as expected and align with findings in the existing growth literature, supporting the robustness of the model specification. While the dynamic threshold regression identifies the threshold level, the conclusions drawn from the estimated slope coefficients of government consumption appear mixed. Therefore, exploring a nonlinear model that imposes no restrictions on the government consumption-growth relationship is essential. Consequently, we investigate this relationship using a varying coefficient regression model.

[Figure 1](#) displays the estimated relationship between government consumption and growth from the varying coefficient model. We observe a nonlinear relationship in which the effect of government consumption exhibits an exponential decay as government consumption increases. Furthermore, the magnitude of the point estimates is heavily influenced by the level of government consumption. Our findings suggest that countries experience economic growth as government consumption increases, although the rate of growth slows as consumption rises further. However, the positive impact weakens and ultimately stops when government consumption reaches approximately 10.05% [\[13\]](#).

[Table 5](#) summarizes the means and percentiles of varying coefficient estimates, providing a significant advantage over linear and threshold models by calculating the slope at each point. This feature enables a practical interpretation and comparison of these slopes. On average, the varying coefficient model estimates a slope of 0.389, compared to the linear model's coefficient of -0.189 . On average, a one percentage point increase in government consumption as is associated with a 0.39 percentage point increase in GDP growth in the varying coefficient model. [Table 5](#) also presents standard errors across the quartiles, highlighting statistical significance at the 75th percentile, while the estimates at the 25th percentile, mean and median remain statistically insignificant.

The second and third columns of [Table 5](#) display the varying coefficient estimates for developing and developed countries, respectively. In developing countries, the 25th and 75th percentiles of the estimates range between 0.30 and 0.69, while for developed countries, these percentiles range between -1.49 and -1.21 . The estimates carry considerable uncertainty, as evidenced by the large standard errors. Notably, the threshold regression also

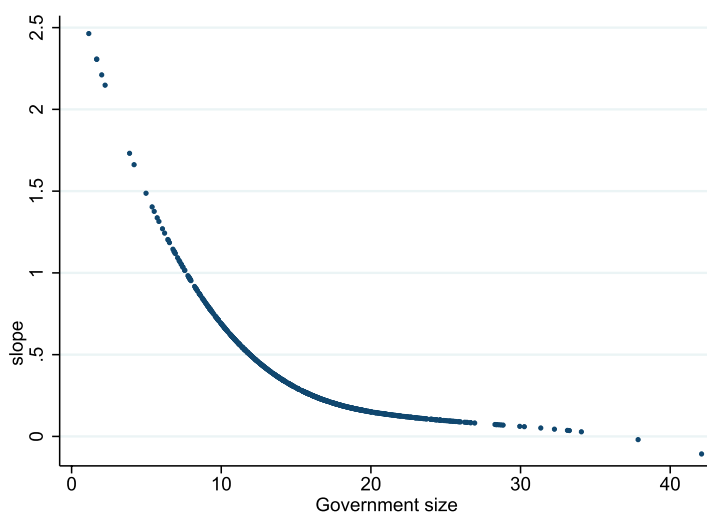


Figure 1. Varying coefficient estimate – full sample

Note(s): This figure illustrates the estimated relationship between government size (consumption) and economic growth, as derived from the varying coefficient model. The varying coefficient represents the marginal effect of government size on growth

Source: Authors' own work

Table 5. Dynamic panel data – varying coefficient estimates

Statistic	Full sample	Developing	Developed
Mean	0.389 (0.314)	0.553 (0.346)	-1.363 (1.218)
Q1	0.171 (0.221)	0.299 (0.253)	-1.486 (1.445)
Q2	0.278 (0.270)	0.440 (0.306)	-1.315 (1.134)
Q3	0.531* (0.319)	0.687* (0.392)	-1.213 (0.986)
Time dummies	Yes	Yes	Yes
Number of countries	86	52	34
T	8	8	8

Note(s): This table presents the mean, median, first and third quartile of the varying coefficient estimate $\hat{\theta}(Gov_{it})$. The bootstrap standard error for the estimated coefficient is given in parentheses. Full sample includes all countries; developing includes only developing countries; developed includes only developed countries. Dependent variable: GDP growth. Sample period: 1980–2019. *Significance at 10% level

Source(s): Authors' own work

produced negative and coefficients for the two regimes in developed countries, making the negative varying coefficient estimates unsurprising.

Figure 2 provides visual support for interpreting the results in Table 5. This figure compares the varying coefficient estimates with the regime coefficients from the threshold regression. It is important to highlight that the varying coefficient model does not define distinct regimes but instead estimates the slope coefficient continuously. In contrast, the threshold model shows notable differences in slope estimates, particularly when government

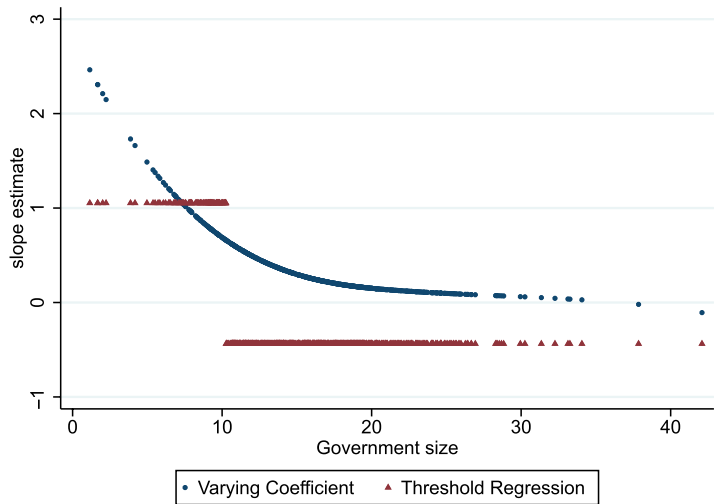


Figure 2. Varying coefficient and threshold regression – full sample

Note(s): This figure illustrates a comparison of the partial effects of government size on growth, as estimated using the dynamic threshold regression model (triangles) and the varying coefficient model (circles). The estimates are based on the full sample

Source: Authors' own work

consumption is low. In the first regime of the threshold model, the varying coefficient estimate is higher. However, once government consumption exceeds 7.32%, the varying coefficient estimate becomes more aligned with the first regime's slope. In the second regime, where government consumption exceeds 10.26%, the varying coefficient estimate remains positive but gradually approaches zero, while the threshold regression estimate stays negative. Although the data-generating process is unknown, the flexible approach of the varying coefficient model provides valuable insights.

Taken together, the linear, threshold and varying coefficient models provide consistent evidence of a nonlinear relationship between government size and economic growth. The linear model yields a negative average effect, reflecting the influence of high-spending countries where marginal returns to government consumption appear limited. The threshold model relaxes the constant-effect assumption and identifies a significant positive effect below 10.26% of GDP and a negative but statistically insignificant effect above it, suggesting no systematic harmful impact and pointing instead to diminishing or neutral returns at higher spending levels. The varying coefficient model reinforces this pattern, revealing a smooth decline in the marginal effect that becomes statistically insignificant at approximately 10.05%. The threshold model's insignificant upper-regime effect is consistent with the varying coefficient model's smooth decline, as both point to diminishing fiscal effectiveness at higher spending levels rather than a shift to negative growth impacts. While the linear model imposes a constant effect, and the threshold model allows for discrete regimes, the semiparametric approach captures continuous variation in the growth effect across spending levels. Although the linear model yields a uniformly negative effect due to its restrictive structure, both the threshold and varying coefficient models provide a more flexible representation, converging on the interpretation that government consumption promotes

growth at lower levels but generates diminishing returns as spending rises. We interpret the post-threshold insignificance not as a methodological artifact, but as a genuine plateau in fiscal effectiveness, consistent with theoretical expectations and supported by multiple estimation strategies.

In empirical growth literature, parameter heterogeneity plays a significant role. Several authors, including [Durlauf and Johnson \(1995\)](#) and [Masanjala and Papageorgiou \(2004\)](#), document strong evidence for extensive heterogeneity. An attractive feature of our semiparametric approach is that we can illuminate the heterogeneity of the partial effects of government size on growth across countries. [Table 6](#) presents the average partial effect of government consumption on growth across the countries in our sample. There is a significant variation across regions and economic contexts, highlighting how the impact of government spending can differ widely based on national circumstances. For instance, Nigeria exhibits the highest mean effect at 1.856, indicating a robust positive impact of government consumption on growth. Similarly, other developing nations such as Chad (1.071), the Dominican Republic (1.025) and Guatemala (0.929) also show substantial positive effects, suggesting that the size of government consumption in these countries significantly promotes economic growth. In contrast, developed economies like Germany (0.158) and Canada (0.137) display relatively lower mean effects, reflecting the possibility that the marginal benefit of government consumption on growth may be less pronounced in more developed economies. Interestingly, Seychelles has the lowest mean effect at 0.044, indicating minimal impact of government spending on growth.

Table 6. Varying coefficient estimates for each country

Country	Mean	Country	Mean	Country	Mean	Country	Mean
Nigeria	1.856	Bahamas, The	0.507	Belize	0.294	Greece	0.177
Chad	1.071	Chile	0.497	Kenya	0.291	Australia	0.176
Dominican Republic	1.025	Korea, rep.	0.485	United States	0.287	Italy	0.174
Guatemala	0.929	Central African Republic	0.458	Niger	0.276	Bhutan	0.167
Sudan	0.920	Ecuador	0.448	Brazil	0.270	United Kingdom	0.167
Hong Kong SAR, China	0.902	Uruguay	0.440	Luxembourg	0.261	Austria	0.166
Nepal	0.849	Malaysia	0.422	Burkina faso	0.257	Vanuatu	0.164
Indonesia	0.831	Thailand	0.416	Cyprus	0.255	Germany	0.158
Ghana	0.720	Iran, Islamic Rep.	0.404	Japan	0.249	Norway	0.144
Philippines	0.719	Colombia	0.392	Algeria	0.248	Canada	0.137
Mexico	0.696	El salvador	0.391	Portugal	0.236	Finland	0.133
Singapore	0.693	Rwanda	0.388	Ireland	0.233	Jordan	0.128
India	0.602	Mauritius	0.376	Tunisia	0.228	Belgium	0.121
Pakistan	0.599	Bolivia	0.375	Bahrain	0.223	France	0.116
Honduras	0.593	Panama	0.362	Morocco	0.222	Netherlands	0.114
Peru	0.590	Jamaica	0.354	South Africa	0.221	Denmark	0.096
Switzerland	0.583	Barbados	0.353	Spain	0.218	Saudi Arabia	0.095
Cameroon	0.572	Senegal	0.339	Malta	0.205	Sweden	0.092
Togo	0.556	Gabon	0.337	Fiji	0.202	Botswana	0.084
Gambia, the	0.556	Burundi	0.329	Tonga	0.199	Seychelles	0.044
Turkiye	0.521	Madagascar	0.319	New Zealand	0.189		
Egypt, Arab Rep.	0.509	Costa Rica	0.307	Eswatini	0.181		

Note(s): This table presents the average partial effect of government consumption on growth across countries, calculated from varying coefficient estimates. The varying coefficient is estimated for the full sample and averaged over time for each country

Source(s): Authors' own work

Several countries exhibit a range of mean effects, with these values distributed across different values. For example, Hong Kong (0.902) and Nepal (0.849) both demonstrate significant positive impacts, while other nations such as Greece (0.177) and Italy (0.174) show lower but still positive impacts. This suggests that while government consumption generally promotes growth, the magnitude of its impact can vary widely, influenced by each nation’s unique economic structures, policies and stages of development. These findings emphasize the potential of government consumption as a catalyst for economic growth. However, it’s crucial to recognize that its effectiveness varies significantly across countries. Therefore, adopting tailored approaches that take into account the financial conditions and development stages of individual countries is essential for optimizing the positive impact of government spending on growth. Potential explanations – such as institutional quality, corruption and the composition of government spending – are examined in the robustness analysis and further discussed in Section 5. Additionally, Table 7 presents the coefficient estimates and bootstrap standard errors for the control variables included linearly in the semiparametric varying coefficient model. The estimated effects of the control variables are broadly consistent with those obtained from the linear specification.

