Differential Growth Effects of Different Types of Government Expenditures

Reina Kawai Eskimez
World Bank

and

Stephen J. Turnovsky
University of Washington

Efficient fiscal spending is essential for fostering long-run growth, yet the precise fiscal conditions that enable such growth remain unexplored. To address this issue in a general framework, we construct an endogenous growth model. Then, utilizing data from 163 countries from 1980–2019, this study introduces a structured framework to analyze government expenditure and growth determinants. By addressing model uncertainty and endogeneity, we find that public investment stimulates growth regardless of the fiscal origins of income taxes or public debt—provided these levels are not excessively high. This growth effect is mainly driven by emerging markets and developing economies (EMDEs). Conversely, the impact of government consumption on growth is mixed, regardless of fiscal revenues.

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I) Introduction

The relationship between fiscal policy and economic growth has been a cornerstone of macroeconomic theory and policy debate. Fiscal policy plays a pivotal role in shaping the trajectory of an economy (Afonso et al., 2005; Afonso and Jalles, 2014; Ramey and Zubairy, 2018). This paper explores long-run growth dynamics to analyze the channels through which fiscal policy influences growth on long-run equilibrium. In particular, we address two questions in this paper: (1) How will different types of government expenditures impact long-run growth? And (2) How will this impact differ depending on the level of public debt, income tax, and economic development?

Our analysis uses a dataset covering 163 countries from 1980 to 2019, incorporating key fiscal variables: public debt, labor income tax, public investment, and government consumption. Employing Ordinary Least Squares (OLS) and addressing model uncertainty and endogeneity through Instrumental Variable Bayesian Model Averaging (IVBMA), we analyze the relationship between fiscal policy and long-term growth.

We found that public investment consistently spurs growth, driven by EMDEs, provided public debt and income tax levels remain moderate. In contrast, the impact of government consumption on growth is mixed, irrespective of fiscal revenue sources.

Importantly, our findings highlight the role of EMDEs, where public investment has a significant impact: a 1% increase in public investment raises EMDEs' growth rate by over 0.1 percentage points more than non-EMDEs. Our empirical models align with neoclassical and new growth theories, emphasizing determinants such as initial GDP, population growth, and public investment, alongside additional influences like religious fractionalization, regional characteristics, fertility, and inflation.

The remainder of this paper is structured as follows: Section II illustrates the literature review, followed by a summary of the canonical model and equilibrium changes in Section III. Section IV describes the data and methodology, while Section V discusses our empirical findings. Finally, Section VI concludes. The Appendix presents a detailed description of the data and robustness checks.

II) Related Literature

To examine the long-run relationship between fiscal spending and economic growth, this paper first applies Ordinary Least Squares (OLS) estimation, followed by addressing model uncertainty and endogeneity through Instrumental Variable Bayesian Model Averaging (IVBMA). This approach is based on the extensive literature on long-run growth models (Hall and Jones, 1999; Durlauf, Kourtellos, and Tan, 2008; Eicher et al., 2009; Henderson, Papageorgiou, and Parmeter, 2012; Eicher and Kuenzel, 2016). Multiplicative interaction terms are then used to understand the historical fiscal co-movements (Wright, 1976; Hastie and Tibshirani, 1987; Brambor et al., 2006; Hainmueller et al., 2020). Despite extensive research on long-run growth, studies explicitly exploring fiscal instruments' co-movement with growth under varying conditions remain limited.

Aizenman et al. (2007) analyzed the effects of income tax, public debt, public investment, and government consumption on growth using a non-stochastic CRS endogenous growth model and system GMM estimates. They advised against excessive debt in developing countries due to its negative impact on welfare and growth. Nelson and Phillips (2021) supported this conclusion with an overlapping-generations (OLG) model, but they did not address tax-financed public investment and tax-financed government consumption explicitly.

Empirical studies often focus on total government expenditure, overlooking its components' impact on growth. Many studies using GMM or fixed-effects regressions report a negative relationship between total government expenditure and growth (Miller and Russek, 1997; Bellettini and Ceroni, 2000; Afonso and Jalles, 2013). While Agell et al. (2006) found no significant relationship when controlling for simultaneity and sample selection bias. These mixed findings signal the importance of exploring the impact of spending components on growth.

Public investment generally yields positive medium- to long-term output effects, based on growth regressions (Romero-Avila and Strauch, 2008; Chen et al., 2017), Bayesian Model Averaging (León-González and Montolio, 2004; Arin et al., 2019), and the Local Projections approach (Furceri and Li, 2017; Abiad et al., 2016).

On the aspect of government consumption, the effect on growth in literature is generally mixed; government consumption may negatively affect growth (Miller and Russek, 1997; Bellettini and Ceroni, 2000; Afonso and Jalles, 2013), while looking at the short to medium run growth impact, Duval and Furceri (2018) and Abiad et al. (2016) found a positive government consumption-growth nexus for Advanced Economies, highlighting efficacy of fiscal multipliers focusing on short to medium run relations. While the importance of fiscal policy was discussed in the context of government consumption, Gechert (2015) found mixed findings in the literature based on meta-analysis.

Literature suggests that the level of economic development may also influence the growth impact of government spending (Aizenman et al., 2007; Romero-Avila and Strauch, 2008; Abiad et al., 2016). We examine this relationship and confirm that EMDEs generally have greater potential for growth when fiscal revenue is allocated to public investment. Specifically, a 1% increase in public investment raises the growth rate in EMDEs by over 0.1 percentage points more than in non-EMDEs.

III) A Canonical Model of Fiscal Policy and Balanced Growth

In this section, we present a small model the purpose of which is to identify the channels whereby the different fiscal instruments impact the growth rate. The model is adapted from Bruce and Turnovsky (1999), which itself is a modification of the basic Barro (1990) model of endogenous growth.

We consider an economy in which output, Y, is determined according to a simple Cobb-Douglas technology of the form

$$Y = \alpha G_P^{\beta} K^{1-\beta} \equiv \alpha (G_P / K)^{\beta} K \qquad 0 \le \beta \le 1 \qquad (1)$$

where K denotes the private capital stock, assumed to be infinitely durable, and G_P denotes the flow of services from government spending on the economy's infrastructure. Although the firm faces diminishing returns to the accumulation of its private capital stock, the overall technology is linearly homogeneous in the two factors of production taken together. This permits an equilibrium in which the economy follows a path of ongoing endogenous growth.

The economy is populated by an infinitely lived representative agent who maximizes the intertemporal isoelastic utility function:

$$U \equiv \int_0^{\infty} \frac{1}{\gamma} \left(C G_C^{\eta} K^{\theta} \right)^{\gamma} e^{-\rho t} dt \qquad -\infty < \gamma < 1,\ \eta > 0,\ \theta > 0,\ 1 > \gamma(1+\eta+\theta) \qquad (2)$$

where C denotes private consumption, G_C denotes the consumption services of a government-provided public good, and the parameter η measures the impact of public consumption on the welfare of the private agent. We assume that both private and public consumption yield positive marginal utility, so that $\eta > 0$. In addition, we assume that the household derives utility from its wealth, K. This term was first introduced into the utility function by Kurz (1968) and subsequently by Zou (1994) and others in their analysis of the "spirit of capitalism". Our reason for doing so is to demonstrate that it is the only channel whereby government consumption impacts the equilibrium growth rate. The parameter γ is related to the intertemporal elasticity of substitution (IES), s say, by $s = 1/(1-\gamma)$. The remaining constraints on the coefficients appearing in (2) are required to ensure that the utility function is concave in the quantities C, G_C, K.

