

Public spending reallocations and economic growth across different income levels

Santiago Acosta-Ormaechea

Atsuyoshi Morozumi

International Monetary Fund *

University of Nottingham †

July 15, 2016

Abstract

This paper examines the effects of public spending reallocations on economic growth. Assembling a disaggregated public spending dataset of 83 countries over the 1970-2011 period, we show that spending reallocations towards education, from health and social protection, have significant growth-promoting effects across a wide range of countries' income levels. However, income heterogeneity matters, particularly when reallocations involve infrastructure spending. Specifically, a reallocation from this spending to education also promotes growth, albeit primarily when the income level is low. This occurs because the effects of infrastructure spending are particularly weak in low-income countries, possibly due to the low quality of governance.

Keywords: Public spending reallocation, Economic growth, Education spending, Infrastructure spending, Income heterogeneity, Governance quality **JEL:** O43, H50, O11

*Tel: +1 202 623 7391. 1919 Pennsylvania Ave NW, Washington DC 20006, USA. Email: SAcostaOrmaechea@imf.org.

†Corresponding author. Tel: +44 115 84 67847. School of Economics & CFCM, University of Nottingham, University Park, Nottingham NG7 2RD, UK. Email: Atsuyoshi.Morozumi@nottingham.ac.uk.

1 Introduction

Can a government promote long-run growth by changing the *composition* of public spending while keeping the total *level* fixed? For example, is there a room for a rise in public education spending to foster growth, when it is financed by a fall in other spending items, such as defense, health, social protection and infrastructure spending? Answering these questions is important at least for two reasons. First, even when high levels of public indebtedness prevent a government from raising the level of public spending in several years to come (as is often the case in the aftermath of the financial crisis of 2007-09), a government may still seek to promote growth by reallocating spending components. Second, when facing an expected rise in health and social protection spending amid ongoing population aging, governments may need to decide which other types of spending to cut over the next few decades, while still trying to preserve growth.¹

Various previous studies shed light on this important policy question. For example, [Barro \(1990\)](#) theoretically shows that if a government increases ‘utility-enhancing’ public consumption while reducing ‘production-enhancing’ spending, growth rates fall regardless of the level of total spending.² However, as theoretical studies often classify spending in a relatively abstract manner (e.g., utility-enhancing spending), concrete policy implications are often difficult to draw. Empirically, [Devarajan et al. \(1996\)](#), for example, find that a spending reallocation towards economic infrastructure is associated with slower growth, particularly in developing countries.³ However, because these previous empirical works normally do not clarify which *specific* spending component is used as a financing item (i.e., a component for which spending is decreased, to keep the level of total spending constant), their policy implications may still be limited. In short, the literature has not yet clarified how a government

¹[Clements et al. \(2012\)](#), for example, discuss the expected increasing trends in health and pension spending in advanced and developing countries over the long run.

²[Agénor \(2010\)](#), also theoretically, shows that a spending reallocation toward public infrastructure from ‘unproductive’ spending can help increase growth rates, if public investment is sufficiently efficient.

³[Ghosh and Gregoriou \(2008\)](#), using data from 15 developing countries, show that a reallocation towards capital spending has a negative effect on growth.

could potentially promote growth through specific spending reallocations. The objective of this paper is to fill this gap.

Importantly, however, even when certain specific spending reallocations promote growth in one country, they may not have the same positive effects in others. For instance, [Pritchett \(2000\)](#) argues that infrastructure spending in developing countries can be particularly unproductive, because government officials, often unconstrained in institutions of low quality, may be allowed to pursue their private rents in the public infrastructure management.⁴ This implies that for all else equal, a reallocation towards this spending item may not foster growth in these countries.⁵ More generally, [Gemmell et al. \(2013\)](#) point out that private production requires different types of public inputs depending on countries' development levels, implying the potentially heterogeneous growth effects of spending reallocations. Overall, therefore, we pay particular attention to the potential role of countries' income levels in the spending reallocations-growth nexus.

To proceed, we first assemble a disaggregated public spending dataset. Based on the IMF's Government Finance Statistics (GFS) Yearbook, it covers the functional components including *defense, health, social protection, education, and transport and communication*, for 83 countries from different income levels over the 1970-2011 period.⁶ One key innovation of this dataset is that, to address the potential importance of spending decentralization movements in certain spending items such as health and education, it has a version which utilizes not only central government (CG) level-, but also general government (GG) level-data.⁷ We then examine the growth effects of various spending reallocations across different

⁴[Keefer and Knack \(2007\)](#) find that the level of capital spending increases in the worsening of governance quality, suggesting that this type of spending may be unproductive in countries with poor governance. Given that infrastructure spending is largely capital intensive, their finding relates to [Pritchett \(2000\)](#).

⁵Although [Devarajan et al. \(1996\)](#) show the growth-retarding effect of infrastructure spending (without specifying its financing item), their reasoning is different. Their argument is that the negative effect is attributed to the excessive use of this type of spending in developing countries, not necessarily highlighting the quality of this spending.

⁶The list of the 83 countries is given in the Online Appendix A.

⁷To explain briefly, we would ideally like to use only GG-level data, because it is more comprehensive, covering the local/state government levels, as well as the CG level. However, GG-level data are generally much scarcer than CG-level data and it is unfeasible to conduct analyses based solely on it. Thus, this

income levels. Notably, we address potential endogeneity concerns in various ways. First, we address fiscal variables' association with business cycles by basing the analyses mainly on an 8-year framework, yielding 5 observations per country at maximum.⁸ Second, we mitigate reverse causality issues by adopting a lag structure of public spending variables. Third, we tackle other potential endogeneity issues by using the Generalized Method of Moments (GMM) dynamic panel data estimation approach.⁹

Our main results are summarized as follows. First, considering the growth effects of spending reallocations without taking account of income heterogeneity across countries, we show that reallocations towards education, specifically from health and social protection spending, exhibit a particularly robust growth-promoting effect. However, we find that income heterogeneity matters in the spending reallocations-growth nexus, particularly when infrastructure spending (proxied by transport and communications) is involved. Specifically, while the above-mentioned reallocations towards education tend to promote growth across a wide range of income levels, reallocations away from infrastructure spending, to items including education, also foster growth, albeit *primarily when* the income level is low. What happens is that while the growth-promoting effects of education spending prevail independent of income levels, the effects of infrastructure spending exhibit a distinctly positive association with them. Evidence suggests that in line with [Pritchett \(2000\)](#), this particularly weak growth-promoting effect of infrastructure spending in low-income countries may be driven by the low quality of governance, as often observed in these countries. For instance, if political officeholders are not properly constrained, the effectiveness of infrastructure spending may *particularly* suffer in these countries, because this type of spending, being capital intensive, tends to be a convenient vehicle for rent seeking.¹⁰

version of the dataset adopts a hybrid approach, replacing CG-level with GG-level data, particularly when the degree of spending decentralization is known to be high in a country. Details are explained below.

⁸We also consider a 5-year frameworks in robustness checks.

⁹This approach is developed by [Holtz-Eakin et al. \(1988\)](#), [Arellano and Bond \(1991\)](#), and [Blundell and Bond \(1998\)](#).

¹⁰While acknowledging that the low quality of governance can also be a problem for education spending, the fact that this type of spending, largely comprising teachers' wage payments, is often predetermined outside officials' discretion means that there may be less room for their rent-seeking behavior.

In the literature, several previous works identify the key channels through which different spending items may affect growth. For example, theoretical models by [Glomm and Ravikumar \(1997\)](#) and [Blankenau and Simpson \(2004\)](#) suggest that public education spending may foster growth through promoting human capital accumulation. [Aísa and Pueyo \(2006\)](#) and [Agénor \(2010\)](#) show that health spending can also promote growth by enhancing life expectancy, making agents more patient, and thus encouraging private saving. [Barro and Sala-i-Martin \(2004\)](#) argue that defense spending fosters private investment and thus growth by enhancing entrepreneurs' property rights. Further, studies such as [Turnovsky and Fisher \(1995\)](#) and [Glomm and Ravikumar \(1997\)](#) show that infrastructure spending can promote private firms' productivity and thus growth, albeit with the caveats indicated by [Pritchett \(2000\)](#) for developing countries. Notice, therefore, that with each spending appearing to have a growth-promoting potential on its own, it is not obvious, *a priori*, which spending item is *more* growth promoting.¹¹ In this regard, this paper adds to the literature by empirically studying reallocation effects, i.e., practically comparing the effects of different spending items, across different income levels.