To effectively summarize the cross-sectional variation in our results, we generate a kernel density plot of the partial effect estimates. Initially, we compute the mean partial effect for each country in our sample, averaged across time. Subsequently, we analyze the distribution of these mean partial effects. Figure 3 presents the kernel density of the partial effect estimates. We use a Gaussian kernel with an optimal bandwidth to portray the distribution accurately. The estimated values all fall within the positive range, and the distribution displays significant dispersion. The estimated density exhibits a unimodal pattern, with the mode centered around 0.3, and it demonstrates a positively skewed distribution. These findings reveal an interesting aspect of the relationship between government size and economic growth: while the average effect of government size is positive, there is considerable variation across different countries.

Figure 4 presents a comparative analysis of the estimated partial effects of government spending on growth, derived from both the threshold and semiparametric varying coefficient models, applied separately to developing and developed countries. In Panel (a), which focuses on developing countries, the partial effect estimated by the

Table 7. Parametric component of the semiparametric model

Variables	Full sample	Developing	Developed
Lagged growth	0.158* (0.086)	0.075 (0.093)	0.310* (0.160)
log(Inflation)	−0.750*** (0.184)	−0.751*** (0.208)	−0.815*** (0.253)
Capital formation	0.073* (0.041)	0.058 (0.049)	0.126* (0.068)
Population	0.431 (0.672)	1.374 (0.923)	−1.218*** (0.248)
Openness	0.043*** (0.010)	0.050*** (0.016)	0.038*** (0.010)
Human capital	0.043 (0.159)	−0.030 (0.144)	−0.146 (0.351)
Time dummies	Yes	Yes	Yes
Number of countries	86	52	34
T	8	8	8

Note(s): This table reports point estimates and standard errors for the linear portion of the semiparametric model. Bootstrap standard errors are in parentheses below each estimate. Full sample includes all countries; developing includes only developing countries; developed includes only developed countries. Dependent variable: GDP growth. Sample period: 1980–2019. ***Significance at 1% level, *Significance at 10% level

Source(s): Authors’ own work

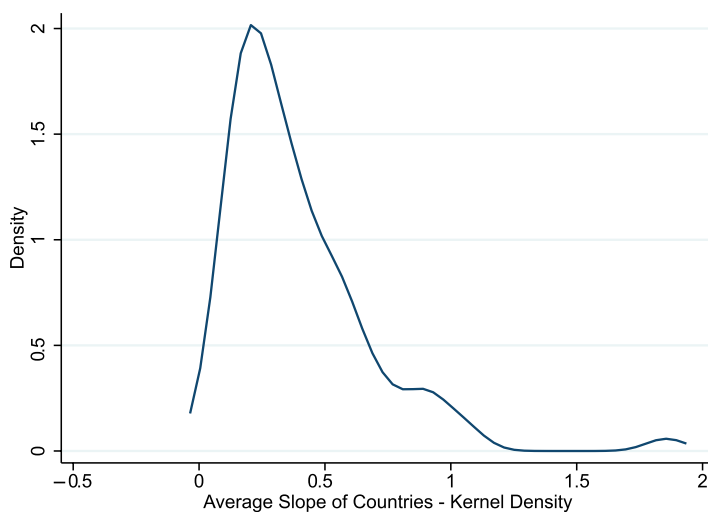


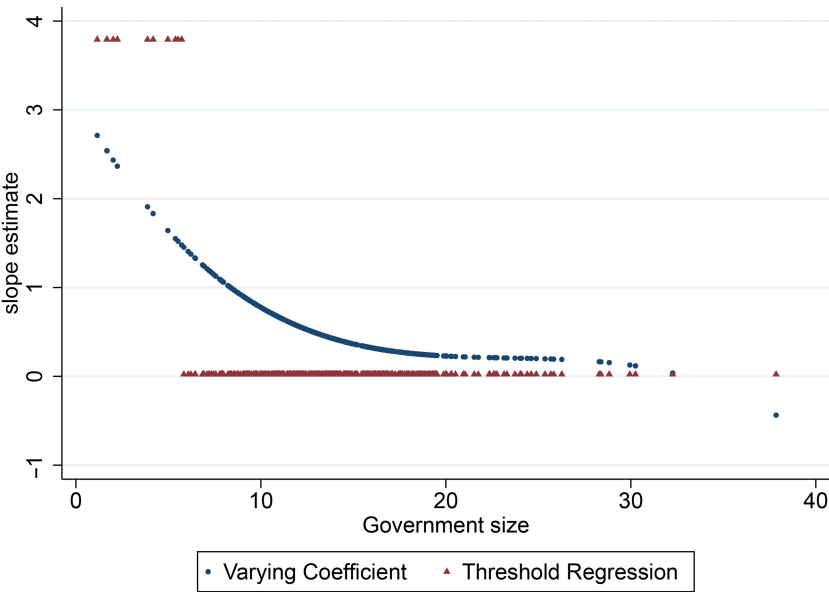
Figure 3. Distribution of average slope of countries – full sample

Note(s): This figure displays the kernel density of partial effect estimates across all countries in the sample, utilizing a Gaussian kernel and an optimal bandwidth, i.e. $h = 1.06\hat{\sigma}n^{-1/5}$. The slopes are estimated for each country across all years in the sample, and the reported values represent the average slope for each country, computed as the mean of its estimated slopes over time

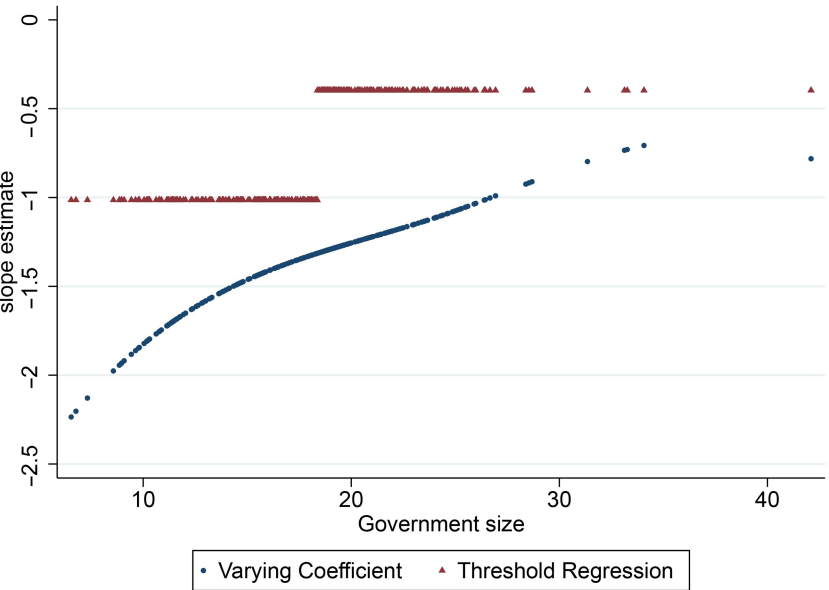
Source: Authors' own work

threshold model shows a positive impact of government spending below the threshold of 5.784%, which then shifts to a negative impact beyond this value. By contrast, the varying coefficient model estimates a lower partial effect than the threshold model when the government size is below 5.784%. However, above the threshold, the semiparametric model's partial effect approaches zero but remains slightly positive. The differences between the two models are particularly pronounced when government size is below the 5.784% threshold. This distinction is crucial because the partial effect estimates from the threshold model may be biased if the true underlying relationship is not strictly piecewise linear. The advantage of the semiparametric varying coefficient model lies in its flexibility; it does not impose a fixed structure on the relationship between government size and growth, allowing for a more adaptive estimation.

Panel (b) focuses on developed countries, where the government consumption threshold is notably higher than in developing countries, estimated at 18.37%. The piecewise linear model shows that, below the threshold, government size has a strong negative effect on growth, with an estimated impact of -1.014 . However, the effect becomes less negative above the threshold, shifting from -1.014 to -0.397 , indicating a movement toward zero while remaining negative. In the varying coefficient model, the effect of government size below 18.37% is also negative, with an average magnitude of -1.55 . Above this threshold, the partial effect remains negative, with an average value of -1.18 , indicating a reduction in the adverse impact as government size increases. The difference between the models is most evident below 18.37% for developed countries, mirroring the pattern observed in developing countries.



(a) Panel A



(b) Panel B

Figure 4. Partial effect estimates – developing vs developed countries

Note(s): This figure compares the partial effects of government size on growth from the dynamic threshold regression model (circles) and the varying coefficient model (dots). Panel (A) displays estimates for developing countries, while Panel (B) shows estimates for developed countries

Source: Authors' own work

5. Robustness checks

This section conducts several robustness checks to examine the sensitivity of the main findings to alternative model specifications and sample structures. The analysis considers a conventional quadratic specification for government size to benchmark nonlinear effects, introduces controls for global economic crises and financial development, and reestimates the model using three-year averaging to examine sensitivity to temporal aggregation. In addition, further analysis investigates the heterogeneous effects of government consumption between developing and developed countries. By incorporating measures of institutional quality, corruption and the composition of government expenditure – specifically health and military spending – the results provide greater insight into the mechanisms driving the differential growth effects across income groups, reinforcing the robustness and interpretability of the main findings.

5.1 Quadratic specification

A conventional approach to capturing nonlinearities in the relationship between government size and economic growth is to include a quadratic term for government consumption. This specification is an alternative to the threshold and semiparametric models employed in the primary analysis and offers a parametric benchmark commonly used in the empirical growth literature. As a robustness check, the model is reestimated with the linear and squared terms of government consumption to assess whether a concave or convex relationship better characterizes the data. In particular, we estimate:

$$y_{it} = \alpha_i + x'_{it}\beta_1 + Gov'_{it}\beta_2 + Gov'^2_{it}\beta_3 + \varepsilon_{it}$$

where all variables are defined in section 2.1. The first three columns of [Table 8](#) present estimates from the quadratic specification, which includes both the level and squared terms of government consumption to capture potential nonlinearities. In the full sample, both coefficients are negative but statistically insignificant. For developing countries, the linear term is positive and the squared term negative, yet neither is statistically significant, indicating no clear nonlinear pattern. In contrast, for developed countries, the linear term is negative and highly significant, while the squared term is positive but remains insignificant.