At any point in time the household faces the flow budget constraint

$$\dot{K} + \dot{B} = (1-\tau)(rB + Y) - C - T \qquad (3)$$

where B denotes the value of government bonds held by the household and r denotes the real rate of on government bonds. The government taxes income at the rate τ. We also allow for a lump-sum tax (transfer if negative) denoted by T. This tax plays the role of a "balancing item" in our analysis and we do not relate it to any existing part of the government tax structure. All the variables, except for the two taxes, are time dependent, although for notational convenience, the time notation is suppressed. Finally, a dot indicates a time derivative.

The household chooses the time path for consumption, and the accumulation of capital and government bonds, so as to maximize its intertemporal utility function, (2), subject to the production function, (1), and its flow budget constraint, (3). In performing this optimization, all government fiscal variables, tax rates as well as expenditure levels, are taken as given.

The agent's optimality conditions can be expressed as:

$$C^{\gamma-1}G_C^{\eta\gamma}K^{\theta\gamma}=\lambda \tag{4a}$$

$$r(1-\tau)=\theta\left(C/K\right)+\alpha(1-\beta)(1-\tau)\left(G_P/K\right)^{\beta}=\rho-\dot{\lambda}/\lambda \tag{4b}$$

where λ is the marginal utility of wealth. The first condition equates the marginal utility of consumption to the tax-adjusted marginal utility of wealth. The second condition equates the after-tax rate of return on savings, either in the form of bonds or physical capital, to the rate of return on consumption, in accordance with the Keynes-Ramsey consumption rule. In addition, the following transversality conditions must hold:

$$\lim_{t\to\infty}\lambda Be^{-\rho t}=\lim_{t\to\infty}\lambda Ke^{-\rho t}=0 \tag{4c}$$

Taking the time derivative of (4a) and combining with (4b), leads to the growth relationship

$$(\gamma-1)\frac{\dot{C}}{C}+\eta\gamma\frac{\dot{G}_C}{G_C}+\theta\gamma\frac{\dot{K}}{K}=\rho-r(1-\tau) \tag{5a}$$

while taking the first equality in (4b) implies that the interest rate is determined by

$$r=\frac{\theta\left(C/K\right)}{1-\tau}+\alpha(1-\beta)\left(G_P/K\right)^{\beta} \tag{5b}$$

Thus, as the ratio of government infrastructure per unit of capital increases, rendering capital more productive, the equilibrium interest rate must rise. Also, to the extent that capital enhances utility, the interest rate must adjust to reflect that.

Balanced Growth

To see the role of the various fiscal instruments, we restrict our attention to fiscal policies that are consistent with a balanced growth equilibrium. Thus, we assume that the income tax rate is constant over time, and that government consumption and infrastructure, though taken as given at any point in time by the household, grow at the same constant rate as output. Specifically, the government is assumed to set its expenditures as constant spending ratios, $G_C=g_CY$ and $G_P=g_PY$, where $0<g_C,g_P<1$ are constants through time, so

$$\frac{\dot{Y}}{Y}=\frac{\dot{K}}{K}=\frac{\dot{B}}{B}=\frac{\dot{C}}{C}=\frac{\dot{G}_C}{G_C}=\frac{\dot{G}_P}{G_P}\equiv\phi \tag{6}$$

denotes the balanced growth rate at which all real quantities grow. Combining this relationship with (5a) immediately yields the following expression for the equilibrium growth rate:

$$\phi = \frac{r(1-\tau)-\rho}{1-\gamma(1+\eta+\theta)} \tag{7}$$

Also, we can use the aggregate production function to express $G_P/K = (\alpha g_P)^{1/(1-\beta)}$ and substitute in (1) and (5b) to express output and the interest rate in the form

$$\frac{Y}{K} = (\alpha g_P^{\beta})^{1/(1-\beta)} \tag{1'}$$

$$r(1-\tau) = \theta\left(C/K\right) + (1-\beta)(1-\tau)(\alpha g_P^{\beta})^{1/(1-\beta)} \tag{5b'}$$

which, with the spending share constant over time, also remains constant. Finally, dividing the economy-wide resource constraint, $Y = C + G_C + G_P + \dot{K}$, by *K*, we can solve for the constant ratio of consumption to capital in the form:

$$\frac{C}{K} = (1-g_C-g_P)(\alpha g_P^{\beta})^{1/(1-\beta)} - \phi \tag{8}$$

Substituting into (5b'):

$$r(1-\tau) = \theta\left((1-g_C-g_P)(\alpha g_P^{\beta})^{1/(1-\beta)} - \phi\right) + (1-\beta)(1-\tau)(\alpha g_P^{\beta})^{1/(1-\beta)}$$

and hence, the equilibrium growth rate is

$$\phi = \frac{[\theta(1-g_C-g_P)+(1-\beta)(1-\tau)]\left(\alpha g_P^{\beta}\right)^{1/(1-\beta)} - \rho}{1-\gamma(1+\eta+\theta)+\theta} \tag{9}$$

The following conclusions regarding fiscal policy can be drawn immediately. These are partial effects and are based on the assumption that the fiscal shock is financed either by lump-sum taxation or by issuing more debt:

(i) An increase in the income tax rate raises the private consumption ratio and reduces the growth rate.

(ii) If $\theta > 0$ an increase in the government consumption ratio reduces the growth rate. In most endogenous growth models, $\theta = 0$ in which case government consumption has no effect on the growth rate (see Eaton, 1981). On the other hand, some growth models introduce elastic labor supply, in which case they find that an increase in government consumption increases the growth rate.

(iii) An increase in the fraction of output spent by the government on infrastructure raises both the real interest rate and the growth rate unless it is too large (Barro, 1990).

The model is more general than much of this literature in that we extend the range of fiscal instruments available to the policy maker, thus permitting a more general treatment of fiscal issues. This accounts for differences in some of the results from those obtained in the literature. For example, by assuming that, Barro (1990) identifies two offsetting effects of increased government expenditure on infrastructure on the growth rate. With our more general fiscal specification, these are now decomposed into two components, the negative income tax effect in (i) and the positive productivity effect in (iv). On the other hand, the invariance of the growth rate with respect to a bond-financed increase in government consumption expenditure is familiar from early work by Eaton (1981).

Before proceeding further with the analysis two limitations of the model should be noted. First, like Barro (1990), Rebelo (1991), Ireland (1994) we assume that labor is supplied inelastically. This assumption is important in that it implies the neutrality of the consumption tax, noted in (iii) above. An important reason for assuming an inelastic labor supply is to eliminate the static source of supply side effects of tax cuts and focus purely on the dynamic growth effects. Some implications of endogenizing labor supply will be noted in our conclusions. A second assumption of the model is that it assumes complete compliance with the tax code. This ignores the fact that one margin along which agents respond to changes in tax rates is in the resources they devote to tax avoidance activities; see e.g. Cremer and Gahvari (1993), Fullerton and Karayannis (1994). Both of these effects could modify our results and should be kept in mind when considering them.

IV) Empirical Methodology

IV.1) Data

Our dataset comprises 163 countries from 1980 to 2019. Four fiscal data—public debt to GDP ratio, labor income tax to GDP ratio, public investment to GDP ratio, and government consumption to GDP ratio—are collected from the World Economic Outlook (2023 October). Missing values were then filled in using the World Revenue Longitudinal Database (IMF, 2024) and the OECD.

