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Can a government enhance long-run growth by changing the composition of public expenditure?*

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Abstract

This paper examines the impact of a compositional change in public expenditure on long-run growth. To do this, we construct a new dataset based on the IMF's government finance statistics (GFS) yearbook covering the period 1970-2010 for 56 countries (14 low-, 16 medium-, and 26 high-income countries). We then study the causal effects of changes in the composition of expenditure on growth using generalized-method-of-moments (GMM) dynamic panel estimators. Our main finding is that a government can promote long-run growth by increasing education spending offset by a fall in social spending (i.e., health and social protection). An increase in public spending on infrastructure, however, does not appear to enhance growth when compensated by a fall in spending on other components, most notably education and social spending.

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1 Introduction

Can a government promote long-run growth by changing the composition of public expenditure? This question is relevant to many economies around the world for various reasons. For example, if a government faces high levels of indebtedness and decides to undertake fiscal austerity measures to reduce the debt burden, it may not be able to increase public spending for several years.[1] However, a government may still attempt to foster growth by changing the composition of its spending envelope. Amid current demographic trends of population aging, various governments may also find it inevitable to increase health and social protection spending over the next several years. Since at least part of the increasing bill needs to be covered by a reduction in spending in other components, policymakers will need to decide which type of spending to reduce while trying to preserve growth. One relevant historical example of spending reallocations is found in western countries after the end of the Cold War. In the face of the fall in defense-related outlays, policymakers then needed to consider how to reallocate this so-called 'peace dividend' to other components such as economic infrastructure or social protection to cope with the economic and social challenges of that time.

Despite its apparent importance, the effects of public expenditure composition on growth have been rarely investigated, apart from a few notable exceptions. These include theoretical works such as Barro (1990), who shows that when a government increases 'utility-enhancing' public consumption while reducing 'production-enhancing' public spending, growth rates fall regardless of the level of total spending. While theoretical models shed valuable light on the way compositional changes exert their effects on growth, their implications are often not specific enough for active policymaking, since the contents of their classifications such as utility-enhancing expenditure can be debatable.[2] As for the empirical work, Devarajan et al. (1996) find that an increase in spending on economic infrastructure is associated with slower growth in developing countries.[3] However, because they often do not clarify which components are used as compensating factors (to keep

[1]For example, the 2012 UK's 'autumn statement' (the annual statement made by HM treasury on economic forecasts) indicates that the ongoing fiscal austerity program would continue through 2018.

[2]Another theoretical work that we are aware of on the link between public expenditure composition and growth is Agénor (2010). He shows how a reallocation from 'unproductive' public spending to infrastructure spending helps a country move to a steady state of higher growth.

[3]Ghosh and Gregoriou (2008) extend Devarajan et al. (1996)'s empirical specification by assuming that a government sets the composition of expenditure to maximize a representative household's utility function. Using data from 15 developing countries, they show that capital spending still has a negative effect on growth.

the level of total spending constant), their policy implications may still not be practical enough.[4] In short, the literature has not yet offered clear policy recommendations as to how a government should reallocate spending among different components to promote long-run growth.

This paper attempts to fill in this gap. For this purpose, we first assemble a new dataset based on historical fiscal data reported to the IMF's government finance statistics (GFS) yearbook from 1970 to 2010. The novelty of the dataset is that it directly confronts methodological changes occurred from mid 1990s to early 2000s with the introduction of a new GFS manual (i.e., GFSM2001). These methodological changes include differences in the way in which components are categorized in the economic and functional classifications of expenditures.[5] Although we had to undertake important assumptions to bridge the two methodologies, for instance mixing cash and accrual basis concepts in certain cases, our dataset still offers *comparable* fiscal data across periods. This dataset, being an unbalanced panel, covers in total 56 countries (14 low-, 16 medium- and 26 high-income countries) during the period 1970-2010 at the central government level.[6]

We then attempt to capture the causal effects of government spending reallocation on growth both in terms of the economic and functional classifications of expenditure. To do this, we use the Generalized-method-of-moments (GMM) dynamic panel estimators developed by Holtz-Eakin et al. (1990) and Arellano and Bond (1991).[7] These estimators, in addition to being flexible to accommodate unbalanced panels while also handling the bias from unobserved country-specific effects, have the advantage of dealing with potential endogeneity problems. This property is important in our context. For instance, even if we observe a positive correlation between the share of education spending in total spending and economic growth, it does not necessarily imply that a higher share

[4]To be exact, Devarajan et al. (1996) note on page 327 that "(...) a unit increase in the budgetary share of (...) spending has to be matched by a unit decrease in some other spending share(s), as the size of total spending remains fixed (...)."