[Figure 5](#) compares the partial effect estimates from the quadratic and varying coefficient models. In the full sample and among developing countries (Panels A and B), the estimates from the quadratic specification remain near zero and generally negative, with no statistically significant pattern. In contrast, the varying coefficient model reveals more flexibility, particularly at lower levels of government consumption (0% to 15% of GDP), where the marginal effects turn positive. This suggests that the parametric quadratic form may not adequately capture potential nonlinearities in this range. For developed countries (Panel C), both models indicate a negative relationship between government size and growth, although the varying coefficient model shows a steeper decline at lower levels. At higher levels of government consumption, the two estimates converge somewhat, although neither model produces statistically significant results across the full range. Overall, while the quadratic model does not replicate the nonlinear pattern captured by the varying coefficient approach, its inclusion serves as a robustness check and does not contradict the broader finding of diminishing returns to government consumption.

5.2 Global crisis

As part of the robustness analysis, we control for the potential influence of major global crises on the relationship between government consumption and economic growth. Given

Table 8. Linear dynamic panel data model – robustness

Variables	Full sample	Quadratic model Developing	Developed	Full sample	Global crisis Developing	Developed	Full sample	Finance Developing	Developed
Lagged growth	0.057 (0.042)	0.029 (0.058)	-0.066 (0.070)	0.064 (0.042)	0.040 (0.059)	-0.074 (0.070)	0.039 (0.048)	0.056 (0.059)	-0.097 (0.091)
Government size	-0.053 (0.116)	0.103 (0.172)	-0.538*** (0.192)	-0.181*** (0.043)	-0.144** (0.058)	-0.340*** (0.066)	-0.149*** (0.048)	-0.137** (0.058)	-0.298*** (0.085)
Government Size ²	-0.004 (0.003)	-0.008 (0.005)	0.004 (0.004)						
log(Inflation)	-0.413*** (0.123)	-0.459*** (0.168)	-0.151 (0.175)	-0.423*** (0.123)	-0.505*** (0.165)	-0.101 (0.175)	-0.461*** (0.133)	-0.515*** (0.164)	-0.024 (0.288)
Capital formation	0.095*** (0.026)	0.085*** (0.028)	0.033 (0.036)	0.095*** (0.026)	0.079*** (0.027)	0.031 (0.035)	0.086*** (0.023)	0.084*** (0.026)	0.017 (0.051)
Population	0.0244 (0.160)	0.231 (0.239)	-0.568** (0.219)	-0.230 (0.160)	0.289 (0.239)	-0.535* (0.220)	0.096 (0.215)	0.242 (0.239)	-0.106 (0.388)
Openness	0.022 (0.005)	0.10 (0.010)	0.006 (0.005)	0.0230 (0.005)	0.012 (0.005)	0.005 (0.005)	0.004 (0.007)	0.014 (0.01)	-0.067 (0.010)
Human capital	0.097** (0.044)	0.057 (0.055)	-0.408** (0.166)	0.089* (0.044)	0.04 (0.055)	-0.438*** (0.165)	0.071 (0.046)	0.041 (0.053)	-0.185 (0.205)
Global crisis × government				-0.085* (0.047)	-0.072 (0.077)	-0.013 (0.057)	-0.037 (0.052)	-0.059 (0.077)	0.005 (0.076)
Private credit							-0.021*** (0.007)	-0.026** (0.013)	-0.006 (0.007)
Time dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Number of countries	86	52	34	86	52	34	69	52	17
T	8	8	8	8	8	8	8	8	8

Note(s): This table reports point estimates and standard errors for the linear dynamic panel data model with additional variables included for robustness. Standard errors are reported in parentheses below each estimate. Each column presents results based on the bias-corrected estimator of [Bruno \(2005\)](#). The quadratic specification includes the square of government size, while the Global Crisis specification incorporates an interaction term between government size and a dummy variable for the 2008 and 2009 financial crisis. The Finance specification introduces a control for domestic credit to the private sector by banks. The full sample includes all countries; the developing group consists of developing countries, while the developed group includes only developed countries. Dependent variable: GDP growth. Sample period: 1980–2019.

***Significance at 1% level, **Significance at 5% level, *Significance at 10% level

Source(s): Authors' own work

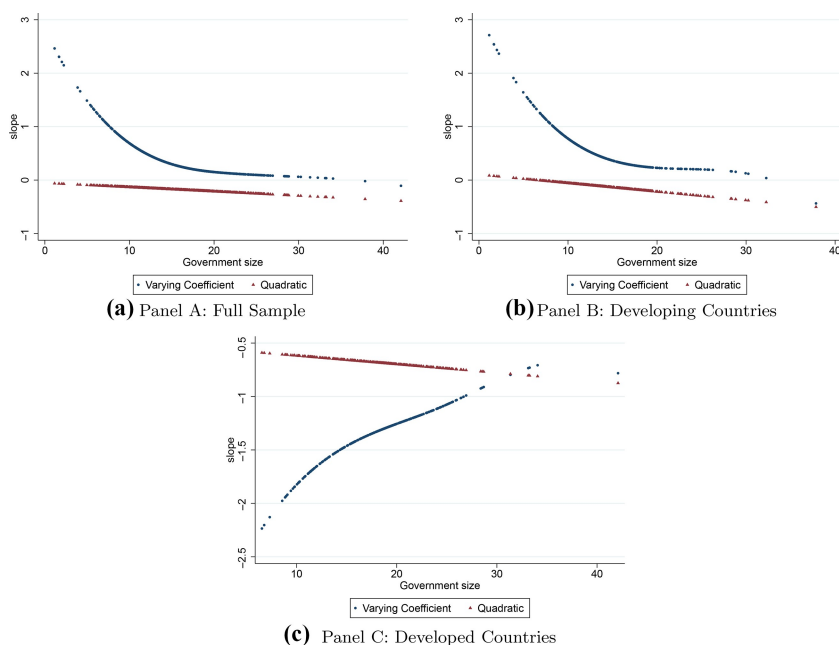


Figure 5. Partial effect estimates – varying coefficient model vs quadratic model

Note(s): This figure compares the partial effects of government size on growth from the varying coefficient model (dots) and quadratic model (triangles)

Source: Authors' own work

that our sample spans 1980–2019, which includes only one major global recession, we focus on the 2008–2009 global financial crisis (The Great Recession). We incorporate a dummy variable, *Global Crisis*, which equals one for 2008 and 2009 and zero otherwise. We interact the *Global Crisis* dummy with government consumption to account for possible shifts in the fiscal-growth relationship during this period. Specifically, we estimate the following linear model:

$$y_{it} = \alpha_i + x'_{it}\beta_1 + Gov'_{it}\beta_2 + GlobalCrisis \times Gov'_{it}\beta_3 + \varepsilon_{it},$$

where all variables are defined in section 2.1. This specification allows us to evaluate the robustness of our estimates by explicitly examining whether the relationship between government consumption and growth changes during crisis periods. While the interaction term is presented here within the linear framework, we also incorporate it into the threshold and varying coefficient models to maintain consistency across specifications and assess our results' robustness under alternative estimation approaches. Columns 4–6 of Table 8 present estimates from the global crisis specification. These estimates can be compared with the corresponding government size estimates in Table 3, which are derived from the linear specification that does not include the global crisis interaction. The comparison shows that the estimated effects of government consumption are remarkably similar across the two

specifications; they are consistently negative and statistically significant. This indicates that the inclusion of the global crisis interaction does not significantly change the linear relationship between government size and economic growth.

Columns 1–3 of [Table 9](#) report the threshold regression results that incorporate the global crisis interaction. The threshold values remain consistent across specifications relative to the baseline estimates in [Table 4](#). For example, the estimated thresholds are 10.34% for the full sample, 6.15% for developing countries and 19.30% for developed countries, which are closely aligned with the corresponding baseline values of 10.26%, 5.78% and 18.37%, respectively. The consistency of threshold estimates across specifications indicates that the government size thresholds are robust to the inclusion of the crisis interaction term.

Turning to the government size estimates, the overall pattern remains consistent with the baseline results. For the full sample and developing countries, government consumption is associated with positive and statistically significant growth effects below the estimated threshold, and negative effects above it. In the case of developed countries, the relationship is negative on both sides of the threshold, although the magnitude is substantially larger below the threshold, suggesting that higher levels of government consumption are more detrimental to growth when public spending is relatively low. When the global crisis interaction is included, the below-threshold estimates strengthen across all groups. In the full sample and developing countries, the effects become more positive, while in developed countries, the negative impact becomes smaller in magnitude. This does not imply greater fiscal policy effectiveness but rather reflects the separation of crisis years – when government size is typically higher and spending less effective. The negative interaction term captures this crisis-specific effect, while the below-threshold coefficient reflects the more favorable impact of government consumption during noncrisis periods. Therefore, accounting for the global crisis, we still observe the nonlinear pattern in the benchmark threshold regression, reinforcing the conclusion that the growth effects of government consumption vary with its size and economic conditions.

[Figure 6](#), Panel A, presents the varying coefficient estimates from the specification that includes an interaction with the global crisis indicator, based on the full sample. Consistent with our earlier findings in [Figure 1](#), the results reveal a nonlinear, downward-sloping relationship, where the marginal effect of government consumption decreases steadily as government size increases. On average, the varying coefficient model yields a positive slope of approximately 0.387 for the full sample; however, there is considerable variation, with the estimates remaining positive but ranging from 0.169 at the first quartile to 0.528 at the third quartile.

In developing countries, the estimated effects are generally greater in magnitude and uniformly positive. The average coefficient is 0.564, with values ranging from approximately 0.307 at the lower quartile to 0.700 at the upper quartile. This suggests that government consumption is more growth-enhancing in developing countries. In contrast, the estimates for developed countries are consistently negative across the entire distribution, with an average slope of -1.405 and quartile values ranging from -1.531 to -1.245 . These results are consistent with our earlier findings from specifications that did not include the crisis interaction term, further supporting the notion that the growth impact of government consumption differs systematically by level of development [\[14\]](#).

5.3 Financial development

To further examine the sensitivity of our results, we control for the potential influence of financial development on the relationship between government consumption and economic growth. Financial development is captured by the availability of private credit, measured as

Table 9. Nonlinear dynamic panel data – threshold regression – robustness

Variables	Full sample	Global crisis Developing	Developed	Full sample	Finance Developing	Developed
Threshold	10.34*** (0.157)	6.152*** (0.278)	19.30*** (0.556)	14.11*** (0.229)	13.68*** (1.353)	16.27** (8.004)
<i>Government size</i>						
Below threshold	1.905*** (0.155)	2.830*** (0.436)	-0.754*** (0.049)	0.333*** (0.064)	-0.129* (0.068)	0.714 (1.656)
Above threshold	-0.589* (0.321)	-0.257 (0.877)	-0.212*** (0.879)	-0.502*** (0.156)	-0.363*** (0.142)	-0.539 (3.546)
Lagged growth	-0.094*** (0.018)	-0.092*** (0.011)	-0.245*** (0.014)	-0.047*** (0.013)	-0.123*** (0.014)	-0.210** (0.104)
log(Inflation)	-0.523*** (0.060)	-0.628*** (0.079)	0.005 (0.074)	-0.448*** (0.038)	-0.613*** (0.058)	-0.165 (0.650)
Capital formation	0.136*** (0.011)	0.083*** (0.013)	0.127*** (0.015)	0.145*** (0.005)	0.145*** (0.010)	0.083 (0.130)
Population	-0.277*** (0.095)	0.701*** (0.131)	-1.454*** (0.095)	0.147*** (0.051)	0.699*** (0.103)	-0.424 (0.674)
Openness	0.027*** (0.003)	0.037*** (0.004)	0.011*** (0.002)	0.053*** (0.002)	0.023*** (0.005)	0.038** (0.018)
Human capital	-0.046*** (0.015)	0.093*** (0.018)	-0.241*** (0.040)	0.010 (0.009)	0.162*** (0.017)	-0.792*** (0.261)
Global crisis × government	-0.046*** (0.004)	-0.004 (0.004)	-0.044*** (0.003)	-0.026*** (0.003)	-0.036*** (0.004)	-0.043* (0.023)
Private credit				-0.050*** (0.003)	-0.054*** (0.004)	-0.004 (0.037)
Time dummies	Yes	Yes	Yes	Yes	Yes	Yes
Number of countries	86	52	34	69	52	17
T	8	8	8	8	8	8