For long-run growth determinants, data was obtained from existing studies (Durlauf, Kourtellos, and Tan, 2008; Henderson, Papageorgiou, and Parmeter, 2012; Eicher and Kuenzel, 2016). Based on their variable selection on Barro (2003) and Eicher and Kuenzel (2016), we included proxies for six growth theories: (i) neoclassical growth theory, using initial real GDP per capita, population growth, public investment, and education, instrumented with one-period lagged values; (ii) demographic change, using life expectancy and fertility; (iii) macroeconomic policies, using government consumption, openness, and average changes in the CPI, also instrumented with lagged values; (iv) geography, using regional continents data; (v) institutions, using the law and order, with dummy variables for English and French legal origins, ethnic fractionalization, and lagged values of law and order as instruments; and (vi) religion, using the share of major religions (Eastern, Hindu, Jewish, Muslim, Orthodox, Protestant, and others) in 1900 as instruments for current religious shares. Exact definitions and sources for each variable are provided in Appendix X.

IV.2) Model Uncertainty and Endogeneity:

The Instrumental Variable Bayesian Model Averaging (IVBMA) estimation method addresses issues of model uncertainty and potential endogeneity. By comparing Ordinary Least Squares (OLS) estimates with IVBMA results, we can evaluate the degree of bias present and derive the robustness of results. This dual-method strategy facilitates a more rigorous analysis of the relationship between fiscal variables and economic growth.

We outline the IVBMA, following Eicher et al. (2009) and Eicher and Kuenzel (2016), which combine model uncertainty and endogeneity into a unified framework. Karl and Lenkoski (2012) also explored based on Gibbs sampler of Rossi, Allenby, and McCulloch (2006) for instrumental variables models and uses conditional Bayes factors to account for model uncertainty in this Gibbs algorithm. The method operates in two stages: first, by identifying suitable instrumental variables, and second, by estimating the structural relationships within the model.

Model Framework:

In the first stage, to identify instruments (z) for the endogenous variables (w):

$$w = z\theta + x\beta + \eta,$$

where w is an endogenous variable, z are instruments, x are exogenous covariates, and η is the error term. The posterior probability for each model (M_i) is calculated as:

$$P(M_i \mid D) \propto P(D \mid M_i)\, P(M_i)$$

where $P(M_i \mid D)$ is the posterior probability of model M_i, showing how likely model M_i is, given

the data D. The data, D, includes the observed values of y, x, and z. $P(D \mid M_i)$ is the marginal likelihood of the data under model M_i to explain how well M_i explains D, and lastly, $P(M_i)$ is the prior probability of model M_i, reflecting beliefs about the plausibility of M_i before observing D.

In the second stage, to estimate the structural model using the predicted values ($\hat{w}$) from the first stage:

$$y = x\gamma + \hat{w}\lambda + \varepsilon,$$

where y is the dependent variable, which is real GDP growth in our case, x is the same exogenous covariates defined in the first stage, $\hat{w}$ is the predicted values of the endogenous variable, obtained using the instruments (z), and ε is the error term. γ and λ are the respective coefficients for x and $\hat{w}$.

Weighted posterior estimates are obtained as:

$$\beta_{IVBMA} = \Sigma M \, P(M \mid D)\beta_M.$$

IVBMA improves robustness by incorporating model uncertainty in both stages and adjusting for instrument quality. Variable inclusion probabilities indicate thresholds for statistical significance as outlined by Kass and Raftery (1995) and Eicher et al. (2009).

V) Empirical Results: OLS and IVBMA

We first utilize Ordinary Least Squares (OLS) and address model uncertainty and endogeneity using Instrumental Variable Bayesian Model Averaging (IVBMA). Table 1 column 1 presents a simple Ordinary Least Squares (OLS) regression, estimating the relationship between economic growth and a set of baseline covariates. Key drivers include public investment (positively and significantly associated with growth) and openness (also positively significant). Conversely, government consumption and inflation negatively influence growth, aligning with growth theories. Initial GDP shows a negative coefficient, suggesting conditional convergence.

Table 1 column 2 includes public debt and income tax in the baseline model from column 1 to account for fiscal revenue effects on long-term growth. Fiscal variables play a role in growth dynamics while reinforcing baseline determinants such as investment and openness. Public debt is statistically significant with a negative coefficient, implying that a 1 percent increase in the debt-to-GDP ratio may reduce growth by 0.01 percent. This finding is consistent in magnitude with De Soyres et al. (2022). The inclusion of these variables alters other coefficients, such as population growth becoming more significant and negative, but results remain largely consistent.

OLS growth model highlights various potential determinants, from structural factors to policy variables, complicating variable selection. Omitting relevant variables or including irrelevant ones can bias estimates, and traditional models fail to capture true relationships.

To address this, IVBMA integrates the IV and BMA methods to address endogeneity and model uncertainty, offering more robust and reliable insights for growth analysis and policymaking. In particular, Instrumental Variable (IV) approach mitigates this issue by isolating exogenous variation. Then, Bayesian Model Averaging (BMA) evaluates all variable combinations, weighting them by posterior probabilities to identify robust predictors. With this in mind, IVBMA analysis is presented next.

Table 1 column 3, that is based on IVBMA, provides the following information. The **Posterior Inclusion Probability (PIP)** identifies variable importance in explaining growth. As expected, **Initial GDP** (PIP: 0.958) and **Population Growth** (PIP: 0.943) emerge as critical predictors. PIP thresholds are as follows: < 0.5-0.75 (weak evidence), 0.75-0.95 (positive evidence), and 0.95-0.99 (strong evidence), and > 0.99 (decisive evidence). **Public Debt** has a PIP of 0.748, suggests its sizable detrimental impact on growth compared to other fiscal variables.

Aligning with Barro (2003) and Durlauf et al. (2008), some robust effects in OLS would vanish once endogeneity is considered. For example, openness becomes less significant, while the influence of religious and regional fractions (e.g., Muslim Fraction) becomes more apparent, signaling the complexity of growth determinants.

Table 1: OLS and IVBMA Estimates

	(1) OLS Baseline	(2) OLS Baseline+ITax+Debt	(3) IVBMA Baseline+ITax+Debt		
			PIP	**Post.Mean**	**Post.SD**
Investment	**0.125*** **	**0.244*** **			
	(0.046)	(0.073)	0.071	0.006	0.051
GovCons	**-0.050** **	**-0.084*** **			
	(0.021)	(0.026)	0.042	-0.011	0.022
PublicDebt		**-0.012*** **			
		(0.004)	**0.748**	-0.016	0.005
IncomeTax		-0.012			
		(0.027)	0.096	0.035	0.024
InitialGDP	**-0.711** **	-0.278			
	(0.325)	(0.481)	**0.958**	-0.894	0.376
PopulationGrowth	-0.293	**-0.554** **			
	(0.250)	(0.237)	**0.943**	-0.910	0.178
Education	-0.007	0.012			
	(0.008)	(0.010)	0.136	-0.008	0.017
Openness	**0.578** **	**0.582** *			
	(0.293)	(0.343)	0.066	0.243	0.319
Inflation	**-0.001*** **	**-0.001*** **			
	(0.000)	(0.000)	**0.648**	-0.003	0.003
EasternReligionFraction	0.206	-0.891			
	(0.907)	(1.900)	**0.590**	6.298	2.364
HinduFraction	0.317	0.098			
	(0.651)	(0.764)	0.030	-0.188	0.774
JewishFraction	0.634	1.030			
	(0.704)	(0.751)	0.101	2.812	1.903
MuslimFraction	**-1.210** **	**-1.729** *			
	(0.601)	(0.929)	0.035	0.020	0.415