Further, several studies examine the growth effects of public spending for different financing sources, including a rise in revenue or budget deficits, rather than spending reallocations. For instance, [Kneller et al. \(1999\)](#), using a panel of 22 OECD countries over the 1970-95 period, find that a rise in 'productive' expenditure financed by an equal rise in 'non-distortionary' taxes promotes growth, whereas a rise in 'unproductive' expenditure, coupled with a rise in 'distortionary' taxes, reduces growth. [Bose et al. \(2007\)](#), using a panel of 30 developing countries during the 1970s and 1980s, show that a rise in education spending, offset by non-tax revenue, is associated with higher growth, while a rise in transport spending is not. Meanwhile, [Gupta et al. \(2005\)](#), focusing on 39 developing countries during the 1990s, show that a rise in capital spending has a positive effect on growth, when financed through

¹¹Even social protection spending may promote growth by itself. For instance, [Lambrecht et al. \(2005\)](#) show that in cases where parents do not leave bequests to their children, social security spending can enhance growth, in contrast to cases where parents leave bequests.

budget deficits, but that a rise in current spending, particularly wages, has the opposite effect. While these studies can be seen as parallel with this paper, a spending reallocation could often be a more viable policy option. This is because securing a given financing through revenue may not be straightforward, due to the elusive relationship between tax rates and tax revenue (as reflected in the Laffer curve), while deficit financing may be implausible for many countries in the face of high levels of indebtedness.¹²

The remainder of the paper is structured as follows. Section 2 describes the dataset. Section 3 explains our empirical methodology and Section 4 presents regression results. Lastly, Section 5 presents concluding remarks.

2 The Dataset

2.1 Construction of the dataset

Classification of public spending To conduct analyses on public spending reallocations and growth, we assemble a new disaggregated public spending dataset. Based on historical data reported in the IMF’s GFS Yearbook between 1970 and 2011, it classifies public expenditure according to its function.¹³ One innovation of this dataset is to bridge methodological changes caused by the introduction of the new GFS manual (GFSM2001) from mid 1990s to the early 2000s.¹⁴ In particular, realizing that GFSM2001 divides total spending into 10 major functional categories, while the old manual, GFSM1986, divides them into 14 categories (see [Wickens \(2002\)](#) for details), we re-categorize spending items under GFSM1986 into the

¹²See [Trabandt and Uhlig \(2011\)](#), for example, for a recent examination of Laffer curves for different taxes.

¹³Disaggregation of public spending can also be based on economic classification, with expenditure allocated by its economic characteristics such as wages, subsidies, social benefits, and capital spending. However, because detailed disaggregation following this classification tends to reduce the sample size drastically, this paper focuses on the functional classification instead.

¹⁴The exact years of migration to the GFSM2001 differ depending on the country.

items defined by GFSM2001, to make the unified series comparable.^{15,16} While following the GFSM2001 categorization, however, we do not attempt to cover all the 10 major components, because data on some of the components are quite scarce. Specifically, our dataset covers the following 8 of them: general public services; defense; economic affairs; housing and community amenities; health; recreation, culture, and religion; education; and social protection.¹⁷ Among these, we highlight, largely in accordance with the literature, the following 5 components: *defense*; *transport and communication* (transport, for short), a part of economic affairs; *health*; *education*; and *social protection*, while combining the rest of spending into one component (i.e., the remaining three major items and the rest of economic affairs). To note, since data on transport spending, being a subcomponent itself, are sometimes unavailable even when data on economic affairs are available, we do not disaggregate economic affairs unless the reallocation under consideration involves a change in this spending.

Institutional coverage of the government As another notable innovation, we create two versions of the dataset, differing in terms of coverage of the government level. To explain, note first that under GFSM1986, countries report data at most at the consolidated central government (CG) level, whereas under GFSM2001, they provide data not only at the CG level, but often at the consolidated general government (GG) level, which also covers state and local government levels.¹⁸ With our aim of constructing long data series unifying GFSM1986 and 2001, the first version of the dataset uses data only at the consolidated CG level. However, it is important to realize that spending in certain functional components such as health and education is heavily decentralized in some countries, rendering CG-level

¹⁵Admittedly, the unification process is not exact, but approximate, primarily due to the change in the form in which governments report statistics, from the predominant use of a cash basis under GFSM1986 to the recommended use of an accrual basis under GFSM2001, resulting in the coexistence of both bases under the latter manual. (Under an accrual basis, flows are recorded at the times that transactions occur, independently of the flow of cash; under a cash basis, transactions are recorded when cash effectively flows.)

¹⁶When it happens that spending data is reported based on both accrual and cash bases under GFSM2001, we use the data on the former basis, as it is economically more relevant.

¹⁷The two remaining, relatively small, items are public order and safety, and environmental protection.

¹⁸When the data for the different government units are consolidated, statistics are presented as if they constituted a single unit, netting out transfers among them.

data a poor proxy for more comprehensive GG-level data. To address this, we assemble the second version of the dataset. Briefly, the idea is that while using CG-level data as a base, we replace it with GG-level data, if the country’s public finances are known to be highly decentralized. Specifically, we take the following procedure: 1) we calculate, to the extent the data are available, the ratios of spending at the CG- to GG-levels under GFSM2001 for all the individual components covered in our analyses (as explained above) and take country-level averages; 2) if the average ratio is less than 50 percent, even in *one* of these spending items for a country, we abandon the entire CG-level data available for this country and instead use the available GG-level data; 3) while GG-level data under GFSM2001 is used in such cases, when the OECD provides larger GG-level data series, we instead use the data from this alternative source.^{19,20} Overall, this alternative dataset, though smaller due to the relative scarcity of GG-level data in general, is less susceptible to the effects from possible decentralization movements. In what follows, the first version of the dataset is denoted CG-based, while the second is CG-GG-based.

2.2 Description of the dataset

Table 1 presents the dataset used in the subsequent regression analyses. They follow an 8-year framework, i.e., 1972-1979, 1980-1987, ... , 2004-2011 (thus yielding 5 observations per country at maximum), where all the public spending items take the *initial* values in each period.²¹ The purpose of taking this measure is threefold. First, compared with the framework comprising annual data, this setup is less prone to business cycle effects on spending components (e.g., a possible rise in unemployment benefits in recessionary periods). Second,

¹⁹In robustness tests, we use another dataset with the CG/GG ratio threshold value of 75 percent.

²⁰Since the OECD follows the same functional classification as GFSM2001, their data are comparable.

²¹While we examine below a 5-year framework too, we prefer a 8-year framework as a baseline. This is primarily because, 5 years may be too short to capture the effects of certain spending such as education spending (on primary/secondary school). This choice of period length is in line with, for example, [Bleaney et al. \(2001\)](#), who, using a sample of OECD countries during 1970-95, show that eight annual lags are required to fully account for the long-run effects of fiscal policy on growth. Nonetheless, it is important to acknowledge that using 8-years averages is not without issues: in particular, it may not be the most suitable way of addressing business cycle effects, since 8 years may be too long for the length of business cycles.

the lag structure, focusing on the initial spending values, helps mitigate reverse causality issues. For example, it is unlikely that governments’ anticipation of higher future growth rates over the next 8 years prompts a change in the spending share of education in the current period. Third, this structure squares with the apparent reality that public spending tends to have delayed effects on growth. Before describing this dataset, one clarification about the lag structure is in order. That is, to deal with the fact that disaggregated spending data is unbalanced, we calculate initial spending figures by taking an average over certain years, as long as at least one observation is available over these years. In reference analyses below, we form initial spending by taking an average over 4 years up to the initial year of each period, i.e., for the 1980-87 period, for example, an average is taken over 1977-1980.^{22,23}

Table 1: Descriptive Statistics

Variable	CG-based dataset				CG-GG-based dataset			
	Mean	S.d.	Min.	Max.	Mean	S.d.	Min.	Max.
Growth rate (over 8 years)	18.7	17.8	-41.4	66.1	18.1	18.6	-41.4	66.1
Total spend/GDP	27.4	10	8.8	54.8	28.7	11.6	8.8	62.3
Defense/Total spend	9.7	7.4	0.8	39	9.7	7.9	0.7	39
Transport/Total spend	5.9	3.4	0.8	19.5	6.2	3.4	0.2	19.5
Health/Total spend	7.9	5	0.7	23.5	8.8	4.9	0.9	23.5
Educ/Total spend	11.7	6.1	1	29.6	13.5	5.7	1	29.6
Soc prot/Total spend	25	16	0.8	62.2	23.2	15.7	0.8	62.2
Rest/Total spend	39.9	13.7	13.9	82.4	38.6	14.1	13.9	80.7
Initial GDP p.c. (log)	9.1	1	6	10.9	9	1.1	6	10.9
Initial level of schooling	7.5	3.1	0.4	13.4	7.3	3.2	0.4	13.4
Investment/GDP	22.2	4.7	8.6	40.9	22.2	4.9	8.6	40.9
Population growth	1.2	1.2	-1.6	6.4	1.3	1.2	-1.6	6.4

Note: Statistics for CG- and CG-GG-based datasets are based on 206 and 180 observations from 82 countries. All the fiscal variables are the initial values in each 8-year period. The Initial GDP p.c. is the log of 2005 US\$ per capita. Initial level of schooling years are the average years of schooling for population aged between 25 and 64. Investment share and population growth rates are averages over an 8-year period. The figures except for initial GDP and schooling years are in percent.