Note(s): This table reports point estimates and standard errors for the dynamic panel threshold regression. Bootstrap standard errors are in parentheses below each estimate. The Global Crisis specification incorporates an interaction term between government size and a dummy variable for the 2008 and 2009 financial crisis. The Finance specification introduces a control for domestic credit to the private sector by banks. Full sample includes all countries; developing includes only developing countries; developed includes only developed countries. Dependent variable: GDP growth. Sample period: 1980–2019. ***Significance at 1% level, **Significance at 5% level, *Significance at 10% level

Source(s): Authors' own work

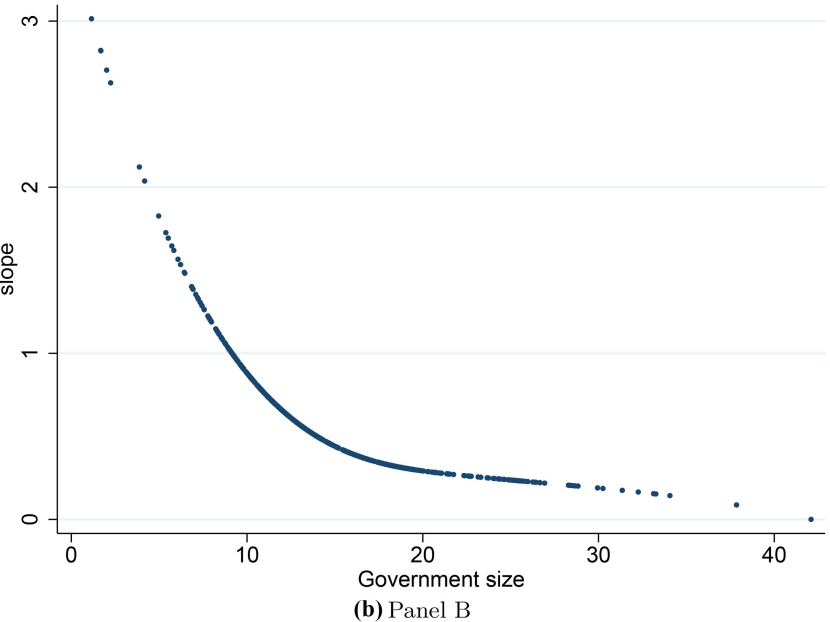
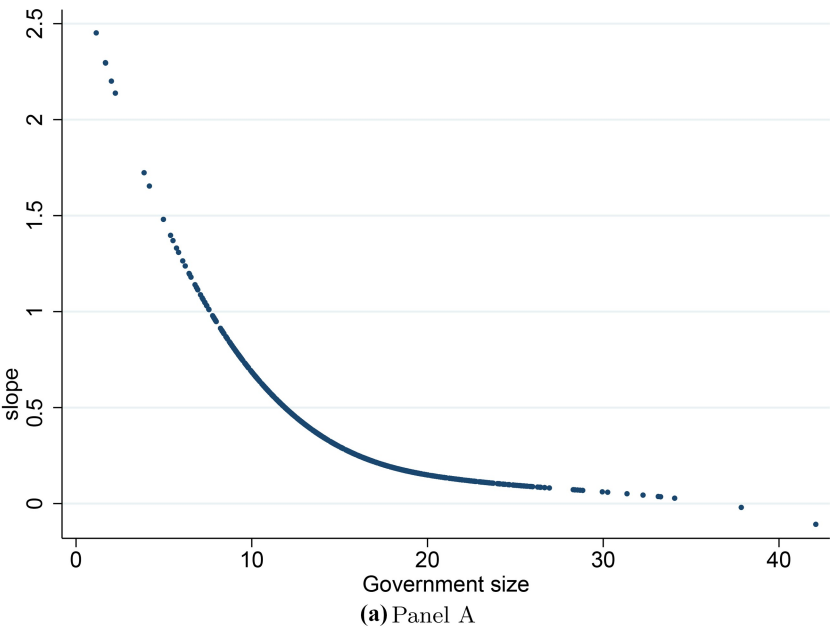


Figure 6. Partial effect estimates – robustness – global crisis and finance

Note(s): This figure displays the partial effects of government size on growth from the varying coefficient model (dots). Panel (A) displays estimates when Global Crisis interaction term is added as an additional control variable, while Panel (B) shows estimates when finance and Global Crisis interaction added to the model

Source: Authors' own work

domestic credit to the private sector by banks as a percentage of GDP. In this specification, we include all macroeconomic control variables described in Section 2.1, and additionally account for financial development and the global crisis interaction term included in the preceding specification. Columns 7–9 of Table 8 present our estimates. When comparing these results to the corresponding government size estimates reported in Table 3, we find that controlling for financial development has little effect on the overall relationship between government size and economic growth. While the magnitude of the coefficients is slightly reduced in some specifications, the estimated effects remain consistently negative and statistically significant. This pattern reinforces the robustness of the negative association observed in the linear specification.

Columns 4–6 of Table 9 report the threshold regression results that include financial development as an additional control. We compare these estimates with the baseline threshold results presented in Table 4. Due to data limitations for the financial development variable, 17 developed countries are excluded from the sample. As a result, the number of developed countries decreases to 17, and the total number of countries drops to 69. Notably, there is no change in the number of developing countries included in the analysis. The comparison shows some differences in the estimated thresholds, particularly for the developing countries. The threshold increases from 10.26% in the baseline model to 14.11% when financial development is included. For developed countries, the change is relatively small, with the threshold shifting from 18.37% to 16.27%. These results suggest that the inclusion of financial development does not substantially alter the estimated threshold in the full sample or among developed economies. The most significant change in threshold estimates occurs in developing countries, where the threshold increases from 5.78% in the baseline model to 13.68%. This notable shift likely reflects the impact of financial development on the growth effects of government consumption. In many developing economies, where credit markets tend to be underdeveloped, government spending can partially substitute for private credit. If financial development is not considered in the model, its influence may be mistakenly attributed to the size of government, resulting in omitted variable bias. Consequently, the threshold estimate could be biased downward, combining both fiscal and financial effects instead of isolating the true impact of government consumption. By controlling for financial development, the model more accurately isolates the independent contribution of government size, allowing for a higher threshold before any negative effects on growth become apparent. Therefore, a developing country with a well-developed financial sector can maintain a larger government sector without adversely affecting economic growth. In interpreting the threshold regression results, we note a key limitation: the developed countries include only 17 countries, which limits statistical power and likely explains the lack of significance in the estimates. As a result, we do not draw firm conclusions for this group. In contrast, the full sample shows a consistent nonlinear pattern: the growth effect is positive below the threshold and negative above, similar to earlier results. However, the magnitudes differ due to the excluded countries. For developing countries, the threshold regression yields negative marginal effects below and above the estimated threshold. Specifically, the effect is -0.129 below the threshold and -0.363 above. These results suggest that once financial development is controlled for, even moderate levels of government consumption are associated with lower growth and that the negative effect intensifies as government size increases.

Figure 6, Panel B, presents the varying coefficient estimates, based on the full sample. Consistent with our earlier findings in Figure 1, the results reveal a nonlinear, downward-sloping relationship, where the marginal effect of government consumption decreases steadily as government size increases. On average, the varying coefficient model yields a

positive slope of approximately 0.596 for the full sample; however, there is considerable variation, with the estimates remaining positive but ranging from 0.338 at the first quartile to 0.747 at the third quartile. For developing countries, the estimated slope from the varying coefficient model is positive across all observed levels but declines nonlinearly as government size increases. This behavior closely mirrors the results for the full sample. While government consumption may still support growth at low to moderate levels, its marginal contribution diminishes rapidly as the public sector expands. Although the effect remains positive within the sample range, the steep decline is consistent with diminishing returns to government size.

While the threshold and varying coefficient models differ in functional form and the sign of their estimated effects, they point to a similar conclusion: the growth impact of government consumption declines as its share of GDP rises. The threshold model provides average effects within discrete regimes, which may include countries already experiencing low or negative returns. In contrast, the varying coefficient model offers pointwise marginal effects, capturing how the growth impact weakens continuously with government size. The results suggest that beyond a certain point, government expansion becomes less supportive of growth and may even have adverse effects, particularly in settings where the financial system is underdeveloped.

5.4 Three-year averages

As part of the robustness analysis, we estimate all models using three-year averaged data rather than the baseline five-year averages. Shortening the averaging window allows for greater sensitivity to short-term fluctuations in government consumption and economic growth. This alternative specification enables us to assess whether the choice of temporal aggregation drives the primary findings or whether they remain consistent when capturing more frequent variations in macroeconomic conditions.

Table 10 presents the results for the linear model. When comparing these results to the corresponding government size estimates reported in the baseline model with the global crisis dummy, we find that shortening the averaging window to three years has virtually no

Table 10. Linear dynamic panel data model – 3-year averages

Variables	Full sample	Developing	Developed
Lagged growth	0.150*** (0.031)	0.102** (0.040)	0.184*** (0.054)
Government size	−0.175*** (0.036)	−0.151*** (0.045)	−0.293*** (0.063)
log(Inflation)	−0.131 (0.099)	−0.243** (0.122)	−0.0381 (0.146)
Capital formation	0.058*** (0.017)	0.053** (0.022)	−0.010 (0.030)
Population	−0.225 (0.138)	0.299 (0.189)	−0.631*** (0.197)
Openness	0.003 (0.004)	0.015* (0.009)	0.008 (0.005)
Human capital	0.114*** (0.039)	0.060 (0.047)	−0.148 (0.158)
Global crisis × government	−0.160*** (0.054)	−0.137 (0.086)	−0.042 (0.071)
Time dummies	Yes	Yes	Yes
Number of countries	86	52	34
T	13	13	13

Note(s): This table presents point estimates and standard errors for the linear dynamic panel data model. Standard errors are reported in parentheses below each estimate. The analysis is based on Three-year averaged data. Each column presents results based on the bias-corrected estimator of Bruno (2005). The full sample includes all countries; the developing group consists of developing countries, while the developed group includes only developed countries. Dependent variable: GDP growth. Sample period: 1980–2019. ***Significance at 1% level, **Significance at 5% level, *Significance at 10% level

Source(s): Authors’ own work

effect on the overall relationship between government size and economic growth. The estimated coefficients remain negative and statistically significant across all specifications, with magnitudes closely comparable to those obtained under the baseline five-year averaging. This consistency reinforces the robustness of the negative association observed between government consumption and economic growth.