OrthodoxFraction	-0.339	0.182			
	(0.904)	(0.768)	0.048	0.722	0.774
ProtestantFraction	-0.282	**-1.112****			
	(0.462)	(0.505)	0.067	-0.568	0.610
OtherReligionsFraction	-2.134	-1.763			
	(1.512)	(1.706)	0.396	-5.377	2.425
Law	-0.061	0.077			
	(0.196)	(0.349)	0.189	0.169	0.103
LifeExpectancy	0.363	-0.547			
	(0.430)	(0.376)	**0.740**	-0.045	0.038
Fertility	-0.379	0.034			
	(0.238)	(0.305)	0.233	-0.493	0.399
Asia	**0.996*****	**1.019****			
	(0.335)	(0.463)	**0.924**	1.475	0.430
SubSaharanAfrica	0.129	**-0.974***			
	(0.556)	(0.578)	0.033	-0.133	0.399
LatinAmerica	**-0.797****	**-0.850***			
	(0.395)	(0.514)	0.246	0.036	1.792
Constant	1.651	-2.275			
	(1.823)	(1.646)	0.173	0.285	0.227
Observations	926	618	565		
Adj R-squared	0.183	0.178	Sargan test p-value	0.999	

Note: Standard errors are in parentheses. * p > 0.10, ** p > 0.05, *** p > 0.01

Income Tax Spending vs. Public Debt Spending

This section extends the IVBMA framework to investigate the comparative impact of income tax-based and public debt-based fiscal spending on growth, with a particular focus on how these spending components to public investment and government consumption would impact growth.

Studies show that change in income tax-financed spending affects labor supply and savings decisions, influencing economic output, investment, and consumption. Taxes on labor income reduce after-tax wages, lowering the incentive to work additional hours (Barnea et al., 1981; Feldstein, 1984; Temple, 1994; Uchida and Ono, 2021). Reduced incentive to work is offset by the need to compensate for lower income, which fosters increased labor supply to recover lost after-tax income. The former effect is generally greater in various assessments (e.g., Blanchard and Perotti, 2002). Consequently, higher labor taxes, especially in high-debt environments, reduce work hours, discourage saving and investment, and ultimately hinder economic growth.

Public debt can also impede growth by increasing economic uncertainty, reducing private investment, and diverting resources from productive public spending (Aizenman et al., 2009; De Soyres et al., 2022). High debt often signals future tax hikes or spending cuts, discouraging savings and business investment. Debt servicing limits fiscal flexibility, crowds out private sector borrowing, and restricts counter-cyclical policies. As debt rises, funding for key growth investments like infrastructure and education diminishes, undermining long-term economic performance.

Income Tax Spending (Table 2 Column 4):
In Table 2, Column 4, we examine the relationship between income tax-financed government expenditure and economic growth. The results indicate that income tax revenue allocated to public investment is a significant driver of growth (PIP: 0.908). The positive posterior mean of the interaction term (0.021)

suggests that tax-financed public investment enhances growth, aligning with the theoretical expectation that productive, tax-funded investment supports sustainable economic expansion.

This increase in public investment reduces sensitivity of growth rates to the adverse effects of rising public debt-to-GDP ratios. These intangible benefits of public investment contribute to the observed positive multiplicative effects of public investment and income tax.

In contrast, the interaction between income tax and government consumption yields mixed results, as the composite coefficient and interaction term show inconsistent effects.

Debt Spending (Table 2 Column 5):
We next examine the relationship between public debt-financed government spending and economic growth in Table 2, Column 5. Consistent with the findings for income tax-financed public investment, debt-financed public investment demonstrates strong significance (PIP: 0.965) with a slightly positive posterior mean of the interaction term effect (0.002). This suggests that debt-financed investment promotes growth, although with a smaller magnitude compared to income tax-financed investment.

These results indicate that the multiplicative effects of public investment and public debt are more sensitive to the level of public debt, resulting in a lower coefficient for debt-financed public investment. Public debt-financed government consumption of composite coefficient and simple interacted term also exhibit non-zero effects (PIP: 0.830 and 0.261, respectively), with posterior means indicating a minor and mixed influence. These findings are consistent with concerns in the growth literature that excessive reliance on public debt may lead to diminishing returns, particularly when fiscal resources are allocated to less productive sectors.

Comparing the results in Columns 4 and 5, an important emerging question arises: How does the interaction between fiscal spending (e.g., public investment and government consumption) and key moderating variables (public debt-to-GDP and income tax-to-GDP ratios) affect the five-year average GDP growth rate? This question is addressed in Appendix A, which highlights the critical role of public debt and income tax levels in shaping the effects of these multiplicative fiscal instruments on one another.

EMDE-Specific Growth Effects (Table 2, Columns 6 and 7)

Next, we investigate whether the relationships differ in EMDEs to understand the heterogeneity of growth determinants across income groups. Observing Table 2, Columns 6 and 7, several notable findings emerge. Public investment in EMDEs positively impacts growth, with significant interaction term (EMDE × Investment, PIP: 0.559). A 1% increase in public investment raises the growth rate in EMDEs by over 0.1 percentage points more than in non-EMDEs. This reinforces the argument that productive investment is particularly important for fostering growth in developing countries.

In contrast, government consumption shows a relatively small multiplicative effect with EMDEs, as indicated by its low significance (PIP: 0.250). Unlike government spending, EMDE-specific fiscal revenue mechanisms do not exhibit a clear association with economic growth.