²²For the first period only, we take an average over 3 years, i.e., 1970-72, because the data starts in 1970.

²³Considering, for example, 3- or 5-year averages yields similar results below. In general, however, when the period length becomes too short, the sample becomes too small for analyses, while when it is too long, consistency across periods can be lost easily. (For example, with 6-year averages, with an extreme case, the initial value for the 1980-87 period may be the one in 1975, while the one for the 1972-79 period may be the one in 1972, yielding a gap of only 3 years.)

Table 1 presents the summary statistics, corresponding to the reference analyses below. For brevity, it focuses on the case where transport spending, a subcomponent of economic affairs, is available. Ensuring the availability of all the spending items of interest, the final CG- (CG-GG-) based datasets contain 206 (180) observations from 82 countries.²⁴ Starting with spending variables in the CG-based dataset, the share of total spending in GDP is 27.4 percent on average.²⁵ The total is then divided into the respective components of our particular interest. For instance, the mean values of health and education spending shares in the total are 7.9 and 11.7 percent, respectively. The average growth rate is 18.7 percent over the 8 years, corresponding to an annual growth rate of about 2.3 percent. Further, the table covers the other explanatory variables, including initial GDP, initial level of schooling, investment relative to GDP, and population growth rates, whose rationale is commented below.²⁶ Turning to the CG-GG-based dataset, the key difference is found in the different spending shares of certain spending items. Specifically, consistent with the well-known facts that health and education components are often particularly decentralized, these shares in the CG-GG dataset are noticeably larger, i.e., 8.8 and 13.5 percent, respectively.

3 Empirical Specification and Methodology

3.1 Empirical specification

Our empirical specification is motivated by neoclassical growth models. The models generally relate the growth of real GDP per capita to two types of variables: state and control/environmental (control, for short) variables (see Barro and Sala-i-Martin (2004)). The former variables describe the initial position of the economy, whereas the latter determine the steady

²⁴In case transport spending is not disaggregated, the number of observations is 213 (185), for CG- (CG-GG-) based datasets, from 83 countries.

²⁵Because the dataset does not cover public order and safety, and environmental protection (due to the severely limited data availability), this total spending figure does not equal the actual total. However, since they generally account for small shares, this figure still approximately equals the actual total.

²⁶Detailed data sources of the variables are found in the Online Appendix B.

state. A key prediction of such models is that when the initial position of the economy is controlled for, an increase in steady state output leads to higher growth rates during the seemingly long adjustment period towards the steady state.²⁷ Based on this prediction, we examine how public spending reallocations affect the steady state and thus the growth of real GDP, while assessing the role of countries' income levels.²⁸

Formally, we consider the following regression model:

$$y_{i,t} - y_{i,t-x} = \alpha y_{i,t-x} + \beta h_{i,t-x} + \sum_{j=1}^m \gamma_j s_{i,j,t-x} + \sum_{j=1}^m \zeta_j s_{i,j,t-x} y_{i,t-x} + \delta e_{i,t-x} + \bar{z}'_{i,t} \eta + \nu_i + \xi_t + \epsilon_{i,t}, \quad (1)$$

where with the 8-year framework, $t = 1979, 87, \dots, 2011$ and $x = 8$. On the left-hand side (LHS), $y_{i,t}$ ($y_{i,t-x}$) is the log of real GDP per capita in country i in year t (year $t - x$). Explanatory variables on the right-hand side (RHS) include initial real GDP per capita, $y_{i,t-x}$, and initial average years of schooling, $h_{i,t-x}$, as state variables. The former is a convergence variable, while the latter proxies initial human capital. Turning to control variables, $s_{i,j,t-x}$ represents the share of a public spending component, j , in total spending. As explained, spending variables also take initial values. We then have interaction terms between the spending shares and initial GDP per capita. Next, we control for the ratio of total spending to GDP, $e_{i,t-x}$, to focus on analyses on the growth effects of the composition of spending (as in [Devarajan et al. \(1996\)](#)). Further, motivated by the Solow growth model, $\bar{z}_{i,t}$ include additional control variables such as investment rates and population growth rates, as their

²⁷The steady state growth rate is determined exogenously in these growth models.

²⁸Endogenous growth models also predict that fiscal policies play a role in the determination of growth rates. For example, they can indicate that the share of 'productive' government spending to GDP directly determines the long-run GDP per capita growth rate (e.g., [Barro \(1990\)](#)). However, because neoclassical models naturally assign the role of income levels through convergence effects, and this characteristic, in turn, facilitates us to examine the role of income levels in the effects of public spending reallocations through an interaction approach (as seen below), we regard neoclassical growth models as a more suitable theoretical foundation for our analyses.

period-averaged values.^{29,30} ν_i captures unobserved country-specific effects, while ξ_t is a time dummy, reflecting international shocks during each period.

With Eq. 1, we examine the spending reallocations-growth nexus as follows. First, notice that due to exact multicollinearity caused by the fact that $\sum_{j=1}^m s_{i,j,t-x} = 1$, we need to proceed by omitting at least one component share from the equation. If, for instance, the share of component m , $s_{i,m,t-x}$, is omitted, it becomes

$$y_{i,t} - y_{i,t-x} = (\alpha + \zeta_m) y_{i,t-x} + \beta h_{i,t-x} + \sum_{j=1}^{m-1} (\gamma_j - \gamma_m) s_{i,j,t-x} + \sum_{j=1}^{m-1} (\zeta_j - \zeta_m) s_{i,j,t-x} y_{i,t-x} \quad (2)$$

$$+ \delta e_{i,t-x} + \bar{z}'_{i,t} \eta + \gamma_m + \nu_i + \xi_t + \epsilon_{i,t}.$$

Then, estimating Eq. 2, the marginal effect of $s_{i,j,t-x}$ is obtained as

$$\frac{\partial(y_{i,t} - y_{i,t-x})}{\partial s_{i,j,t-x}} = (\gamma_j - \gamma_m) + (\zeta_j - \zeta_m) y_{i,t-x}. \quad (3)$$

Importantly, this is the difference of marginal effects of spending component j and m , thus capturing the marginal growth effect of spending *reallocations* to the former component from the latter, as a function of income levels. In what follows, we examine the effects of different reallocation combinations, while considering the potential role of initial income levels.

3.2 Estimation strategy

To estimate the dynamic panel data model of Eq. 2, we follow the Generalized Method of Moments (GMM) approach. The reasons for this choice are as follows. First, the framework is flexible enough to accommodate our unbalanced panel. Second, it enables us to handle

²⁹While we admit that it is more relevant to use labor force growth instead of (total) population growth, using the former variable severely restricts the sample size, particularly for the low-income countries (LICs). Thus, in line with other similar cross-country regressions in the literature which also cover LICs (e.g., [Levine et al. \(2000\)](#)), we use the latter variable.

³⁰In the robustness checks, we additionally control for demographic variables such as the fraction of the population below 15 and above 65 years old. Further, we consider inflation rates, the degree of trade openness, and the ratio of credit extended to the private sector to GDP too.

country fixed effects.³¹ Third, it helps us address potential endogeneity of public spending variables through the use of internal instruments (i.e., instruments based on lagged values of those variables), complementing the use of period averages and the lag structure.

While the GMM approach yields consistent estimators, the original ‘difference’ GMM estimators developed by [Holtz-Eakin et al. \(1988\)](#) and [Arellano and Bond \(1991\)](#) may suffer from finite sample biases. These biases arise particularly when time series are persistent. In fact, [Bond et al. \(2001\)](#) suggest that such biases are likely to be large in the context of empirical growth models, as output tends to be a largely persistent variable. They therefore recommend the use of the alternative ‘system’ GMM estimators developed by [Arellano and Bover \(1995\)](#) and [Blundell and Bond \(1998\)](#), which augment the difference estimator by combining the regression in differences with the regression in levels in a system in which the two equations are separately instrumented. We use this system procedure in what follows.^{32,33}

Specifically, we treat the state variables of the model, initial output and human capital ($y_{i,t-x}$ and $u_{i,t-x}$), and the initial spending variables ($e_{i,t-x}$ and $s_{i,j,t-x}$) as predetermined variables, while the other control variables are assumed as endogenous, unless specified otherwise.³⁴ In what follows, we avoid the problem of instrument proliferation by using only

³¹To handle fixed effects, we transform variables through ‘orthogonal deviations’ ([Arellano and Bover \(1995\)](#)) rather than first differencing, because this transformation maximizes the sample size in our unbalanced panel.