Table 11 displays the threshold regression estimates based on three-year averaged data. The estimated thresholds are 15.08% for the full sample, 8.72% for developing countries and 17.10% for developed countries. Although the threshold estimates for the full sample and developing countries shift modestly compared to the baseline results reported in Table 9, the overall pattern remains broadly consistent. For developing countries, government consumption is associated with a positive and statistically significant effect on growth below the estimated threshold, and a negative but insignificant effect above it. In developed countries, the relationship remains negative on both sides of the threshold, with the below-threshold coefficient substantially more negative, indicating that relatively low levels of government spending are particularly detrimental to growth. Because the full sample aggregates these contrasting dynamics, the resulting coefficients reflect a combination of the strong negative association in developed countries and the still-positive effect in developing ones. Therefore, the nonlinear structure identified in the original threshold regression persists under the three-year specification, reinforcing the conclusion that the growth effects of government consumption are shaped by both its scale and a country's stage of development.

Figure 7 displays the varying coefficient estimates from the three-year averaged specification, based on the full sample and incorporating an interaction with the global crisis indicator. The relationship between government size and its marginal effect on growth exhibits a pronounced nonlinear pattern, characterized by a clear downward-sloping trajectory. The marginal effect declines progressively as government size increases, underscoring the diminishing growth returns to public spending across the distribution. The

Table 11. Nonlinear dynamic panel data – threshold regression – 3-year averages

Variables	Full sample	Developing	Developed
Threshold	15.08*** (0.360)	8.721*** (0.393)	17.10*** (0.463)
<i>Government size</i>			
Below threshold	–0.973*** (0.041)	1.308*** (0.309)	–2.095*** (0.239)
Above threshold	–0.430 (0.095)	–0.787 (0.630)	–0.486 (0.499)
Lagged growth	0.082*** (0.005)	0.074*** (0.023)	0.042 (0.044)
log(Inflation)	–0.640*** (0.026)	–0.742*** (0.170)	–0.333*** (0.102)
Capital formation	0.134*** (0.002)	0.078*** (0.012)	0.070*** (0.021)
Population	–0.590*** (0.053)	0.190 (0.197)	–1.550*** (0.266)
Openness	0.023*** (0.001)	0.029*** (0.005)	0.019*** (0.003)
Human capital	–0.051*** (0.008)	–0.003 (0.031)	–0.327*** (0.067)
Global crisis × government	–0.059*** (0.003)	–0.048*** (0.007)	–0.117*** (0.008)
Time dummies	Yes	Yes	Yes
Number of countries	86	52	34
T	13	13	13

Note(s): This table reports point estimates and standard errors for the dynamic panel threshold regression. Bootstrap standard errors are in parentheses below each estimate. The analysis is based on three-year averaged data. Full sample includes all countries; developing includes only developing countries; developed includes only developed countries. Dependent variable: GDP growth. Sample period: 1980–2019. ***Significance at 1% level

Source(s): Authors' own work

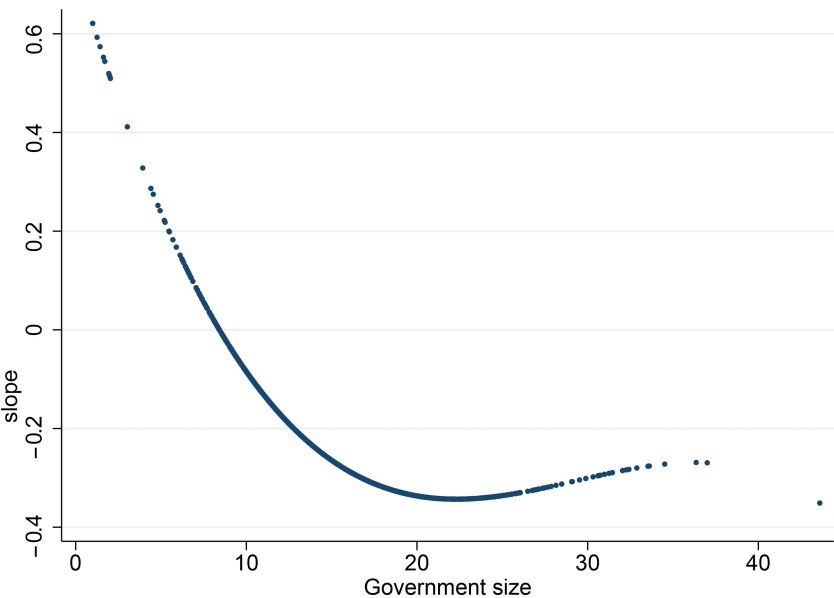


Figure 7. Partial effect estimates – robustness – three-year averages

Note(s): This figure illustrates the estimated relationship between government size (consumption) and economic growth, as derived from the varying coefficient model with three-year averages. The varying coefficient represents the marginal effect of government size on growth

Source: Authors' own work

slope remains positive at lower levels of government consumption but steadily declines as government size increases. Once government size exceeds approximately 8.41%, the varying coefficient turns negative, suggesting that beyond this point, additional government spending becomes increasingly detrimental to growth. The estimates span a wide range – from a high near 0.56 to below -0.20 – indicating substantial variation across the distribution of government size. Our findings reinforce the idea that the effect of government consumption on growth depends on its size, and that the benefits of public spending may turn negative when government spending becomes too large, especially outside of crisis periods.

5.5 Institutional quality, corruption and sectoral channels

This section explores whether institutional quality, control of corruption and the sectoral composition of public spending help explain the stronger growth effects of government consumption observed in developing countries [15]. Specifically, we investigate whether these factors contribute to the differing slopes of the government consumption-growth relationship, with more adverse effects typically observed in developed countries. Therefore, we estimate the varying coefficient model in which the marginal effect of government consumption on growth varies as a function of institutional quality, control of corruption and the relative shares of military and health care expenditures, respectively. Accordingly, we estimate the following model:

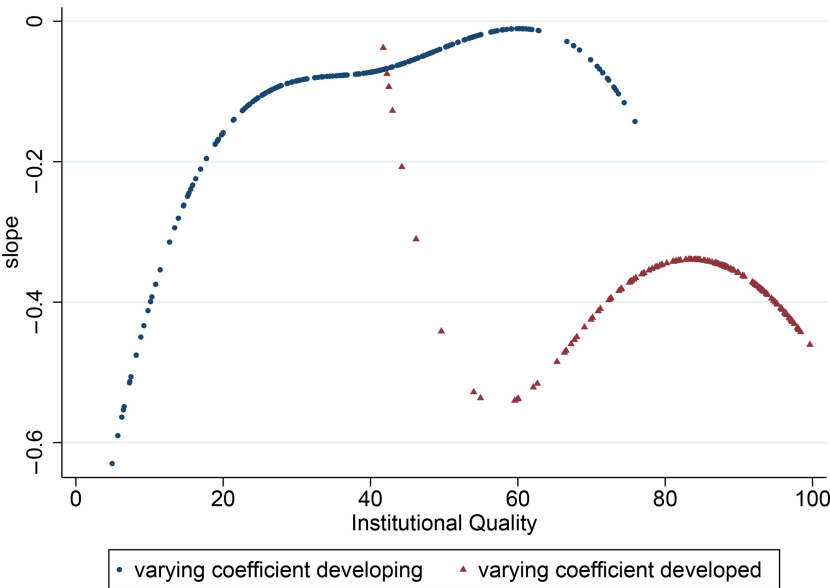
$$y_{it} = \alpha_i + x'_{it}\beta_1 + Gov'_{it}\theta(Z_{it}) + \varepsilon_{it} \quad (8)$$

where $\theta(\cdot)$ denotes an unknown coefficient function that varies smoothly with country-specific variable Z_{it} , which represents, respectively, institutional quality, control of corruption and the relative shares of military and health care expenditures. The remaining variables are defined in Section 2.1.

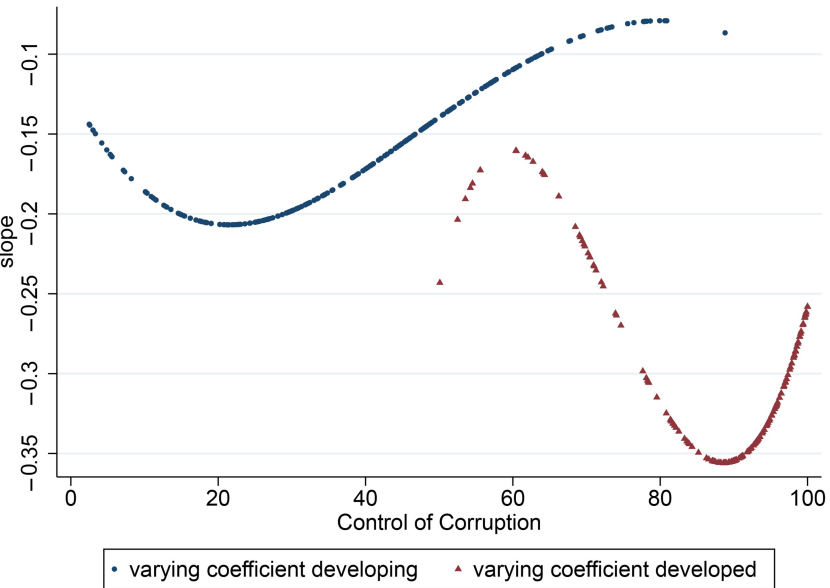
We begin by examining institutional quality. As expected, institutional quality tends to be higher in developed countries, typically ranging from 40 to 80. In contrast, in developing countries it varies more widely, from as low as 5 up to around 75, with most values concentrated between 30 and 60. Panel A of Figure 8 presents the varying coefficient estimates across the institutional quality distribution for developing and developed countries. The relationship appears highly nonlinear. Visually, the distinction between the two groups is evident: for developing countries, the estimated coefficient of government consumption remains close to zero across the range of institutional quality. In contrast, for developed countries, the coefficient fluctuates around -0.40 and displays an inverse U-shaped pattern. This figure offers clear visual evidence of cross-country heterogeneity in the growth effects of government consumption, with institutional quality emerging as a key moderating factor. Both groups of countries display an inverse U-shaped pattern, indicative of a nonmonotonic relationship. At lower levels of institutional quality, the negative impact of government consumption on growth tends to diminish as institutions improve. However, beyond a certain threshold, further improvements in institutional quality are linked to a return of stronger negative effects. This suggests the presence of an optimal range, beyond which government consumption may become increasingly counterproductive for growth.

Table 12 reports summary statistics of the estimated varying coefficient, including its mean and selected quantiles, for each country group. For developing countries, the average value of the varying coefficient is -0.107 , although this estimate is not statistically significant. In contrast, the average for developed countries is -0.377 and statistically significant. To further illustrate the differential responsiveness, consider the interval where institutional quality increases from 50 to 60. Over this range, the varying coefficient for developing countries changes only slightly, from -0.037 to -0.011 , remaining close to zero. For developed countries, however, the coefficient becomes notably more negative, declining from -0.442 to -0.538 . This contrast underscores how the same improvement in institutional quality can produce markedly different growth responses, highlighting the relevance of country-specific characteristics in shaping the effects of government consumption.

The second variable we examine is control of corruption, which is one of the core components of institutional quality. The control of corruption index ranges from 5 to 80 in developing countries and from 50 to 100 in developed countries, consistent with the expectation that corruption is generally lower in more advanced economies. Panel B of Figure 8 presents the estimated varying coefficients across the distribution of control of corruption for both country groups. In both cases, government consumption is associated with adverse growth effects, although the magnitude and shape of the relationship differ. The estimated coefficients display a highly nonlinear, U-shaped pattern. The results suggest the presence of a turning point. As control of corruption weakens, the adverse effect of government consumption on growth becomes more pronounced. Beyond a certain threshold, however, further improvements in control of corruption reduce the severity of this negative relationship, although the effect remains negative throughout. This nonmonotonic pattern is observed in both country groups, but the turning points differ, indicating that the moderating role of corruption varies by development level.