Table 2: IVBMA Estimates

	(4) IVBMA: Tax Spending			(5) IVBMA: Debt Spending			(6) IVBMA: EMDEs Spending			(7) IVBMA: EMDEs Revenues		
	PIP	Post.Mean	Post.SD	PIP	Post.Mean	Post.SD	PIP	Post.Mean	Post.SD	PIP	Post.Mean	Post.SD
Public Investment	0.202	0.022	0.115	**0.768**	-0.237	0.119	0.364	0.065	0.117	0.072	-0.001	0.043
Government Cons	0.058	-0.020	0.035	0.087	-0.031	0.036	0.255	-0.039	0.027	0.041	-0.013	0.020
Income Tax	0.112	0.002	0.073							0.099	0.032	0.025
Public Debt				**0.810**	-0.038	0.011				**0.997**	-0.016	0.004
Initial GDP	**0.936**	-0.975	0.443	**1.000**	-0.801	0.199	**1.000**	-1.236	0.292	**0.989**	-0.774	0.196
Population Growth	**0.749**	-0.745	0.282	**1.000**	-0.986	0.229	**0.812**	-0.573	0.200	**1.000**	-0.940	0.143
Education	0.150	-0.007	0.028	0.083	0.007	0.011	0.088	0.010	0.012	0.100	-0.011	0.012
Openness	0.089	-0.291	0.385	0.049	0.152	0.235	0.034	0.035	0.237	0.057	0.229	0.340
Inflation	**0.870**	-0.002	0.004	**0.541**	-0.003	0.002	**1.000**	-0.005	0.001	**0.634**	-0.002	0.001
EasternReligionFraction	0.490	5.974	2.608	0.205	4.441	2.358	0.056	2.372	2.187	**0.749**	6.053	2.405
HinduFraction	0.027	-0.544	0.910	0.025	-0.495	0.727	0.045	-0.783	0.698	0.017	-0.275	0.756
JewishFraction	0.075	2.663	2.153	0.054	1.990	1.613	0.044	1.319	1.713	0.081	2.386	1.833
MuslimFraction	0.022	0.070	0.504	0.033	-0.034	0.336	0.032	-0.154	0.337	0.024	0.097	0.416
OrthodoxFraction	0.052	1.160	0.812	0.040	-0.182	0.816	0.026	-0.088	0.854	0.028	0.469	0.774
ProtestantFraction	0.061	-0.293	0.640	0.067	-0.574	0.547	0.042	-0.281	0.531	0.066	-0.534	0.592
OtherReligionsFraction	**0.522**	-5.567	2.527	0.058	-0.593	1.783	0.047	0.457	1.664	0.477	-4.855	2.238
Law	0.213	0.198	0.117	0.157	0.132	0.082	0.209	0.179	0.123	0.228	0.186	0.109
Life Expectancy	**0.501**	-0.030	0.037	0.454	-0.020	0.030	0.294	-0.011	0.028	**0.786**	-0.045	0.040
Fertility	**0.614**	-0.607	0.283	**0.584**	-0.388	0.158	**0.998**	-0.768	0.257	0.093	-0.145	0.210
Asia	**0.670**	1.207	0.447	**1.000**	1.895	0.336	**0.993**	1.413	0.281	**0.961**	1.426	0.416
Sub Saharan Africa	0.031	-0.068	0.487	0.050	-0.228	0.396	0.044	-0.420	0.360	0.037	-0.153	0.409
Latin America	0.113	-0.024	1.268	0.241	-0.773	0.587	0.192	1.221	0.799	0.202	-0.991	0.637
Intercept	0.105	0.192	0.243	0.067	0.210	0.230	0.041	0.093	0.216	0.233	0.297	0.218
IncomeTax x PubInv*	**0.908**	0.021	0.019									
IncomeTax x GovCons*	**0.825**	0.055	0.039									
PublicDebt x PubInv*				**0.965**	0.002	0.001						
PublicDebt x GovCons*				**0.830**	0.005	0.003						
EMDE x PubInv*							**0.559**	0.148	0.221			
EMDE x GovCons*							0.275	0.544	0.723			
EMDE x PubInv*										0.147	0.235	0.366
EMDE x IncomeTax*										0.184	0.198	0.317
IncomeTax x PubInv	**0.899**	0.017	0.006									
IncomeTax x GovCons	**0.793**	-0.006	0.002									
PublicDebt x PubInv				**0.955**	0.003	0.002						
PublicDebt x GovCons				0.261	-0.001	0.000						
EMDE							0.043	-0.144	1.343	0.066	0.357	0.491
EMDE x PubInv							**0.546**	0.120	0.090			
EMDE x GovCons							0.250	-0.035	0.028			
EMDE x IncomeTax										0.122	0.040	0.024
EMDE x PublicDebt										0.086	0.006	0.006
Sargan test p-value	0.999			0.999			0.999			0.999		
Observations	565			749			749			565		

* -- Composite coefficient reported, based on the joint posterior distribution of its interaction. Since PIP is not defined for the joint, we report the percentage of the joint posterior distribution of the interaction term which is non-zero.

VII) Conclusion

In conclusion, this study provides valuable insights into the differential growth effects of government expenditure types to offer implications for fiscal policy design. Using a dataset of 163 countries spanning four decades (1980–2019), we highlight the importance of distinguishing between public investment and government consumption in shaping long-term economic growth trajectories. Our findings demonstrate that public investment is a reliable growth driver, particularly in emerging markets and developing economies (EMDEs). Specifically, a 1% increase in public investment is associated with a growth rate improvement of over 0.1 percentage points higher in EMDEs, signaling the unique role of public capital formation in fostering growth.

In contrast, government consumption shows mixed effects on growth, with outcomes largely dependent on economic development levels and fiscal revenue sources. While it may stabilize the economy in the short to medium term, its long-term benefits are mixed.

This study also emphasizes the moderating role of fiscal constraints, particularly public debt and income tax levels. Public investment remains growth-enhancing even when financed through debt or income taxes, provided these levels are not excessively high. However, the findings caution against over-reliance on debt-financed expenditure, as rising debt levels can erode fiscal flexibility, deter private investment, and compromise long-term economic performance. Similarly, while tax-financed public investment fosters sustainable growth, the effects of tax-financed government consumption are less favorable.

In this paper, use of Instrumental Variable Bayesian Model Averaging (IVBMA) provides a novel approach to addressing model uncertainty and endogeneity, ensuring robust and reliable results. This dual-method strategy offers a deeper understanding of the relationship between fiscal variables and growth, contributing to the broader literature on long-run growth determinants. We also highlight the complex interplay between structural, institutional, and fiscal factors, demonstrating how these elements collectively influence growth outcomes.

For policymakers, the results suggest that prioritizing public investment—particularly in infrastructure, education, and other growth-enhancing sectors—can yield substantial economic returns, especially in EMDEs. Governments are encouraged to carefully manage fiscal constraints, striking a balance between leveraging public debt and maintaining fiscal sustainability. Additionally, the mixed effects of government consumption indicate a need for targeted spending that aligns with specific economic priorities and developmental stages.

Future research could build on these findings by exploring the heterogeneity of fiscal impacts across different institutional contexts and stages of economic development. For instance, examining how governance quality, political stability, or regional disparities influence the effectiveness of fiscal spending could offer further insights.

Overall, this study contributes to the ongoing discourse on the role of fiscal policy in economic development, offering actionable recommendations for optimizing government expenditure to achieve sustainable, inclusive growth. By identifying the conditions under which fiscal spending is most effective, it provides a valuable framework for designing policies that address the unique challenges and opportunities faced by diverse economies worldwide.

Appendix A:

Multiplicative Interaction Model:

We consider the classical linear multiplicative interaction model, commonly assumed in empirical work (Hastie and Tibshirani, 1987; Brambor et al., 2006; Hainmueller et al., 2021), as represented by the following regression equation:

$$y = \alpha + \beta X + \gamma D + \eta D \bullet X + \varphi Z + \varepsilon, \quad (1)$$

In this model, y represents the outcome variable, the five-year average GDP growth rate. The primary independent variable of interest, denoted as D, refers to fiscal variables such as public investment and government consumption to GDP. D serves as the "treatment" variable. The moderator variable, X, represents the public debt to GDP ratio and income tax to GDP ratio, which influences the direction and/or strength of the treatment effect. Interaction terms between D and X, and Z, represent a vector of additional growth determinants. The parameters α and ϵ correspond to the constant and error terms.

We focus on cases where the treatment variable D and the moderator X are continuous. We assume that the model is correctly specified with respect to these growth covariates, a plausible assumption based on the existing long-run growth model literature.

Model (1) coefficients are consistently estimated under the standard linear regression assumptions, which imply that the functional form is correctly specified and E[ϵ|D,X,Z]=0. In the context of the multiplicative interaction model, this incorporates the Linear Interaction Effect (LIE) assumption, which states that the marginal effect of the treatment variable D on the outcome variable y is:

$$\frac{dy}{dD} = \gamma + \eta X \quad (2)$$

The LIE assumption posits that the effect of D on Y is a linear function of the moderator X. This implies that the impact of D on y changes linearly with X; specifically, if X increases by one unit, the effect of D on y changes by η, and this change is constant across the entire range of X. While this assumption is convenient, weakness is that one may consider this assumption to be strong, as the heterogeneity in the effect of D on y may not necessarily follow a linear form. When considering the possibility of nonlinear or nonmonotonic effects to address this potential limitation, we did not find strong evidence of a consistent nonlinear relation between D and y.

We employ the classical linear multiplicative interaction model (Hastie and Tibshirani, 1987; Brambor et al., 2006; Hainmueller et al., 2021) to analyze the relationship between fiscal variables and GDP growth. Specifically, our focus is on understanding how the interaction between fiscal spending (e.g., public investment and government consumption) and key moderating variables (public debt-to-GDP and income tax-to-GDP ratios) affects the five-year average GDP growth rate.