³²We considered the choice over difference and system GMM estimators explicitly in our context. Specifically, focusing on the coefficient on the lagged dependent variable (as in [Bond et al. \(2001\)](#) and [Roodman \(2009a\)](#)), and comparing estimates based on these estimators to the range of estimates set by OLS levels and fixed effects (the former as the upper bound and the latter as the lower bound of good estimates of the true parameter), we found that the point estimate from using difference GMM often lies below the corresponding fixed effects estimate, while the estimate from system GMM largely lies between the range. This suggests that difference GMM is seriously biased downwards, i.e., even more biased than fixed effects estimates, while system GMM appears to address this bias observed in difference GMM.

³³Notably, some other works on fiscal policy and growth use the Mean-Group (MG) and/or Pooled Mean-Group (PMG) estimators developed by [Pesaran and Smith \(1995\)](#) and [Pesaran et al. \(1999\)](#), respectively (e.g., [Gemmell et al. \(2011\)](#) and [Arnold et al. \(2011\)](#)). However, one potential disadvantage of using these alternative approaches is that because the use of annual data is usually required (to have a large number of time series observations), business cycle effects can be more problematic than in our 8-year framework. More fundamentally, however, the fact that our highly disaggregated spending dataset is unbalanced practically prohibits the use of these alternative estimators.

³⁴That is, with the 8-year framework, we assume that $\epsilon_{i,t}$, the country-specific time-varying shocks from year $t - 7$ to t , are uncorrelated with initial GDP, human capital, and fiscal variables in $t - 8$ and earlier, while they are uncorrelated with the average of the other control variables from $t - 15$ to $t - 8$ and earlier.

one lag as an internal instrument.³⁵ To consider the validity of this system GMM approach, we conduct various specification tests. The first is the Arellano-Bond test, whose purpose is to examine the hypothesis that the error term is not serially correlated, which is implicitly assumed in the orthogonality conditions. The second is the Hansen test, which checks the overall validity of the various instruments of the system. The third is the difference-in-Hansen test, which examines the validity of instruments used in the level part of the system.

4 Results

4.1 Spending reallocation effects without income level considered

As a benchmark, we first consider the growth effects of spending reallocations without taking account of income levels, i.e., by assuming $\zeta_j = 0$ for all j in Eq. 1. In this case, the regression equation simplifies to (cf. Eq. 2)

$$y_{i,t} - y_{i,t-x} = \alpha y_{i,t-x} + \beta h_{i,t-x} + \sum_{j=1}^{m-1} (\gamma_j - \gamma_m) s_{i,j,t-x} + \delta e_{i,t-x} + \bar{z}'_{i,t} \eta + \gamma_m + \nu_i + \xi_t + \epsilon_{i,t}, \quad (4)$$

where a coefficient on spending item j , $\gamma_j - \gamma_m$, captures the reallocation effect to j from m , independent of income levels.

Table 2 presents the estimation results using the CG-based dataset, with the 8-year framework as a reference. For example, in Column (4), which includes the shares of education and the composite of all the items except education and defense (denoted as ‘Rest excl. Financing comp/Total’) and thus omits defense, the coefficient on education spending captures the growth effect of spending reallocation to education from defense. Specifically, the coefficient of 0.85, being statistically significant at the 5 percent level, indicates that a 1 percentage point rise in the share of education spending throughout an 8-year period, financed by a

³⁵As discussed in Roodman (2009b), the key issue of having “too many” instruments is that it weakens the Hansen test of the instruments’ joint validity (mentioned below). Although there is little formal guidance on how many instruments are “too many”, a rule of thumb is that the number of instruments should not outnumber individual units in the panel (Roodman (2009a)).

corresponding fall in defense spending, is associated with a 0.85 percentage points increase in the growth rate over the period, or an approximately 0.11 percentage points annual rise. Columns (5), (6), and (10), which investigate the effects of education spending, when it is financed by health, social protection, and transport spending, respectively, show that reallocations from these components also significantly promote growth.³⁶ Turning to the remaining combinations, reallocations to defense and social protection from health significantly foster growth (Column (1) and (3)), while reallocations to defense and social protection, away from transport spending, also exhibit positive growth effects.

³⁶In Column (10), the coefficient on transport spending is significantly negative when education spending is omitted. This implies that a spending reallocation towards education from transport fosters growth.

Table 2: Spending reallocations and growth: using CG-based dataset

Regressors	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Total spend/GDP	-0.364 (0.242)	-0.323 (0.256)	-0.110 (0.250)	-0.153 (0.254)	-0.060 (0.253)	-0.172 (0.278)	-0.444** (0.193)	-0.112 (0.269)	-0.174 (0.241)	-0.044 (0.295)
Health/Total spend	-0.977** (0.377)									
Socprot/Total spend	-0.204 (0.398)		0.755** (0.365)							
Educ/Total spend		0.854** (0.376)	1.887*** (0.475)	1.018** (0.429)						
Transport/Total spend							-1.227** (0.586)	-0.712 (0.810)	-1.329** (0.661)	-2.058*** (0.696)
Rest excl. Financing comp/Total	-0.019 (0.292)	-0.040 (0.322)	0.911*** (0.302)	-0.112 (0.299)	0.833** (0.320)	0.124 (0.219)	0.121 (0.367)	0.682 (0.468)	0.153 (0.209)	-0.545 (0.373)
Initial GDP p.c.	-5.999** (2.565)	-5.744* (2.950)	-7.444*** (2.798)	-6.799*** (2.498)	-7.768*** (2.569)	-7.202** (2.953)	-5.540* (2.850)	-7.327** (3.079)	-6.309** (2.723)	-6.842*** (3.295)
Initial schooling years	2.673** (1.149)	2.924** (1.197)	3.366*** (1.249)	3.514*** (1.222)	3.773*** (1.221)	4.571*** (1.311)	2.056 (1.397)	2.700** (1.294)	3.405** (1.326)	3.120** (1.430)
Investment/GDP	2.377*** (0.381)	2.239*** (0.441)	2.415*** (0.382)	2.259*** (0.337)	2.286*** (0.275)	2.216*** (0.359)	2.278*** (0.465)	2.440*** (0.346)	2.411*** (0.364)	2.614*** (0.360)
Pop growth rate	-2.937 (2.356)	-2.787 (3.006)	-2.766 (2.966)	-2.401 (2.541)	-2.977 (2.099)	-1.007 (2.893)	-2.353 (3.226)	-1.743 (2.341)	-0.910 (2.932)	-0.810 (2.108)
Financing Component										
Observations	213	213	213	213	213	213	206	206	206	206
No. of Countries	83	83	83	83	83	83	82	82	82	82
No. of Instruments	57	57	57	57	57	57	57	57	57	57
Arellano-Bond AR(1), p-value	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.02	0.02	0.02
Arellano-Bond AR(2), p-value	0.78	0.88	0.68	0.78	0.69	0.66	0.65	0.55	0.56	0.54
Hansen	0.33	0.41	0.38	0.40	0.38	0.45	0.22	0.46	0.35	0.75
Diff Hansen	0.75	0.80	0.63	0.69	0.56	0.66	0.36	0.63	0.24	0.90

Notes: System GMM estimations for dynamic panel data models. Constant and time dummies are not shown for brevity. All explanatory variables were treated as predetermined except for investment rate and population growth rate, which were treated as endogenous. Orthogonal deviation was used to transform variables. Only one lag was used as an internal instrument to reduce the number of instruments. Robust standard errors are in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. All the diagnostic tests present corresponding p values. Rest excl. Financing comp/Total' differs across columns (e.g., in Column (1), it is the share of the composite of all the spending items excluding health and defense in the total).

Regarding the other variables, the ratio of total spending to GDP mostly has an insignificant growth effect. This happens because the level effect of total spending is offset by a change in other fiscal components to satisfy the government budget constraint. For instance, to the extent that a rise in possibly growth-promoting total spending is financed by a rise in distortionary taxes, the combined effect can be insignificant. Next, the coefficient on the initial GDP per capita, expressed in percent, is significantly negative, being consistent with the conditional convergence hypothesis.³⁷ The years of schooling, a proxy for initial human capital, has a significantly positive effect in most cases. Lastly, the effect of the ratio of investment to GDP is significantly positive, while the population’s growth rate has a negative effect, though insignificant. To note, the diagnostic test results support the use of system GMM estimators.³⁸

Table 3: Spending reallocations and growth: using CG-GG-based dataset

		Share increased				
		Defense	Health	Socprot	Education	Transport
Share decreased	Defense	n/a	–	–	+**	–***
	Health		n/a	+	+***	–
	Socprot			n/a	+***	–**
	Education				n/a	–***
	Transport					n/a

Notes: + (–): growth enhancing (reducing). *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. For the full results and explanation of specifications, see Table 6 in the Online Appendix C.