(a) Panel A



(b) Panel B

Figure 8. Varying coefficient estimates – institutional quality and control of corruption
Note(s): This figure displays the the varying coefficient estimates for developing (circles) and developed countries (triangles). The varying coefficient estimate $\hat{\theta}(Z_{it})$ is estimated from the semiparametric regression $y_{it} = \alpha_i + x'_{it}\beta_1 + Gov'_{it}\theta(Z_{it}) + \varepsilon_{it}$, where Z_{it} is Institutional Quality and Control of Corruption, respectively. Panel (A) displays the Institutional Quality and Panel (B) exhibits Control of Corruption

Source: Authors' own work

Table 12. Dynamic panel data – varying coefficient estimates – institutional quality and sectoral decomposition

Statistic	Institutional quality		Control of corruption		Health expenditure		Military expenditure	
	Developing	Developed	Developing	Developed	Developing	Developed	Developing	Developed
Mean	-0.107 (0.104)	-0.377*** (0.137)	-0.159 (0.108)	-0.303*** (0.098)	0.075 (0.157)	-0.550** (0.241)	-0.123 (0.108)	-0.466*** (0.104)
Q1	-0.103 (0.104)	-0.415*** (0.155)	-0.198 (0.117)	-0.353*** (0.107)	0.033 (0.168)	-0.706*** (0.262)	-0.135 (0.107)	-0.482*** (0.094)
Q2	-0.075 (0.097)	-0.372*** (0.135)	-0.165* (0.109)	-0.336*** (0.101)	0.117 (0.110)	-0.611** (0.258)	-0.116 (0.122)	-0.474 (0.095)
Q3	-0.048 (0.099)	-0.345*** (0.123)	-0.127 (0.104)	-0.312** (0.123)	0.153 (0.114)	-0.374 (0.279)	-0.099 (0.126)	-0.466 (0.104)
Time dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Number of countries	51	34	51	34	52	33	42	31
T	5	5	5	5	4	4	8	8

Note(s): This table presents the mean, median, first and third quartile of the varying coefficient estimate $\hat{\theta}(Z_{it})$ in the semiparametric regression $y_{it} = \alpha_i + x'_{it}\beta_1 + Gov'_{it}\theta(Z_{it}) + \varepsilon_{it}$, where Z_{it} is Institutional Quality, Control of Corruption, Health Expenditure and Military Expenditure, respectively. Bootstrap standard errors are in parentheses below each estimate. The developing group consists of developing countries, while the developed group includes only developed countries. Dependent variable: GDP growth. *** Significance at 1% level, ** Significance at 5% level, * Significance at 10% level

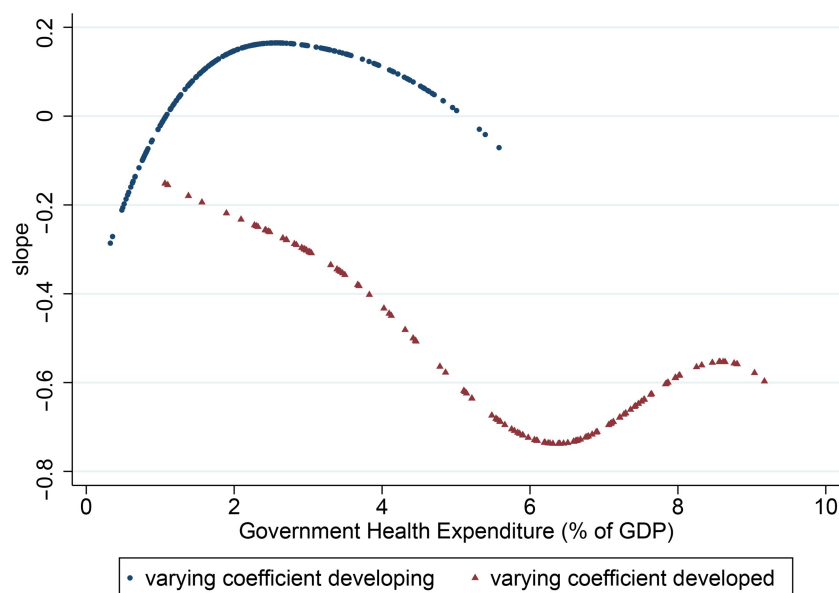
Source(s): Authors' own work

Table 12 reports summary statistics of the estimated varying coefficients for control of corruption. For developing countries, the average value is -0.159 and is not statistically significant. In contrast, for developed countries, the average is -0.303 and statistically significant, with roughly twice the magnitude. To illustrate these differences more concretely, consider the interval where the control of corruption index improves from 70 to 80. Over this range, the varying coefficient for developed countries declines from -0.225 to -0.325 , indicating a stronger negative effect. The coefficient changes slightly for developing countries, from -0.089 to -0.079 . Once again, this comparison shows that countries respond differently to changes in corruption, further confirming the importance of accounting for institutional differences when analyzing the growth effects of government consumption.

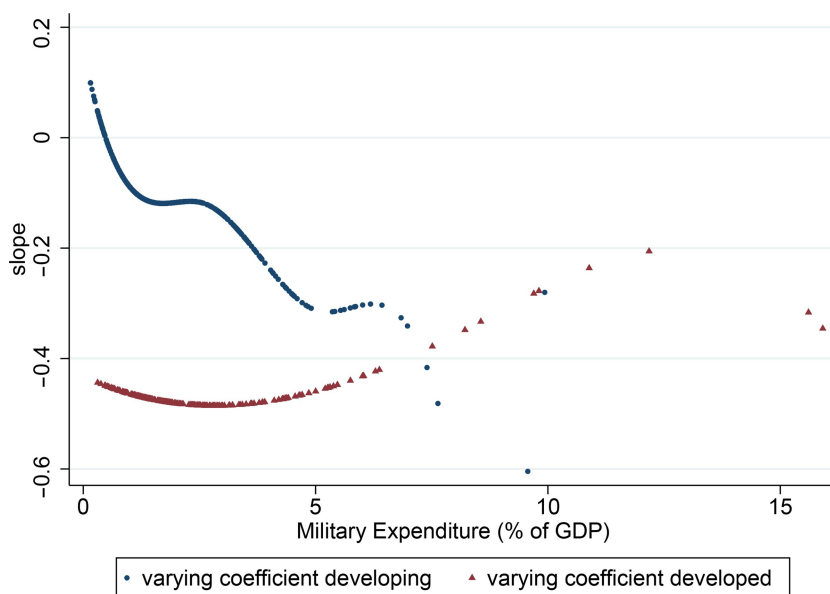
We now examine the sectoral composition of government spending to see whether differences in how countries allocate public funds help explain the variation in the growth effects of government consumption. Specifically, we focus on two key areas - health and military expenditures - which represent different roles of the state and may affect growth in different ways. Figure 9, Panel A, presents the estimates of the varying coefficient on government consumption as a function of health expenditure. Health spending, measured as a share of GDP, ranges from 0.32% to 6% in developing countries and from 1.06% to 9.17% in developed countries. The estimated relationship differs markedly across the two groups. In developing countries, the varying coefficient fluctuates around zero and is mostly positive across the distribution of health spending. In contrast, for developed countries, the coefficient remains consistently negative throughout. Table 12 confirms this divergence. The average value of the varying coefficient for developing countries is 0.075 and statistically insignificant, while for developed countries, the average is -0.550 and statistically significant. To illustrate the contrast more clearly, consider the case where health expenditure equals 5% of GDP. At this level, the estimated coefficient for developing countries is 0.013, suggesting a slightly positive (although insignificant) effect of government consumption on growth. In developed countries, the coefficient is -0.618 , indicating a substantial adverse effect. These findings provide direct evidence that differences in health spending contribute to the heterogeneous growth effects of government consumption.

Finally, we examine military expenditure to assess whether it contributes to the differential growth effects of government consumption. Figure 9, Panel B, presents the varying coefficient estimates across the distribution of military spending. The results resemble those observed for institutional quality, corruption and health expenditure. In both developing and developed countries, the estimated coefficients are predominantly negative. Furthermore, Figure 9, Panel B, shows that the negative effects are consistently larger in magnitude for developed countries. For developing countries, the adverse effect of government consumption intensifies as military expenditure rises. In contrast, the negative impact for developed countries remains relatively stable across the distribution. Table 12 supports these findings: the average value of the varying coefficient for developing countries is -0.123 and not statistically significant, while for developed countries, the mean is -0.466 and statistically significant. The pattern is consistent with the earlier results, reinforcing that country-specific characteristics condition the growth effects of government consumption.

To illustrate the difference more clearly, consider the case where military expenditure equals 3% of GDP. At this level, the varying coefficient is -0.140 for developing countries and -0.485 for developed countries, indicating that both groups experience negative effects. However, the impact is considerably more substantial in more advanced economies. These results suggest that the sectoral allocation of government consumption – whether toward health or defense – helps explain the observed heterogeneity in its growth effects. The



(a) Panel A



(b) Panel B

Figure 9. Varying coefficient estimates – health and military expenditure

Note(s): This figure displays the the varying coefficient estimates for developing (circles) and developed countries (triangles). The varying coefficient estimate $\hat{\theta}(Z_{it})$ is estimated from the semiparametric regression $y_{it} = \alpha_i + x'_{it}\beta_1 + Gov'_{it}\theta(Z_{it}) + \varepsilon_{it}$, where Z_{it} is Government Health Expenditure and Military Expenditure, respectively. Panel (A) displays the Government Health Expenditure and Panel (B) exhibits Military Expenditure

Source: Authors' own work

analysis highlights that not only the size of government, but also how resources are spent, plays a critical role in shaping macroeconomic outcomes across countries at different stages of development.

6. Discussion and policy implications

The empirical results reveal a nonlinear and context-dependent relationship between government consumption and economic growth. This section explores three structural mechanisms that help explain the observed heterogeneity across countries and spending levels: institutional quality, sectoral composition and stage of development. A first channel is institutional quality. [Figure 8](#) shows that the growth effects of government consumption vary systematically with institutional strength and control of corruption. In countries with strong institutions, the negative impact of government spending is significantly attenuated, while in low-governance environments, the effects are markedly more adverse. This pattern aligns with [Dzhumashev \(2014\)](#), who highlights how weak institutions exacerbate inefficiencies and rent-seeking, and with [Kim et al. \(2018\)](#), who demonstrate that governance quality amplifies the productivity of public spending. Building on this line of research, [Sama et al. \(2025\)](#) find a positive synergy between public spending and good governance, reinforcing that institutional context is a critical determinant of fiscal effectiveness. Recent regional-level evidence provides a deeper perspective on this mechanism. Drawing on Italian regional data, [Capasso and Santoro \(2025\)](#) reveals that “active” (coercive) corruption can deeply erode the growth benefits of public spending, while “passive” (collusive) forms have a noticeably milder impact. These results demonstrate, in practical terms, how the particular nature and enforcement of corruption shape fiscal outcomes – reminding us that behind every statistic are real policy implications and societal consequences. Our findings extend these insights by showing that institutional quality does not merely shift the level of fiscal effectiveness but alters its marginal effect across the governance spectrum. Instead of imposing categorical distinctions, we treat governance quality as a continuous variable, allowing its influence on fiscal effectiveness to vary smoothly across institutional environments. This flexible semiparametric approach reveals systematic differences that standard parametric models may fail to detect.