Under the OLS estimates, without accounting for endogeneity and model uncertainty, the multiplicative effects of fiscal spending and moderating variables appear weak. As shown, five multiplicative effect terms analyzed below exhibit no significant impact on the growth rate. This signals the necessity of examining each term with respect to varying levels of effects.

Table 3: OLS Estimates

	(8) OLS Tax Debt	**(9) OLS Con Debt**	**(10) OLS Inv Debt**	**(11) OLS Cons Tax**	**(12) OLS Inv Tax**
Investment	**0.241*** **	**0.121*** **	**0.120** **	**0.256*** **	**0.233*** **
	(0.076)	(0.046)	(0.049)	(0.076)	(0.066)
GovCons	**-0.084*** **	**-0.040***	**-0.036***	**-0.108*** **	**-0.105*** **
	(0.026)	(0.022)	(0.022)	(0.025)	(0.024)
PublicDebt	-0.012	**-0.012*** **	**-0.012*** **		
	(0.004)	(0.004)	(0.004)		
IncomeTax	-0.015			-0.014	-0.009
	(0.029)			(0.034)	(0.027)
InitialGDP	-0.277	**-0.733** **	**-0.742** **	-0.213	-0.205
	(0.480)	(0.322)	(0.324)	(0.498)	(0.492)
PopulationGrowth	**-0.558** **	-0.338	-0.322	**-0.533** **	**-0.530** **
	(0.235)	(0.250)	(0.249)	(0.237)	(0.241)
Education	0.012	-0.005	-0.006	0.012	0.011
	(0.010)	(0.008)	(0.008)	(0.009)	(0.009)
Openness	**0.591***	**0.588***	**0.590** **	0.567	0.552
	(0.341)	(0.304)	(0.298)	(0.347)	(0.340)
Inflation	**-0.001*** **	**-0.001*** **	**-0.001*** **	**-0.001*** **	**-0.001*** **
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
EasternReligionFraction	-0.871	0.679	0.627	-1.787	-1.571
	(1.900)	(0.896)	(0.899)	(1.917)	(1.918)
HinduFraction	0.104	0.535	0.492	-0.112	0.002
	(0.759)	(0.682)	(0.674)	(0.720)	(0.756)
JewishFraction	1.052	0.939	1.175	1.140	0.883
	(0.739)	(0.760)	(0.807)	(0.762)	(0.781)
MuslimFraction	**-1.732***	**-1.295** **	**-1.333** **	**-1.523***	**-1.514***
	(0.929)	(0.611)	(0.599)	(0.923)	(0.913)
OrthodoxFraction	0.169	-0.156	-0.184	-0.105	-0.075
	(0.775)	(0.852)	(0.842)	(0.844)	(0.854)
ProtestantFraction	**-1.143** **	-0.220	-0.255	**-1.174** **	**-1.209** **
	(0.508)	(0.448)	(0.472)	(0.510)	(0.498)
OtherReligionsFraction	-1.789	-2.035	-2.142	-1.700	-1.609
	(1.711)	(1.493)	(1.495)	(1.832)	(1.713)
Law	0.079	-0.087	-0.091	0.117	0.084
	(0.349)	(0.197)	(0.200)	(0.343)	(0.370)
LifeExpectancy	-0.524	0.436	0.442	**-0.757** **	**-0.746** **
	(0.376)	(0.428)	(0.436)	(0.360)	(0.360)
Fertility	0.044	-0.274	-0.292	-0.064	-0.071
	(0.299)	(0.240)	(0.235)	(0.304)	(0.297)
Asia	**1.009** **	**0.974*** **	**0.982*** **	**0.961** **	**0.963** **
	(0.459)	(0.338)	(0.350)	(0.455)	(0.456)
SubSaharanAfrica	**-0.971***	-0.101	-0.169	-0.731	-0.624
	(0.579)	(0.585)	(0.592)	(0.584)	(0.530)
LatinAmerica	**-0.879***	**-0.844** **	**-0.865** **	-0.704	-0.745
	(0.515)	(0.401)	(0.399)	(0.506)	(0.539)

Constant	**-2.184**	**1.965**	**-2.005**	**-3.300****	**-3.297****
	(1.645)	(1.813)	(1.844)	(1.577)	(1.580)
IncomeTax x PubDebt	-0.000				
	(0.001)				
IncomeTax x PubInv					-0.008
					(0.010)
IncomeTax x GovCons				0.000	
				(0.003)	
PublicDebt x PubInv			0.000		
			(0.001)		
PublicDebt x GovCons		0.000			
		(0.000)			
Observations	618	926	926	618	618
Adj R-squared	0.177	0.194	0.193	0.165	0.167

Note: *, **, and *** represent significance at the p-values of 0.10, 0.05, and 0.01 levels, respectively.

Varying Levels of Fiscal Instruments Effects on Growth:

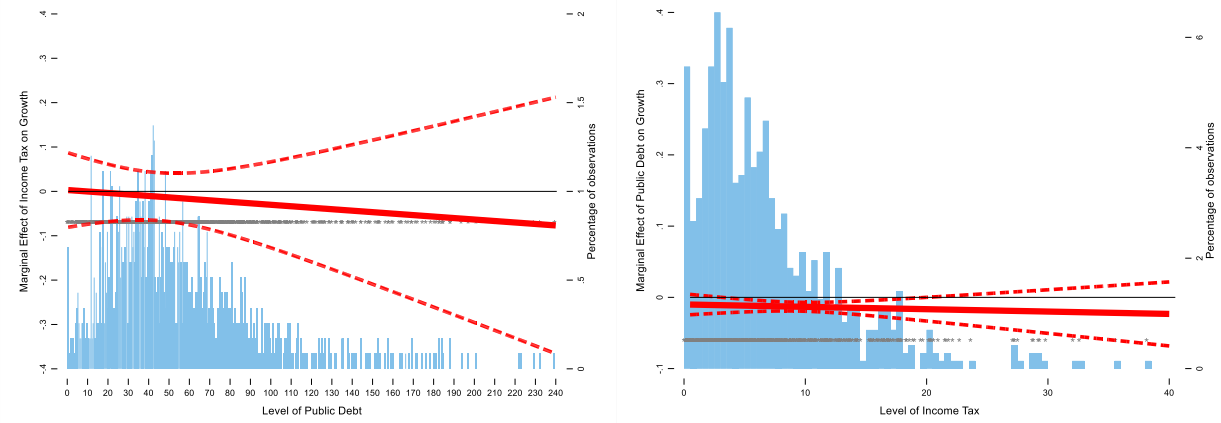
Next, we address how the underlying public debt and income tax levels would impact the fiscal spending growth nexus. Figure 1-Figure 3 depict the OLS estimation results in Table 3 for these marginal effects to account for a direct baseline comparison with previous growth determinant studies.

Our findings on income tax vs. public debt on growth are in line with existing studies (Barnea et al., 1981; Feldstein, 1984; Temple, 1994; Blanchard and Perotti, 2002; Uchida and Ono, 2021). Figure 1 in the left panel shows that marginal effect of income taxation on economic growth marginally diminishes as debt levels increase. As the public debt levels rise, marginal effect of additional income taxation on growth turns more negative. However, the effect of higher debt on growth was not statistically significant. Income taxes may hinder growth under excessive debt burdens.

Figure 1 in the right panel demonstrates a similar pattern observed in the context of public debt. Nevertheless, the effects appear more detrimental as income tax levels increase, highlighting the compounded adverse impact of higher taxation. The widening of the red dashed lines, which represent 95 percent confidence intervals, indicates greater uncertainty in the estimates at higher levels of debt.