Table 3 summarizes the reallocation effects using the CG-GG-based dataset instead. There, each of the five columns (rows) designates the component whose spending share is increased (decreased) and each cell gives respective reallocation effects. To ease presentation, we only show the sign of the effects, i.e., + (–) indicating growth promoting (reducing)

³⁷The convergence rates of around 6-7 percent over the 8 years imply annual average convergence rates of about 0.8-0.9 percent, somewhat smaller relative to the often-reported rates of around 2 percent. This may be because we consider here a rather heterogeneous groups of countries.

³⁸First, the Arellano-Bond test for AR(2) indicates the absence of serial correlation of the error term. Second, the Hansen test validates the instruments used both in the difference and level parts of the system as a whole. Third, the difference Hansen test, which examines the validity of instruments used in the level part of the system as a whole, also supports the use of system GMM estimators.

effects, with star superscripts in case they are statistically significant.³⁹ (See Table 6 in the Online Appendix C for full results.) Notice that the results on education and transport components still stand. That is, the former promotes growth when it is financed by a fall in all the other individual components, while reallocations away from the latter also show the positive effects, except when reallocated to health.⁴⁰ However, the positive effects of reallocations away from health (to defense and social protection), observed with the CG-dataset, are absent, indicating the potential importance of taking into account the effects of decentralization in health spending.⁴¹

Robustness checks We now examine the robustness of the above results. First, we change the decentralization threshold from 50 to 75 percent, meaning that if the ratio of spending at the CG to GG level is less than 75 percent even in one of the components in a country, we replace the entire CG-level data with GG-level data for the country. This measure mitigates the potential bias from decentralization, albeit it reduces the number of observations further. Second, we form initial spending figures by 3- (and 5-year), instead of 4-year, averages. That is, for the 1980-87 period, for example, an average is taken over 1978-80 (1976-80), rather than 1977-80, as long as at least one observation is available over the years. The former measure helps improve the consistency of the data across periods, while the latter increases the number of observations. Third, we control for demographic variables, because while aging societies tend to raise health and social protection spending, this demographic feature,

³⁹Notice that focusing on the upper triangular part of the matrix suffices, due to the symmetric nature of the analysis. That is, if increasing item A and decreasing item B promotes growth, decreasing A and increasing B suppresses it.

⁴⁰Additionally, we report that education spending tends to be more growth enhancing than the spending items which are not highlighted here. Specifically, we find that spending reallocations to education from general public services and the rest of economic affairs other than transport and communication exhibit significantly positive growth effects, for both the CG- and CG-GG-based datasets. The detailed estimation results are available from the authors upon request.

⁴¹Put simply, differences in results between Table 2 and Table 3 are only related to the significance of coefficients involving health spending reallocations. That is, while the signs of all possible reallocations are the same across alternative datasets in both tables, only under the CG-based dataset do reallocations to health, from defense and social protection, have a significantly negative effect. Given recent trends in decentralization of health spending, particularly in advanced economies, these differences in results may not be surprising.

implying a smaller fraction of the working age population between 15-65 years old, can affect growth negatively (e.g., Barro and Sala-i-Martin (2004)). Specifically, we add the percentages of the population below 15 and above 65 years old to the reference specification.⁴² Lastly, we change the way the entire sample period is divided, examining 5-year frameworks instead (with the maximum of 8 observations per country).⁴³

Results are summarized in Table 4.⁴⁴ Overall, while spending reallocations to education from all the other items tend to exhibit growth-promoting effects, the effects appear to be particularly robust when reallocated from health and social protection. Meanwhile, reallocations away from transport spending, toward the other components, may not necessarily exhibit significantly positive effects, except when reallocated to education. Lastly, notice that, although spending reallocations away from health to defense and social protection show some sign of growth-promoting effects, they indeed do not appear robust to the use of GG-based data.⁴⁵

4.2 Role of income levels in the spending reallocation-growth nexus

Although the above analyses shed some light on the growth effects of public spending reallocations, they may mask the potentially important roles of income heterogeneity across countries. Acknowledging this, we now estimate Eq. 2 with the interaction terms present. Figure 1, using the estimation results based on CG-based dataset, graphically illustrates how the marginal effects of spending reallocations change across the observed range of income levels, for all the different reallocations considered above. (See Table 7 in the Online Appendix C for the estimation results.)

⁴²To avoid the issue of instrument proliferation, we treat these additional variables as exogenous.

⁴³With the larger time dimension (i.e., 8 periods), the issue of instrument proliferation again arises, even when only one lagged value is used as an internal instrument. Therefore, in this case, while still treating investment rate and population growth rate as endogenous (and using one lag for instruments), we use the option collapse of the command `xtabond2` for Stata, for these variables.

⁴⁴All the detailed results are available from the authors upon request.

⁴⁵To note, we also examined the robustness by adding the extra controls often considered in growth regressions, namely, inflation rates, the degree of trade openness, and the ratio of credit extended to private sector to GDP. However, since the key results obtained here still stand, the result of this robustness check is not shown for brevity.

Table 4: Robustness checks: growth effects of spending reallocations

		Share increased				
		Defense	Health	Socprot	Education	Transport
<i>CG-GG-data with a 75 percent decentralization threshold</i>						
Share decreased	Defense	n/a	–	–	+	–*
	Health		n/a	+	+***	–
	Socprot			n/a	+***	–*
	Education				n/a	–***
	Transport					n/a
<i>CG (and CG-GG) data with initial spending as 3-year averages</i>						
Share decreased	Defense	n/a	–*(–)	–(–)	+**(+**)	–(–*)
	Health		n/a	+*(+)	+***(+**)	–(+)
	Socprot			n/a	+**(+**)	–(–)
	Education				n/a	–**(-***)
	Transport					n/a
<i>CG (and CG-GG) data with initial spending as 5-year averages</i>						
Share decreased	Defense	n/a	–***(-)	–(–)	+*(+)	–**(-***)
	Health		n/a	+**(+)	+***(+***)	–(–)
	Socprot			n/a	+*(+**)	–**(-***)
	Education				n/a	–***(-***)
	Transport					n/a
<i>CG (and CG-GG) data with demographic controls</i>						
Share decreased	Defense	n/a	–***(-)	–(–)	+**(+*)	–**(-***)
	Health		n/a	+**(+)	+***(+**)	–(–)
	Socprot			n/a	+**(+**)	–**(-***)
	Education				n/a	–***(-***)
	Transport					n/a
<i>CG (and CG-GG) data with 5-year periods</i>						
Share decreased	Defense	n/a	–(–*)	+(+)	+***(+**)	–(–)
	Health		n/a	+***(+*)	+***(+***)	+(+)
	Socprot			n/a	+***(+*)	–(–)
	Education				n/a	–(–)
	Transport					n/a

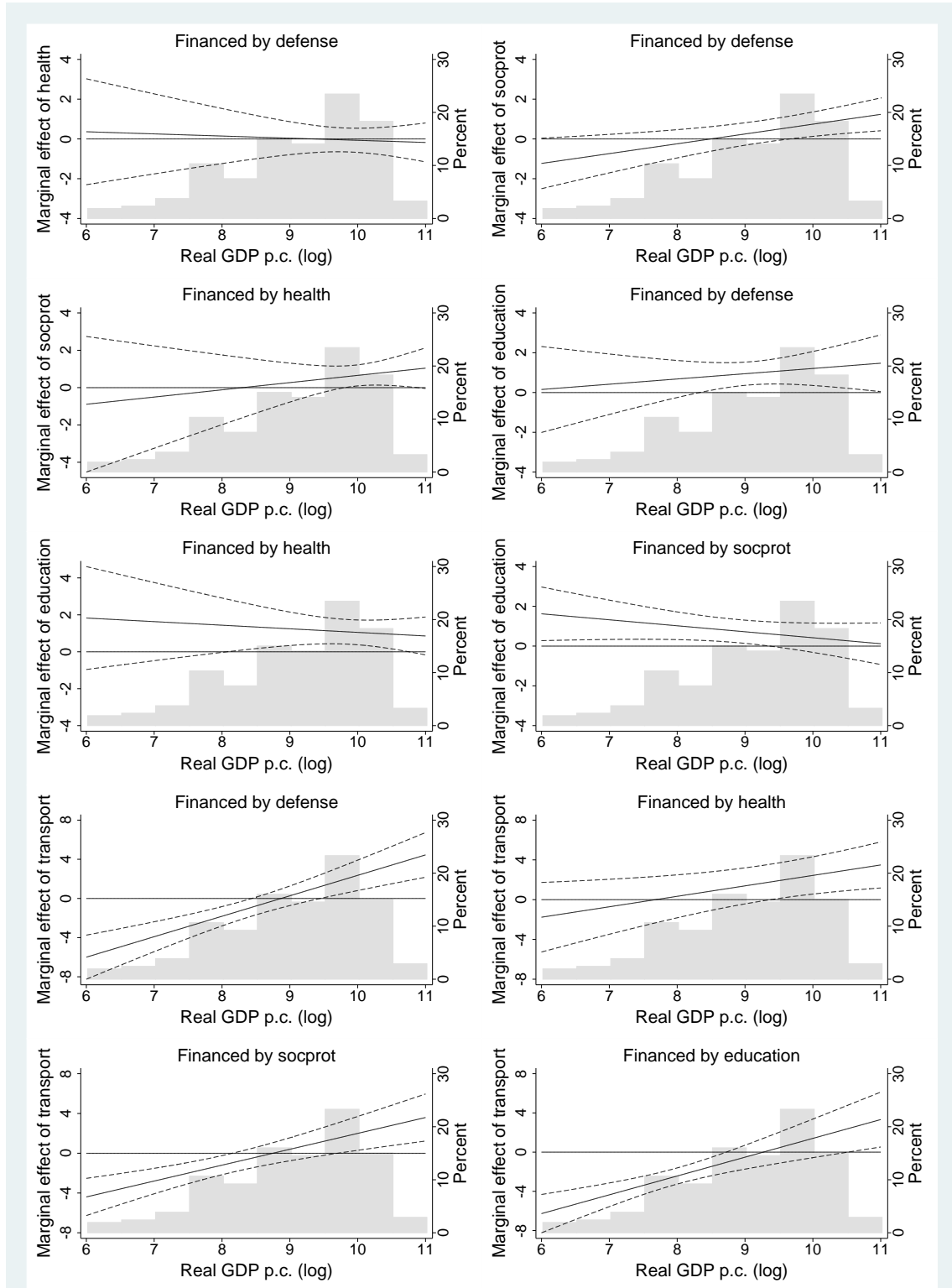
Notes: + (–): growth enhancing (reducing). *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. When using CG-GG data with a 75 percent threshold (and without economic affairs disaggregated), results are based on 83 countries covering 171 observations. For the case with initial spending as 3-year average (initial spending as 5-year average, demographic variables, 5-year periods) using CG-based dataset without economic affairs disaggregated, results are based on 80 (83, 82, 84) countries covering 202 (224, 211, 354) observations. All the underlying estimation results are available from the authors upon request.