A second mechanism concerns the sectoral allocation of government spending. [Figure 9](#) presents varying coefficient estimates by expenditure shares in health and military sectors. Health spending exhibits income-dependent effects: in developing economies, it tends to support growth – likely reflecting gaps in infrastructure and access – whereas in high-income countries, its marginal effects are negative, suggesting diminishing returns. These results support [Devarajan et al. \(1996\)](#), who argue that the composition of spending shapes its productivity, and further highlight that the growth effects of government expenditure vary substantially across income levels in our cross-country framework. Military expenditure, in contrast, is consistently associated with negative growth effects, particularly in developed economies. Our results reinforce the findings of [d’Agostino et al. \(2016\)](#), who document a negative link between military spending and growth under poor governance, but go further by highlighting income-specific nonlinearities. Taken together, these findings indicate that sectoral efficiency is determined not solely by the nature of public expenditure, but also by the broader institutional and developmental context of a given country. In alignment with this perspective, [Antolin-Diaz and Surico \(2025\)](#) present long-horizon evidence from US data, demonstrating that reallocating government spending toward public research and development leads to sustained improvements in productivity and output, whereas increased public consumption expenditure yields, at best, modest long-term effects. These results

underscore the critical role of expenditure composition in influencing long-run growth trajectories.

The third mechanism is the level of economic development itself. Both the threshold and varying coefficient models show that the adverse effects of government consumption intensify with income. In lower-income countries, public spending often supports productive investment in infrastructure, education and health – sectors underprovided by markets. This is consistent with Barro (1990), who underscores the productive role of government in early development stages, and with Aydin and Esen (2019) and Akram and Rath (2020), who find that optimal government size depends on development stage and regional context. In contrast, in high-income countries where the state is already large, further expansion can lead to crowding out, bureaucratic inefficiencies and reduced incentives for private initiative, consistent with findings by Guseh (1997) and Fölster and Henrekson (2001). Our study contributes to this literature in three ways. First, we show that the marginal effects of government consumption vary systematically with institutional quality, reflecting deeper governance-capacity dynamics. Second, we demonstrate that expenditure composition, particularly in health and military sectors, plays a key role in determining the growth effects of public spending. Third, we use a complementary empirical strategy that integrates threshold and semiparametric models, providing a flexible framework to capture nonlinearities and cross-country heterogeneity. These findings deepen our understanding of how public spending influences growth and offer a data-driven foundation for designing fiscal policy aligned with institutional capacity and stages of development.

The results point to actionable fiscal strategies that vary by a country's level of development and institutional capacity. In advanced economies, where public spending already comprises a substantial share of GDP, further increases tend to hinder growth. Rather than cutting spending indiscriminately, governments should shift expenditures away from inefficient areas, such as excessive defense budgets, toward innovation, education and climate resilience. Strengthening fiscal performance through digitalization, results-based budgeting and spending reviews can enhance impact. In developing economies, scaling up government consumption can support growth, particularly when focused on infrastructure, health and education, but only up to a point. Once spending surpasses roughly 6% of GDP, additional gains are unlikely without institutional reforms that improve governance, curb corruption and ensure accountability. The evidence highlights the importance of country-specific fiscal planning. Policymakers should adopt adaptive frameworks incorporating continuous diagnostics and flexible tools, such as nonparametric methods, to identify shifting thresholds and realign spending with development priorities. By integrating adaptive diagnostics and prioritizing institutional reforms, governments can strike a balance: advanced economies optimize existing spending, while developing nations scale investments strategically. When aligned with the development stage and governance capacity, fiscal policy becomes a precision tool for sustainable growth.

7. Conclusion

This paper provides new evidence on the nonlinear and heterogeneous relationship between government consumption and economic growth, using a flexible empirical framework that combines threshold and semiparametric varying coefficient models. By uncovering how the marginal effects of public spending vary with governance quality, sectoral composition and development stage, the analysis challenges the notion of a one-size-fits-all fiscal policy and underscores the importance of country-specific strategies. These results carry distinct implications for fiscal policy design. While developing countries may benefit from scaled-up public spending – particularly when directed toward infrastructure and essential services –

advanced economies must focus on optimizing existing expenditures and improving efficiency. Across all contexts, aligning government consumption with institutional capacity and developmental needs is key to ensuring growth-enhancing outcomes.

As with any cross-country analysis, some limitations remain. Our estimates rely on available data, and while the methodology accounts for endogeneity and nonlinearity, unobserved factors such as political dynamics or implementation constraints may still influence outcomes. Importantly, these mechanisms are interrelated. Institutional quality may condition the effectiveness of sectoral spending, while development level may influence institutional capacity and fiscal needs. Other omitted channels—such as fiscal rules, macroeconomic volatility or political incentives—may also shape outcomes and warrant further research.

Acknowledgements

The authors thank the Editor, Niklas Wagner, and two anonymous referees for their insightful and constructive comments and suggestions, which substantially improved the quality of this paper.

Notes

- [1.] Related work also documents nonlinear effects of institutional quality on economic growth. [Karagiannis and Paleologou \(2025\)](#) identify a non-monotonic relationship between governance quality and growth, indicating that the returns to institutional improvements depend on the prevailing governance regime.
- [2.] The role of institutional quality has also been emphasized; for instance, [Sidek \(2021\)](#) finds that government expenditure can reduce inequality, although the effects vary between developed and developing economies.
- [3.] Following [Khan and Ssnhadji \(2001\)](#), we apply a semi-log transformation to inflation: $\pi_{it}^* = \pi_{it} - 1$ if $\pi_{it} \leq 1\%$, and $\pi_{it}^* = \ln(\pi_{it})$ if $\pi_{it} > 1\%$. This transformation, widely adopted in the inflation-growth literature, helps mitigate the influence of extreme inflation values – particularly those observed in some developing countries – by reducing cross-sectional heteroskedasticity while preserving continuity in the data.
- [4.] For details of the grid search algorithm see [Seo and Shin \(2016\)](#).
- [5.] We trim 5% of the observations from top and bottom. We also estimate the threshold model by trimming 10% and 15% and find that threshold estimate is robust to trimming percentage.
- [6.] The approximation functions have the property that as K gets larger, there is a linear combination of the basis functions that can approximate any smooth function arbitrarily well.
- [7.] A typical element of P equals $Gov'_{it}p^K(Gov_{it}) - Gov'_{it-1}p^K(Gov_{it-1})$.
- [8.] Varying coefficient models have been extensively studied in the literature and are used widely in economics. [Cai and Li \(2008\)](#) examines the nonparametric estimation of varying coefficient panel data models with endogenous regressors. [Su et al. \(2013\)](#) study the GMM estimation of varying coefficient models with a mix of discrete and continuous data. [Yonghong et al. \(2016\)](#), [Feng et al. \(2017\)](#) and [Zhang and Zhou \(2021\)](#) consider the varying coefficient panel data models with fixed effects. [Su et al. \(2013\)](#), for instance, look into the wage equation and find that the coefficient of education changes with experience. The effect of FDI on economic growth at various initial income levels is examined by [Kottaridi and Stengos \(2010\)](#).
- [9.] The exclusion restriction is theoretically justified: The second lag of GDP growth is expected to be correlated with the lagged dependent variable but uncorrelated with the first-differenced error term once fixed effects are removed. This identification strategy is consistent with the

moment conditions outlined in [Roodman \(2009\)](#) and underpins the use of lagged levels as valid instruments. To assess the strength of our instrument, we estimate a corresponding two-stage least squares specification and obtain a first-stage F-statistic of 24.14 (p-value=0.000), which confirms that the second lag of GDP growth is relevant and strongly correlated with the endogenous regressor, alleviating concerns of weak instrument bias. For robustness and validation of instrument exogeneity, we extend the instrument set to include both the second and third lags of GDP growth. The residual test for second-order serial correlation yields a p-value of 0.443, indicating no evidence of autocorrelation in the differenced residuals, thereby supporting the validity of using lagged levels of GDP growth as instruments. Furthermore, the Hansen J test of overidentifying restrictions reports a p-value of 0.990, suggesting that the instruments are jointly exogenous and appropriately excluded from the structural equation. While specifications including both the second and third lags yield qualitatively similar results, we opt to retain only the second lag of GDP growth as our instrument in the final model to mitigate concerns about instrument proliferation potentially weakening the Hansen test, as cautioned in the literature.

- [10.] [Appendix](#) provides a detailed list of the countries included in our analysis.
- [11.] The averages are taken for the following years: 1980–1984, 1985–1989, 1990–1994, 1995–1999, 2000–2004, 2005–2009, 2010–2014, and 2015–2019.
- [12.] Several factors may explain this sign reversal. First, System GMM is prone to downward bias in small samples, especially when the time dimension is short; if the true effect of human capital is weakly positive, this method may underestimate it, and bias correction can lift the estimate into positive territory. Second, dynamic panel models are susceptible to Nickell bias due to the inclusion of lagged dependent variables—a bias that System GMM reduces but does not fully eliminate—whereas bias-corrected estimators are specifically designed to account for this distortion, potentially altering the estimated sign of the coefficient. Lastly, model misspecification—due to missing variables or overlooked nonlinear relationships—can cause divergence across estimators. Notably, when additional controls are incorporated in our robustness analysis—such as indicators for global financial crises, measures of financial development, and a quadratic specification for government size—the significance of human capital disappears.
- [13.] We calculated the point estimates of the smooth function and their corresponding standard errors at each value of government consumption. Our findings indicate that the marginal effect of government consumption becomes insignificant after 10.05%, consistent with our threshold regression estimates that show government size is not significant above an 10.26% threshold. [Table 7](#).
- [14.] We do not present the full table of varying coefficient estimates or the separate figures for developing and developed countries here to conserve space; however, the complete set of results is available upon request.
- [15.] We are grateful to an anonymous referee for suggesting this avenue of analysis.

References

- Akram, V. and Rath, B.N. (2020), “Optimum government size and economic growth in case of Indian states: evidence from panel threshold model”, *Economic Modelling*, Vol. 88, pp. 151–162.
- Alesina, A. and Angeletos, G.-M. (2005), “Corruption, inequality, and fairness”, *Journal of Monetary Economics*, Vol. 52 No. 7, pp. 1227–1244.
- Antolin-Diaz, J. and Surico, P. (2025), “The long-run effects of government spending”, *American Economic Review*, Vol. 115 No. 7, pp. 2376–2413.
- Asimakopoulous, S. and Karavias, Y. (2016), “The impact of government size on economic growth: a threshold analysis”, *Economics Letters*, Vol. 139, pp. 65–68.