Figure 1

Marginal Effect of Income Tax (Public Debt) Conditional on Public Debt (Income Tax)



Note: A thick line plot illustrates the sensitivity of marginal responses (Hastie and Tibshirani, 1987; Brambor et al., 2006; Hainmueller et al., 2021) at different debt levels on the left and income tax levels on the right. The dotted lines above and below the marginal responses represent the 95 percent confidence intervals.

Conditional Impact of Public Investment on Growth: Role of Debt and Tax:

Figure 2 illustrates the marginal effects of public investment on economic growth, conditional on public debt levels (left panel) and income tax levels (right panel).

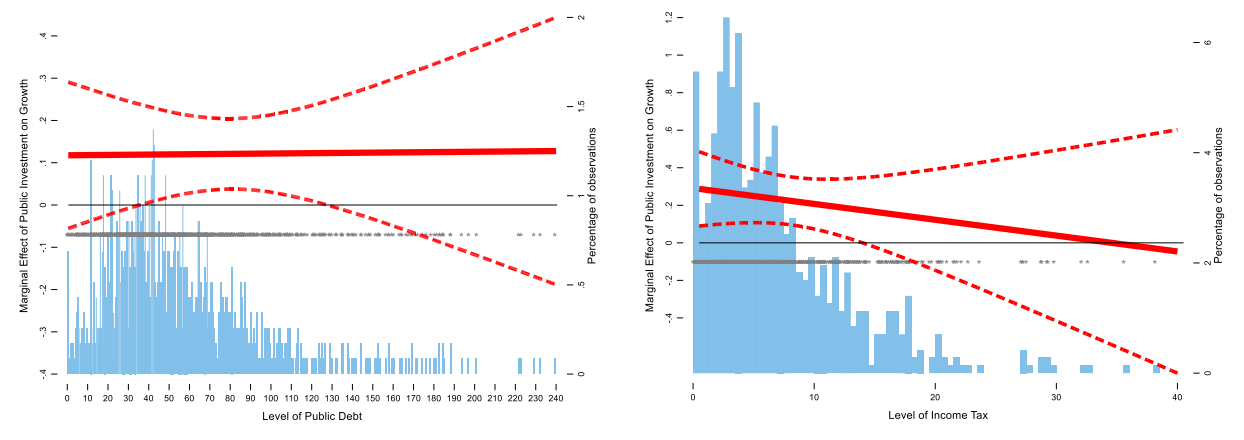
In the left panel, the marginal effect of public investment on growth exhibits a non-linear relationship with public debt levels. At lower debt levels (below 120% of GDP), public investment has a positive and statistically significant impact on growth. However, as public debt increases, the significance diminishes. In line with existing studies (Barro, 1979; Aizenman et al., 2007; Blanchard, 2019), we found that higher levels of debt may erode the effectiveness of public investment in promoting growth. The widening red dashed lines, which represent the 95 percent confidence intervals, indicate increasing uncertainty in the estimates as public debt rises. The distribution of observations, represented by the blue histogram, highlights a concentration of cases at moderate debt levels (30–80% of GDP), with fewer observations at extreme public debt levels.

The right panel presents the marginal effects of public investment on growth as a function of income tax levels. Similar to the case of public debt, the results reveal a diminishing growth return from public investment as income tax levels increase. At lower tax levels (below 20% of GDP), public investment exerts a positive impact on growth. However, as tax levels rise, the marginal effect weakens and becomes negative at higher tax levels (above 20% of GDP). The red dashed lines widen with increasing tax levels, reflecting greater uncertainty in the estimates. The distribution of observations indicates that most cases are concentrated at relatively low levels of income tax, with sparse representation at higher income tax levels.

These highlight the importance of fiscal constraints in shaping the effectiveness of public investment as a driver of economic growth. High public debt or income tax burdens appear to diminish the potential growth benefits of public investment, suggesting the need for balanced fiscal policies to maximize returns on investments.

Figure 2

Marginal Effect of Public Investment Conditional on Public Debt (Income Tax)



Note: A thick line plot illustrates the sensitivity of marginal responses (Hastie and Tibshirani, 1987; Brambor et al., 2006; Hainmueller et al., 2021) at different debt levels on the left and income tax levels on the right. The dotted lines above and below the marginal responses represent the 95 percent confidence intervals.

Conditional Impact of Government Consumption on Growth: Role of Debt and Tax:

Figure 3 examines the marginal effects of government consumption on economic growth, conditional on public debt levels (left panel) and income tax levels (right panel).

In the left panel, the marginal effect of government consumption on growth shows a predominantly negative relationship across varying public debt levels, albeit statistically insignificant. As public debt increases, the effect appears to remain mixed, suggesting no sizable association between government consumption on growth conditional on debt. The red dashed lines, representing confidence intervals, widen at higher debt levels, indicating greater uncertainty in the estimates.

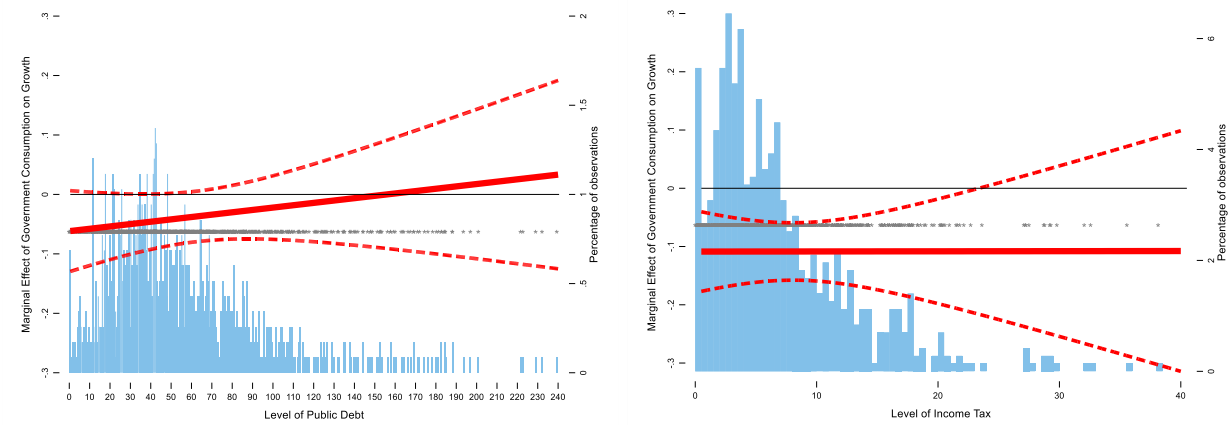
In the right panel, the marginal effects of government consumption on growth are assessed as a function of income tax levels. The results indicate that government consumption has a consistently negative impact on growth across the range of income tax levels. Unlike the case of public debt, the relationship is relatively flat, suggesting that income tax levels do not significantly alter the growth effects of government consumption. The confidence intervals, represented by the red dashed lines, remain relatively narrow across the range of tax levels, reflecting consistent estimates.

These findings are not surprising. Debt-financed government consumption has mixed effects on economic growth in various studies (Elmendorf and Mankiw, 1999; Auerbach and

Gorodnichenko, 2012; Abiad et al., 2016), although research on income tax-financed government consumption is scarce. It appears that government consumption generally exerts a negative influence on economic growth without sizable association with the levels of public debt and income tax.