For example, the left sub-figure in the third row presents the marginal effect (solid line) of a reallocation to education from health, together with the corresponding 90% confidence intervals (dashed lines). Notice that the effects, rather independent of income levels (corresponding to the insignificant coefficient on the interaction term), are significantly positive for

a wide range of the income levels. Specifically, the effects are significantly positive when the log of real GDP p.c. is between 8.1 and 10.8, roughly corresponding to the middle- to high-income range. (Incidentally, the histogram depicting the distribution of income levels shows that about 80 percent of the entire observations are located within this region of positive significance.) A similar comment can be made for the reallocation to education from social protection and also from defense, albeit for the former finance source, the positive effects are observed rather over the low- to middle-income range.⁴⁶

⁴⁶To acknowledge, when countries' income levels are lower, social protection spending tends to be lower and thus there is smaller room to be reallocated from. However, since our analysis focuses on the marginal effects of reallocations, the results are still valid.

Figure 1: Effects of spending reallocations across income levels: using CG-based dataset



Note: Solid (dashed) line represents a marginal effect (90% confidence interval). Histogram describes the distribution of initial income.

Source: Authors' calculations

Meanwhile, the sub-figures in the fourth and fifth rows describe the reallocation effects towards transport, from all the other components. Notice that the marginal effects do exhibit a distinct positive slope, consistent with the significantly positive coefficients on interaction terms in all the cases. Relatedly, the effects are significantly negative primarily in the low-income region (except for the case when it is financed by a fall in health spending), which indicates that a reallocation *away* from transport, to items such as education, promotes growth particularly in low-income countries. Overall, these findings from the interaction analyses highlight the importance of income heterogeneity in the spending reallocations-growth nexus, particularly when transport spending is involved. Lastly, Figure 3 in the Online Appendix C indicates that a similar message can be drawn when using the CG-GG-based dataset, although generally larger standard errors (associated with the smaller number of observations) tend to narrow the income regions where the marginal effects are significant.⁴⁷

Examining reallocation effects using subsamples Next, to check the robustness of the role of income levels, we estimate the growth effects of spending reallocations using subsamples of the entire sample, without interaction terms. Specifically, the following two subsets are considered: one without “poor” countries (57 countries) and another without the “very rich” ones (74 countries).⁴⁸ Table 5 summarize the results on reallocation effects

⁴⁷Running regressions with interaction terms using the CG-GG-based dataset requires a further restriction of instrument counts, as implied by the Hansen statistic of almost unity for the majority of the regressions. Thus, when running these regressions, we use the option collapse (as mentioned above), for investment rate and population growth rate, while still using only one lag for instruments. The detailed results on CG-GG-based dataset is available from the authors upon request.

⁴⁸We take the following procedure to classify countries into rich and poor. First, for each of the 42 years (1970-2011, the period our fiscal dataset spans), we sort the 183 countries available in the IMF’s World Economic Outlook (WEO) according to their GDP per capita level (PPP prices) into two groups: the upper and lower half. Then, counting the number of times each country appears in those groups during the sample period, we classify countries that appear in the upper half most frequently as rich and the remaining countries as poor. Next, to define “very rich” countries, we take a similar approach, sorting the 183 countries into 10 equal groups. Then, we classify countries that appear in the top 10 percentile most frequently as very rich. The reason for choosing this threshold of 10 percentile (say, rather than 25 percentile) is to ensure that sufficient countries/observations are left in the remaining sample.

for both subsets.⁴⁹ First, the upper sub-table shows that when poor countries are excluded, reallocations towards transport spending tend to exhibit *positive* effects, albeit mostly insignificant, unlike significantly negative effects often observed when considering the entire sample (cf. Table 2 and Table 6). In contrast, the lower sub-table reveals that when using a sample without very rich countries, the negative effects are restored. Indeed, these results appear consistent with the ones from the interaction analyses. Second, reallocations towards education from health and social protection exhibit positive effects in both subsamples, implying that these reallocations tend to have growth-promoting effects over a wide range of countries. Again, this is in line with the results from the interaction analyses.

Table 5: Growth effects of spending reallocations in subsamples of countries

		Share increased				
		Defense	Health	Socprot	Education	Transport
<i>CG (and CG-GG) data without poor countries</i>						
Share decreased	Defense	n/a	−(−)	+(−)	+(+)	+(+)
	Health		n/a	+(+)	+***(+**)	+***(+)
	Socprot			n/a	+(+**)	+(+)
	Education				n/a	−(−)
	Transport					n/a
<i>CG (and CG-GG) data without very rich countries</i>						
Share decreased	Defense	n/a	−(−)	−(−)	+**(+)	−***(−***)
	Health		n/a	+(+)	+***(+**)	−(−)
	Socprot			n/a	+**(+***)	−**(-***)
	Education				n/a	−***(−***)
	Transport					n/a

Notes: + (−): growth enhancing (reducing). *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. For the case where economic affairs is not disaggregated into transport and others, the number of observation without poor (very rich) countries with CG-based dataset is 159 (172) from 57 (74) countries. All the underlying estimation results are available from the authors upon request.

Further robustness checks We further examined the robustness of the results on the role of income levels, by repeating some of the checks conducted above (cf. Table 4), for both interaction and subsample analyses.⁵⁰ Specifically, we examined the use of CG- and CG-GG-based datasets with initial spending as 5-year averages and also the addition of demographic

⁴⁹To address instrument proliferation, we use here the option collapse for investment rate and population growth rate. The detailed estimation results are available from the authors upon request.

⁵⁰All the test results are available from the authors upon request.

variables.⁵¹ In short, the interaction analyses indicate that the growth-promoting effects of reallocations to education from health and social protection tend to be rather indifferent to income levels, whereas reallocations away from transport to others such as education promote growth primarily in low-income regions. The subsample analyses yield consistent results.

4.3 Why does income heterogeneity matter?

However, why do spending reallocations towards transport, a proxy for infrastructure, have particularly weak growth-promoting effects in low income countries, while education does not exhibit such effects? Our basic conjecture is that, while both spending items have potentially strong growth-promoting effects (e.g., the former through promoting the productive efficiency of private firms; the latter through enhancing human capital), the efficiency of infrastructure spending may be *particularly* susceptible to the low-quality of governance often observed in these countries.⁵² In our view, there may be at least two bases for this conjecture.