- Aydin, C. and Esen, Ö. (2019), "Does too much government spending depress the economic development of transition economies? Evidences from dynamic panel threshold analysis", *Applied Economics*, Vol. 51 No. 15, pp. 1666-1678.
- Balcilar, M., Gupta, R., Ma, W. and Makena, P. (2021), "Income inequality and economic growth: a re-examination of theory and evidence", *Review of Development Economics*, Vol. 25 No. 2, pp. 737-757.
- Barro, R.J. (1990), "Government spending in a simple model of endogenous growth", *Journal of Political Economy*, Vol. 98 No. 5, Part 2, pp. S103-S125.
- Blundell, R. and Bond, S. (1998), "Initial conditions and moment restrictions in dynamic panel data models", *Journal of Econometrics*, Vol. 87 No. 1, pp. 115-143.
- Bose, N., Haque, M.E. and Osborn, D.R. (2007), "Public expenditure and economic growth: a disaggregated analysis for developing countries", *The Manchester School*, Vol. 75 No. 5, pp. 533-556.
- Bruno, G.S. (2005), "Estimation and inference in dynamic unbalanced panel-data models with a small number of individuals", *The Stata Journal: Promoting Communications on Statistics and Stata*, Vol. 5 No. 4, pp. 473-500.
- Bun, M.J. and Kiviet, J.F. (2003), "On the diminishing returns of higher-order terms in asymptotic expansions of bias", *Economics Letters*, Vol. 79 No. 2, pp. 145-152.
- Buthlezi, E.M. (2023), "Impact of government expenditure on economic growth in different states in South Africa", *Cogent Economics and Finance*, Vol. 11 No. 1, p. 2209959.
- Cai, Z., Chen, L. and Fang, Y. (2018), "A semiparametric quantile panel data model with an application to estimating the growth effect of FDI", *Journal of Econometrics*, Vol. 206 No. 2, pp. 531-553.
- Cai, Z. and Li, Q. (2008), "Nonparametric estimation of varying coefficient dynamic panel data models", *Econometric Theory*, Vol. 24 No. 5, pp. 1321-1342.
- Capasso, S. and Santoro, L. (2025), "Corruption and economic growth: greasing the wheels or sanding the gears? Evidence from Italian regions", *Journal of Policy Modeling*, Vol. 47 No. 6.
- Chen, S.-T. and Lee, C.-C. (2005), "Government size and economic growth in Taiwan: a threshold regression approach", *Journal of Policy Modeling*, Vol. 27 No. 9, pp. 1051-1066.
- Dar, A.A. and AmirKhalkhali, S. (2002), "Government size, factor accumulation, and economic growth: evidence from OECD countries", *Journal of Policy Modeling*, Vol. 24 Nos 7-8, pp. 679-692.
- Devarajan, S., Swaroop, V. and Zou, H-F (1996), "The composition of public expenditure and economic growth", *Journal of Monetary Economics*, Vol. 37 No. 2, pp. 313-344.
- Durlauf, S.N. and Johnson, P.A. (1995), "Multiple regimes and cross-country growth behaviour", *Journal of Applied Econometrics*, Vol. 10 No. 4, pp. 365-384.
- Durlauf, S.N., Kourtellos, A. and Minkin, A. (2001), "The local solow growth model", *European Economic Review*, Vol. 45 Nos 4-6, pp. 928-940.
- Dzhumashev, R. (2014), "Corruption and growth: the role of governance, public spending, and economic development", *Economic Modelling*, Vol. 37, pp. 202-215.
- d'Agostino, G., Dunne, J.P. and Pieroni, L. (2016), "Government spending, corruption and economic growth", *World Development*, Vol. 84, pp. 190-205.
- Feng, G., Gao, J., Peng, B. and Zhang, X. (2017), "A varying-coefficient panel data model with fixed effects: theory and an application to US commercial banks", *Journal of Econometrics*, Vol. 196 No. 1, pp. 68-82.
- Fölster, S. and Henrekson, M. (2001), "Growth effects of government expenditure and taxation in rich countries", *European Economic Review*, Vol. 45 No. 8, pp. 1501-1520.
- Guseh, J.S. (1997), "Government size and economic growth in developing countries: a political-economy framework", *Journal of Macroeconomics*, Vol. 19 No. 1, pp. 175-192.
- Hansen, B.E. (1999), "Threshold effects in non-dynamic panels: estimation, testing, and inference", *Journal of Econometrics*, Vol. 93 No. 2, pp. 345-368.

- Hansen, B.E. (2000), "Sample splitting and threshold estimation", *Econometrica*, Vol. 68 No. 3, pp. 575-603.
- Henderson, D.J., Qian, J. and Wang, L. (2015), "The inequality-growth Plateau", *Economics Letters*, Vol. 128, pp. 17-20.
- Karagiannis, G. and Paleologou, S.-M. (2025), "Governance and economic growth in Africa: evidence from linear, nonlinear and dynamic panel analysis", *Empirical Economics*, Vol. 69 No. 1, pp. 1-37.
- Khan, M.S. and Ssnhadji, A.S. (2001), "Threshold effects in the relationship between inflation and growth", *IMF Staff Papers*, Vol. 48 No. 1, pp. 1-21.
- Kim, D.-H., Wu, Y.-C. and Lin, S.-C. (2018), "Heterogeneity in the effects of government size and governance on economic growth", *Economic Modelling*, Vol. 68, pp. 205-216.
- Kiviet, J.F. (1995), "On bias, inconsistency, and efficiency of various estimators in dynamic panel data models", *Journal of Econometrics*, Vol. 68 No. 1, pp. 53-78.
- Kormendi, R.C. and Meguire, P. (1986), "Government debt, government spending, and private sector behavior: reply", *The American Economic Review*, Vol. 76, pp. 1180-1187.
- Kottaridi, C. and Stengos, T. (2010), "Foreign direct investment, human capital and non-linearities in economic growth", *Journal of Macroeconomics*, Vol. 32 No. 3, pp. 858-871.
- Liu, Z. and Stengos, T. (1999), "Non-linearities in cross-country growth regressions: a semiparametric approach", *Journal of Applied Econometrics*, Vol. 14 No. 5, pp. 527-538.
- Maasoumi, E., Racine, J. and Stengos, T. (2007), "Growth and convergence: a profile of distribution dynamics and mobility", *Journal of Econometrics*, Vol. 136 No. 2, pp. 483-508.
- Masanjala, W.H. and Papageorgiou, C. (2004), "The solow model with CES technology: nonlinearities and parameter heterogeneity", *Journal of Applied Econometrics*, Vol. 19 No. 2, pp. 171-201.
- Matousek, R. and Tzeremes, N.G. (2021), "The asymmetric impact of human capital on economic growth", *Empirical Economics*, Vol. 60 No. 3, pp. 1309-1334.
- Mohd Daud, S.N., Ghazali, N.S. and Mohammad Ismail, N.H. (2024), "ESG, innovation, and economic growth: an empirical evidence", *Studies in Economics and Finance*, Vol. 41 No. 4, pp. 845-870.
- Newey, W.K. and Windmeijer, F. (2009), "Generalized method of moments with many weak moment conditions", *Econometrica*, Vol. 77, pp. 687-719.
- Nugraha, D.A. and Safuan, S. (2025), "Information and communication technologies, financial inclusion and economic growth: evidence from high-and low-income countries", *Studies in Economics and Finance*, Vol. 42 No. 2, pp. 327-351.
- Okui, R. (2009), "The optimal choice of moments in dynamic panel data models", *Journal of Econometrics*, Vol. 151 No. 1, pp. 1-16.
- Olaoye, O.O., Eluwole, O.O., Ayesha, A. and Afolabi, O.O. (2020), "Government spending and economic growth in ECOWAS: an asymmetric analysis", *The Journal of Economic Asymmetries*, Vol. 22, p. e00180.
- Ono, H. (2014), "The government expenditure-economic growth relation in Japan: an analysis by using the ADL test for threshold cointegration", *Applied Economics*, Vol. 46 No. 28, pp. 3523-3531.
- Ram, R. (1986), "Government size and economic growth: a new framework and some evidence from cross-section and time-series data", *The American Economic Review*, Vol. 76, pp. 191-203.
- Ren, X., Tong, Z., Sun, X. and Yan, C. (2022), "Dynamic impacts of energy consumption on economic growth in China: evidence from a non-parametric panel data model", *Energy Economics*, Vol. 107, p. 105855.
- Roodman, D. (2009), "A note on the theme of too many instruments", *Oxford Bulletin of Economics and Statistics*, Vol. 71 No. 1, pp. 135-158.
- Sama, M.C., Oumar, S.B. and Ndam, N.L. (2025), "Public spending and sustainable economic development", *Studies in Economics and Finance*, Vol. 42 No. 2, pp. 218-239.

- Schaltegger, C.A. and Torgler, B. (2006), "Growth effects of public expenditure on the state and local level: evidence from a sample of rich governments", *Applied Economics*, Vol. 38 No. 10, pp. 1181-1192.
- Seo, M.H. and Shin, Y. (2016), "Dynamic panels with threshold effect and endogeneity", *Journal of Econometrics*, Vol. 195 No. 2, pp. 169-186.
- Sidek, N.Z.M. (2021), "Do government expenditure reduce income inequality: evidence from developing and developed countries", *Studies in Economics and Finance*, Vol. 38 No. 2, pp. 447-503.
- Su, L., Murtazashvili, I. and Ullah, A. (2013), "Local linear GMM estimation of functional coefficient IV models with an application to estimating the rate of return to schooling", *Journal of Business and Economic Statistics*, Vol. 31 No. 2, pp. 184-207.
- Vedder, R.K. and Gallaway, L.E. (1998), *Government Size and Economic Growth*, The Committee.
- Yonghong, A., Cheng, H. and Dong, L. (2016), "Semiparametric estimation of partially linear varying coefficient panel data models", in *Essays in Honor of Aman Ullah*, Emerald Group Publishing, pp. 47-65.
- Zhang, Y. and Zhou, Q. (2021), "Partially linear functional-coefficient dynamic panel data models: sieve estimation and specification testing", *Econometric Reviews*, Vol. 40 No. 10, pp. 983-1006.
- Zhang, Y-F. and Sun, K. (2019), "How does infrastructure affect economic growth? Insights from a semiparametric smooth coefficient approach and the case of telecommunications in China", *Economic Inquiry*, Vol. 57 No. 3, pp. 1239-1255.
- Zouaoui, H., Mazioud, M. and Ellouz, N.Z. (2018), "A semi-parametric panel data analysis on financial development-economic volatility nexus in developing countries", *Economics Letters*, Vol. 172, pp. 50-55.

Table A1. List of countries

Developing countries

Algeria	Belize	Bhutan	Bolivia
Botswana	Brazil	Burkina Faso	Burundi
Cameroon	Central African Republic	Chad	Colombia
Costa Rica	Dominican Republic	Ecuador	Egypt, Arab Rep.
El Salvador	Eswatini	Fiji	Gabon
Gambia, The	Ghana	Guatemala	Honduras
India	Indonesia	Iran, Islamic Rep.	Jamaica
Jordan	Kenya	Madagascar	Malaysia
Mauritius	Mexico	Morocco	Nepal
Niger	Nigeria	Pakistan	Panama
Peru	Philippines	Rwanda	Senegal
South Africa	Sudan	Thailand	Togo
Tonga	Tunisia	Turkiye	Vanuatu

Developed countries

Australia	Austria	Bahamas, The	Bahrain
Barbados	Belgium	Canada	Chile
Cyprus	Denmark	Finland	France
Germany	Greece	Hong Kong SAR, China	Ireland
Italy	Japan	Korea, Rep.	Luxembourg
Malta	Netherlands	New Zealand	Norway
Portugal	Saudi Arabia	Seychelles	Singapore
Spain	Sweden	Switzerland	United Kingdom
United States	Uruguay		

Source(s): Authors' own work**Corresponding author**Deniz Baglan can be contacted at: deniz.baglan@howard.edu