Figure 3

Marginal Effect of Government Consumption Conditional on Public Debt (Income Tax)



Note: A thick line plot illustrates the sensitivity of marginal responses (Hastie and Tibshirani, 1987; Brambor et al., 2006; Hainmueller et al., 2021) at different debt levels on the left and income tax levels on the right. The dotted lines above and below the marginal responses represent the 95 percent confidence intervals.

Appendix X:

Data Appendix

Source	Variable Name	Definition
Durlauf, Kourtellos, Tan (EJ 2008) for 1900, 1970, 1980, 1990 and McCleary for 2000	HinduFraction	Hindu share in 1970, 1980, 1990 and 2000 as fraction of the population who expressed adherence to some religion.
Henderson, Papageorgiou, Parmeter (EJ 2011) and World Bank.	Inflation	The average consumer price inflation rate.
World Bank	Openness	Trade share of GDP; (exports + imports)/GDP
Henderson, Papageorgiou, Parmeter (EJ 2011 - PWT 6.2), PWT 7.1.	InitialGDP	Logarithm of initial per capita GDP in each period.
World Economic Outlook data (IMF 2023)	PubInv	Public Investment to GDP ratio.
Durlauf, Kourtellos, Tan (EJ 2008) for 1900, 1970, 1980, 1990 and McCleary for 2000	JewishFraction	Jewish share in 1970, 1980, 1990 and 2000 as fraction of the population who expressed adherence to some religion.
World Bank	LatinAmerica	Dummy variable for Latin America and the Caribbean.
Henderson, Papageorgiou, Parmeter (EJ 2011) and World Bank.	LifeExpectancy	Reciprocals of life expectancy at age 1 in inital years of 5-year periods.
Durlauf, Kourtellos, Tan (EJ 2008) for 1900, 1970, 1980, 1990 and McCleary for 2000	MuslimFraction	Muslim share in 1970, 1980, 1990 and 2000 as fraction of the population who expressed adherence to some religion.
Durlauf, Kourtellos, Tan (EJ 2008) for 1900, 1970, 1980, 1990 and McCleary for 2000	OrthodoxFraction	Orthodox share in 1970, 1980, 1990 and 2000 as fraction of the population who expressed adherence to some religion.
Durlauf, Kourtellos, Tan (EJ 2008) for 1900, 1970, 1980, 1990 and McCleary for 2000	OtherRelFraction	Other Religion share in 1970, 1980, 1990 and 2000 as fraction of the population who expressed adherence to some religion.
Henderson, Papageorgiou, Parmeter (EJ 2011), PWT 7.1.	PopulationGrowth	Logarithm of average population growth rate.
Durlauf, Kourtellos, Tan (EJ 2008) for 1900, 1970, 1980, 1990 and McCleary for 2000	ProtestantFraction	Protestant share in 1970, 1980, 1990 and 2000 as fraction of the population who expressed adherence to some religion.
World Bank	Asia	Dummy variable for Asia
World Bank	SubSaharanAfrica	Dummy variable for Sub-Saharan Africa.
Durlauf, Kourtellos, Tan (EJ 2008) for 1900, 1970, 1980, 1990 and McCleary for 2000	EasternReligionFraction	Eastern Religion share in 1970, 1980, 1990 and 2000 as fraction of the population who expressed adherence to some religion and corresponding share in 1900.
Barro and Lee dataset	Education	Logarithm of the average percentage of a country's working age population that attended secondary school times the completion rate of secondary school for all periods.
Economic Freedom of the World Database	Law	Index based on judicial Independence, Impartial courts, property rights, military interference, legal integrity, contracts, real property, police and crime, and gender diversity
Henderson, Papageorgiou, Parmeter (EJ 2011) and World Bank.	Fertility	Logarithm of the total fertility rate in initial years of 5-year periods.
World Economic Outlook data (IMF 2023)	g	Average real GDP growth rate.
World Economic Outlook data (IMF 2023)	GovExpend	Average ratio of government consumption to GDP.
World Economic Outlook data (IMF 2023)	IncomeTax	Income tax to GDP ratio
World Economic Outlook data (IMF 2023)	PublicDebt	Public debt to GDP ratio

Institution Variables

Source	Variable Name	Definition
Durlauf, Kourtellos, Tan (EJ 2008) for 1900, 1970, 1980, 1990 and McCleary for 2000	EasternReligionFraction1900	Eastern Religion share in 1900 as fraction of the population who expressed adherence to some religion and corresponding share in 1900.
Durlauf, Kourtellos, Tan (EJ 2008) for 1900, 1970, 1980, 1990 and McCleary for 2000	HinduFraction1900	Hindu share in 1900 as fraction of the population who expressed adherence to some religion.
Durlauf, Kourtellos, Tan (EJ 2008) for 1900, 1970, 1980, 1990 and McCleary for 2000	JewishFraction1900	Jewish share in 1900 as fraction of the population who expressed adherence to some religion.
Durlauf, Kourtellos, Tan (EJ 2008) for 1900, 1970, 1980, 1990 and McCleary for 2000	LagEducation	One period lag of logarithm of the average percentage of a country's working age population that attended secondary school times the completion rate of secondary school for all periods.
Durlauf, Kourtellos, Tan (EJ 2008).	LegalOriginsFrench	Dummy variable that takes value if 1 if a country legal system is based on French legal code.
Durlauf, Kourtellos, Tan (EJ 2008).	LegalOriginsUK	Dummy variable that takes value if 1 if a country legal system is based on British legal code.
Henderson, Papageorgiou, Parmeter (EJ 2011) and Alesina (2003).	LinguisticFractionalization	Measure of linguistic fractionalization based on data describing shares of languages spoken as "mother tongues".
Alesina (2003)	EthnicFractionalization	Measures the degree of tension within a country attributable to racial, nationality, or language divisions.
Durlauf, Kourtellos, Tan (EJ 2008) for 1900, 1970, 1980, 1990 and McCleary for 2000	LagGovExpend	One period lag of average ratio of government consumption to GDP.
Durlauf, Kourtellos, Tan (EJ 2008) for 1900, 1970, 1980, 1990 and McCleary for 2000	LagInflation	One period lag of average consumer price inflation rate.
Durlauf, Kourtellos, Tan (EJ 2008) for 1900, 1970, 1980, 1990 and McCleary for 2000	LagInitial GDP	One period lag of logarithm of initial per capita GDP in each period.
Durlauf, Kourtellos, Tan (EJ 2008) for 1900, 1970, 1980, 1990 and McCleary for 2000	LagInvestment	One period lag of average ratio of investment to GDP.
Durlauf, Kourtellos, Tan (EJ 2008) for 1900, 1970, 1980, 1990 and McCleary for 2000	LagPopulationGrowth	One period lag of logarithm of average population growth rate.
Durlauf, Kourtellos, Tan (EJ 2008) for 1900, 1970, 1980, 1990 and McCleary for 2000	MuslimFraction1900	Muslim share in 1900 as fraction of the population who expressed adherence to some religion.
Durlauf, Kourtellos, Tan (EJ 2008) for 1900, 1970, 1980, 1990 and McCleary for 2000	OrthodoxFraction1900	Orthodox share in 1900 as fraction of the population who expressed adherence to some religion.
Durlauf, Kourtellos, Tan (EJ 2008) for 1900, 1970, 1980, 1990 and McCleary for 2000	OtherRelFraction1900	Other Religion share in 1900 as fraction of the population who expressed adherence to some religion.
Durlauf, Kourtellos, Tan (EJ 2008) for 1900, 1970, 1980, 1990 and McCleary for 2000	ProtestantFraction1900	Protestant share in 1900 as fraction of the population who expressed adherence to some religion.

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