To explain the first, it is useful to acknowledge that infrastructure projects tend to be capital intensive, unlike education spending for which its largest share can be rather classified as current spending, such as public wages for teachers. Then, as emphasized by [Tanzi and Davoodi \(1997\)](#) and [Keefer and Knack \(2007\)](#), since capital spending is often a convenient vehicle for government officials' rent seeking (e.g., in the form of commissions from private firms seeking for public capital projects), the efficiency of this type of spending can easily be compromised, particularly when officials are not properly constrained. Meanwhile, in the case of wages, there is less room for rent seeking by officials, because they tend to be predetermined outside officials' discretion. Therefore, the degree of political constraints, a key aspect of governance quality, may influence the effectiveness of infrastructure spending in a particularly critical manner. Second, the quality of bureaucracy in general, another key aspect of governance, can be a particularly important determinant of the efficiency of infras-

⁵¹Given that the interaction approach requires more predetermined variables, i.e., interaction terms, and that the subsample analyses severely restrict the sample size, certain tests, particularly the ones causing the issue of instrument proliferation, are difficult to conduct.

⁵²We define governance as the general manner in which authority is exercised in a country.

structure spending. This is because, in general, a proper conduct of infrastructure projects often involves a particularly long-lasting, potentially complicated, management processes, including appraisal, selection, implementation, and evaluation (see [Dabla-Norris et al. \(2012\)](#) for detailed public investment management processes). Therefore, for a project to be carried out efficiently, a high-quality bureaucracy, which is capable of managing these potentially complicated processes properly, is often required. To clarify, while other public spending components should also benefit from such strong bureaucracies, the particular complexity of infrastructure projects may render their successful completion *more* dependent on their presence.

Is there any evidence for this conjecture? While providing thorough evidence is beyond the scope of this paper, we present here suggestive evidence for the possible importance of governance quality, particularly in the effects of infrastructure spending. For this purpose, we consider the following interaction model similar to Eq. 1:

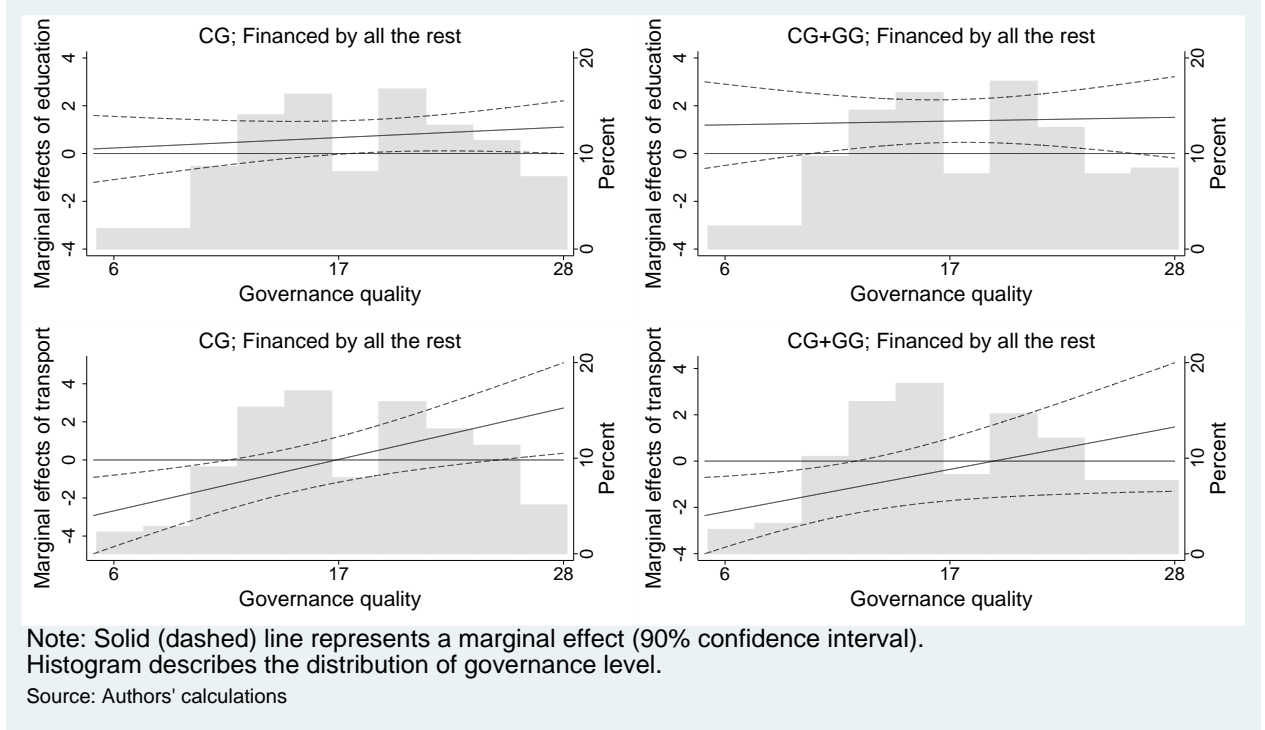
$$y_{i,t} - y_{i,t-x} = \alpha y_{i,t-x} + \beta h_{i,t-x} + \sum_{j=1}^m \gamma_j s_{i,j,t-x} + \sum_{j=1}^m \zeta_j s_{i,j,t-x} g_{i,t-x} + \lambda g_{i,t-x} + \delta e_{i,t-x} + \bar{z}'_{i,t} \eta + \nu_i + \xi_t + \epsilon_{i,t}, \quad (5)$$

where the key difference is that this model rather highlights interactions between the shares of spending components, $s_{i,j,t-x}$ and the governance variable, $g_{i,t-x}$. Following works such as [Keefer and Knack \(2007\)](#), the governance level is proxied by a composite of institutional indicators provided by the International Country Risk Guide (ICRG).^{53,54}

⁵³The indicators used are law and order, corruption, bureaucracy quality, and investment profile. The governance proxy is then created as the unweighted addition of these indicators. (We used investment profile, as a substitute for ‘the risk of expropriation and of repudiation of contracts by government’ used by [Keefer and Knack \(2007\)](#), since this variable is no longer available in the recent versions of the dataset.) A similar ICRG index is also used by [Shi and Svensson \(2006\)](#), particularly to capture the level of rents extracted by politicians whilst in power.

⁵⁴Consistent with the spending shares, we use initial governance proxies in each period. To note, since ICRG index often becomes available only since 1984, to ensure that we cover here at least 4 (8-year) periods since the 1980-87 period, we extrapolate the oldest available figure to 1980, by assuming that governance level did not change over the few years.

Figure 2: Effects of spending reallocations across governance levels



To proceed, we address again multicollinearity by omitting (at least) one spending share. For simplification, we do not specify the financing factor here.⁵⁵ That is, by defining item m as the composite of all the spending items except item j , and omitting this composite, we estimate

$$\begin{aligned}
 y_{i,t} - y_{i,t-x} = & \alpha y_{i,t-x} + \beta h_{i,t-x} + (\gamma_j - \gamma_m) s_{i,j,t-x} + (\zeta_j - \zeta_m) s_{i,j,t-x} g_{i,t-x} + (\lambda + \zeta_m) g_{i,t-x} \\
 & + \delta e_{i,t-x} + \bar{z}'_{i,t} \eta + \gamma_m + \nu_i + \xi_t + \epsilon_{i,t}.
 \end{aligned} \tag{6}$$

Then, the marginal growth effect of spending share j , $(\gamma_j - \gamma_m) + (\zeta_j - \zeta_m) g_{i,t-x}$, captures the effect of spending j , relative to the one of the composite of all the remaining items, m , as a function of the governance level.

⁵⁵This is to deal with the fact that the use of ICRG makes country coverage and observations smaller.

Figure 2 describes how the effects of education and infrastructure (transport) spending change across the observed range of governance levels, where a larger value corresponds to the better-quality of governance. (See Table 8 in the Online Appendix C for the underlying estimation results.) The lower sub-figures suggest that for both CG- and CG-GG-based datasets, the effects of infrastructure spending, relative to all the other spending items, are increasing in the governance quality, consistent with the significantly positive coefficients on the interaction terms in the respective regressions. Relatedly, the effects are negatively significant in the low-quality governance region. Meanwhile, the upper sub-figures show that the growth-promoting effects of education spending are rather unaffected by governance quality, in line with the insignificant coefficients on the interaction terms.⁵⁶ Thus, the implication is that, the above finding of weak growth effects of infrastructure spending in low-income countries is potentially driven by low-quality governance, as often observed in these countries.

5 Concluding Remarks

Having examined the effects of public spending reallocations on growth, we found that reallocations towards education, from health and social protection, robustly promote growth across a wide range of countries' income levels. However, income heterogeneity matters in the spending reallocations-growth nexus, particularly when infrastructure spending is involved. Specifically, only when income levels are low, reallocations away from this spending, to items such as education, enhance growth. This happens because while the growth-promoting effects of education spending tend to prevail across different income levels, the effects of infrastructure spending exhibit a positive association with them. However, the fundamental reason why infrastructure spending has particularly weak growth-promoting effects in low-income countries may be that inefficiencies caused by their low-quality of governance, exemplified by unconstrained officials' rent-seeking behavior, mitigate the positive effects of this spending.

⁵⁶Further, we report that none of the effects of the other spending items, i.e., defense, health, and social protection, exhibits a clear positive association with governance level, as infrastructure spending does.

Our findings have various policy implications. First, while governments may attempt to foster growth through public spending reallocations under different circumstances (say, when adopting fiscal austerity measures), at least from a growth perspective, they may wish to increase education spending and instead curb spending in other categories such as health and social protection. Next, particularly in low-income countries, increasing infrastructure spending through reallocations does not appear to be a growth-promoting policy. Rather, to the extent that low-quality governance is weakening the effects of this spending in these countries, promoting institutional reforms to restrain officials' rent-seeking opportunities in public investment management may be all the more beneficial to them.

However, one important caveat is in order regarding policy implications. That is, despite its undeniable importance, economic growth is *not* the only criterion that a government utilizes in determining the composition of public spending. While this paper focuses on growth, there are other potential elements, such as employment and income inequality, that are of critical importance. Indeed, although social protection spending may not be growth enhancing, it may help reduce income inequality. Therefore, from a broader policy perspective, it is important to consider the effects of spending reallocation policies on these other key elements of economic well-being as well. A careful examination of these effects thus appears to be a fruitful topic for future research.

Finally, another possible topic for future research is to carefully examine the role of political and economic freedom in the relation between public spending and growth. It is possible that these freedom concepts, the former defined as the general public's rights which guarantee their own political participation, and the latter as their rights to pursue their own economic decisions without excessive regulations, may play a different role in the growth effects of different spending items. For example, while this paper suggests that the low quality of governance is associated with the weak growth effects of infrastructure spending, this may also indicate the important role of political freedom in this association. Further

investigation of the possible role of these freedom concepts may shed brighter light on the conditions under which different public spending policies have growth-promoting effects.

Acknowledgement

We thank Alberto Alesina, Yu Aoki, Michael Bleaney, Mark De Broeck, Benedict Clements, Markus Eberhardt, Norman Gemmill, Sourafel Girma, Sanjeev Gupta, Zohal Hessami, Kentaro Katayama, Richard Kneller, Kevin Lee, Mico Loretan, Jorge Martinez-Vazquez, Paolo Mauro, Oliver Morrissey, Jonathan Temple, Harald Uhlig, and Francisco José Veiga for their comments. We also thank Andrea Gamba and Jiae Yoo for their help with the dataset. Any remaining errors are our own responsibility.

References

- AGÉNOR, P.-R. (2010): “A theory of infrastructure-led development,” *Journal of Economic Dynamics & Control*, 34, 932–950.
- AÍSA, R. AND F. PUEYO (2006): “Government health spending and growth in a model of endogenous longevity,” *Economics Letters*, 90, 249–253.
- ARELLANO, M. AND S. BOND (1991): “Some tests of specification for panel data: Monte Carlo evidence and an application to employment equations,” *Review of Economic Studies*, 58, 277–297.
- ARELLANO, M. AND O. BOVER (1995): “Another look at the instrumental-variable estimation of error-components models,” *Journal of Econometrics*, 68, 29–52.
- ARNOLD, J. M., B. BRYE, C. HEADY, Å. JOHANSSON, C. SCHWELLNUS, AND L. VARTIA (2011): “Tax policy for economic recovery and growth,” *Economic Journal*, 121, F59–F80.

- BARRO, R. (1990): "Government spending in a simple model of endogenous growth," *Journal of Political Economy*, 98, S103–S125.
- BARRO, R. AND X. SALA-I-MARTIN (2004): *Economic Growth*, Cambridge, Massachusetts: MIT Press, second ed.
- BLANKENAU, W. F. AND N. B. SIMPSON (2004): "Public education expenditures and growth," *Journal of Development Economics*, 73, 583–605.
- BLEANEY, M., N. GEMMELL, AND R. KNELLER (2001): "Testing the endogenous growth model: Public expenditure, taxation, and growth over the long run," *Canadian Journal of Economics*, 34, 36–57.
- BLUNDELL, R. AND S. BOND (1998): "Initial conditions and moment restrictions in dynamic panel data models," *Journal of Econometrics*, 87, 115–143.
- BOND, S., A. HOEFFLER, AND J. TEMPLE (2001): "GMM Estimation of Empirical Growth Models," Discussion Paper No. 2048, Centre for Economic Policy Research.
- BOSE, N., M. E. HAQUE, AND D. R. OSBORN (2007): "Public expenditure and economic growth: A disaggregated analysis for developing countries," *The Manchester School*, 75, 533–556.
- CLEMENTS, B., D. COADY, F. EICH, S. GUPTA, A. KANGUR, B. SHANG, AND M. SOTO (2012): *The Challenge of Health Care Reform in Advanced and Emerging Economies*, Occasional Paper No 275, Washington DC: International Monetary Fund.
- DABLA-NORRIS, E., J. BRUMBY, A. KYOBE, Z. MILLS, AND C. PAPAGEORGIOU (2012): "Investing in public investment: An index of public investment efficiency," *Journal of Economic Growth*, 17, 235–266.
- DEVARAJAN, S., V. SWAROOP, AND H.-F. ZOU (1996): "The composition of public expenditure and economic growth," *Journal of Monetary Economics*, 37, 313–344.

- GEMMELL, N., R. KNELLER, AND I. SANZ (2011): “The timing and persistence of fiscal policy impacts on growth: Evidence from OECD countries,” *Economic Journal*, 121, F33–F58.
- GEMMELL, N., F. MISCH, AND B. MORENO-DODSON (2013): “Public Spending and Long-Run Growth in Practice: Concepts, Tools, and Evidence,” in *Is Fiscal Policy the Answer? A Developing Country Perspective*, ed. by B. Moreno-Dodson, Washington, D.C.: The World Bank, 69–107.
- GHOSH, S. AND A. GREGORIOU (2008): “The composition of government spending and growth: Is current or capital spending better?” *Oxford Economic Papers*, 60, 484–516.
- GLOMM, G. AND B. RAVIKUMAR (1997): “Productive government expenditures and long-run growth,” *Journal of Economic Dynamics and Control*, 21, 183–204.
- GUPTA, S., B. CLEMENTS, E. BALDACCI, AND C. MULAS-GRANADOS (2005): “Fiscal policy, expenditure composition, and growth in low-income countries,” *Journal of International Money and Finance*, 24, 441–463.
- HOLTZ-EAKIN, D., W. NEWEY, AND H. ROSEN (1988): “Estimating vector autoregressions with panel data,” *Econometrica*, 56, 1371–1395.
- KEEFER, P. AND S. KNACK (2007): “Boondoggles, rent-seeking, and political checks and balances: public investment under unaccountable governments,” *The Review of Economics and Statistics*, 89, 566–572.
- KNELLER, R., M. F. BLEANEY, AND N. GEMMELL (1999): “Fiscal policy and growth: evidence from OECD countries,” *Journal of Public Economics*, 74, 171–190.
- LAMBRECHT, S., P. MICHEL, AND J.-P. VIDAL (2005): “Public pensions and growth,” *European Economic Review*, 49, 1261–1281.

- LEVINE, R., N. LOAYZA, AND T. BECK (2000): “Financial intermediation and growth: Causality and causes,” *Journal of Monetary Economics*, 46, 31–77.
- PESARAN, M. H., Y. SHIN, AND R. P. SMITH (1999): “Pooled mean group estimation of dynamic heterogeneous panels,” *Journal of the American Statistical Association*, 94, 621–34.
- PESARAN, M. H. AND R. P. SMITH (1995): “Estimating long-run relationships from dynamic heterogeneous panels,” *Journal of Econometrics*, 68, 79–113.
- PRITCHETT, L. (2000): “The tyranny of concepts: CUDIE (cumulated, depreciated, investment effort) is not capital,” *Journal of Economic Growth*, 5, 361–384.
- ROODMAN, D. (2009a): “How to do xtabond2: An introduction to difference and system GMM in Stata,” *Stata Journal*, 9, 86–136.
- (2009b): “A Note on the Theme of Too Many Instruments,” *Oxford Bulletin of Economics and Statistics*, 71, 135–58.
- SHI, M. AND J. SVENSSON (2006): “Political budget cycles: Do they differ across countries and why?” *Journal of Public Economics*, 90, 1367–1389.
- TANZI, V. AND H. DAVOODI (1997): “Corruption, public investment, and growth,” IMF Working Paper 97/139.
- TRABANDT, M. AND H. UHLIG (2011): “The Laffer curve revisited,” *Journal of Monetary Economics*, 58, 305–327.
- TURNOVSKY, S. J. AND W. H. FISHER (1995): “The composition of government and its consequences for macroeconomic performance,” *Journal of Economic Dynamics and Control*, 19, 747–786.

WICKENS, T. (2002): "Government Finance Statistics Manual 2001 Companion Material: Classification of GFSM 1986 data to the GFSM 2001 framework," International Monetary Fund.