[5]The former is based on the economic characteristics of expenditure (e.g., wages, net acquisition of non-financial assets, etc.), while the latter is based on the function to which expenditure is allocated (e.g., defense, education, health, etc.)

[6]To classify countries according to their income level along the entire 40 years, we take the following approach. First, we sort countries according to their GDP per capita (PPP prices) for each of the 40 years. Each year the low-income countries group (LICs) contains the lower half of countries in the GDP per capita distribution, the middle-income countries group (MICs) contains instead from the 50th to the 75th percentile, and the high-income countries group (HICs) contains the highest 25th percentile. We then categorize countries as LICs, MICs or HICs based on the frequency at which each country enters into each group considering the whole 40-years period.

[7]To tackle the finite sample biases caused by the use of 'difference' GMM estimators, we use the 'system' GMM approach suggested by Arellano and Bover (1995) and Blundell and Bond (1997).

devoted to education *causes* higher growth. The causality could be reverse, making the education share eventually endogenous.

Our main results are as follows. First, a government may not be able to promote growth by simply changing the composition of spending as defined by the economic classification of expenditure. Specifically, an increase in capital spending financed by a fall in current spending such as wages (or vice versa) does not seem to promote growth. However, when a government reallocates its spending classified by its function, there seems to be room to promote growth. Indeed, our second and most important result is that if a government increases its spending share on education while decreasing the share on social spending such as health or social protection, it can promote growth in the long run. This result is reasonably robust to various checks including the use of lagged fiscal variables (under the assumption that the composition effects on growth emerge with a lag), the addition of various widely-used control variables, and the use of a particular subset of countries. Moreover, although we obtain this main result using consolidated central government level data, we show that it is likely to hold even at the consolidated general government level. Our final result is that public spending on economic infrastructure is not likely to be growth enhancing when compensated by a fall in spending in other components, including social spending and education.

In the related literature, a number of papers have examined the role of public education expenditures on economic growth. This interest is natural because at least since Lucas (1988) the important role of human capital accumulation on growth has been widely acknowledged. Then, to the extent that education spending promotes the accumulation of human capital, one would expect that it enhances growth. However, empirical results so far are not necessarily consistent with this common intuition. For instance, focusing on the level effects of this spending (thus causing an increase in total spending), Easterly and Rebelo (1993) show that education is not always growth-enhancing, pointing out that the promoting effects become statistically insignificant in some specifications. Likewise, Barro (2004), in his comprehensive study of determinants of growth, also finds that an increase in public education spending does not have a statistically significant effect on growth.[8] Facing these inconclusive empirical results, Blankenau and Simpson (2004) theoretically show that the effects of public education spending on growth may be non-monotonic.[9] In particular, their model suggests that while public education spending has a positive impact on growth by

[8]Bose et al. (2007), however, show that this spending is robustly associated with faster growth in developing countries.

[9]Other theoretical works on public education and growth include Kaganovich and Zilcha (1999).

directly promoting human capital accumulation, there are also potentially negative general equilibrium effects depending on, say, the tax structure of the economy. Our work adds to this literature by empirically showing that public education expenditure is growth enhancing particularly when the source of its financing is a fall in social spending.

Turning to public infrastructure spending, empirical findings are again mixed. For instance, while Aschauer (1989) suggests that it has a significant positive effect on growth, Holtz-Eakin (1994) indicates otherwise, showing that the positive effects completely vanish when region-specific effects are controlled for.[10] This controversy regarding the effectiveness of public infrastructure may also appear to be counter-intuitive because this spending, causing an increase in public capital and thus enhancing private firms' productivity (given their private inputs), is expected to promote growth. However, more recent works such as Pritchett (2000) and Dabla-Norris et al. (2012) emphasize that not all actual accounting cost of public investment creates economically valuable capital, which can be exemplified through the expression of public investment turning into 'incomplete roads leading to nowhere'. In line with this valuable point, Agénor (2010) theoretically shows that only when the degree of public investment efficiency is high, a reallocation of spending into infrastructure from 'unproductive' spending can be growth enhancing. Indeed, his result may imply that it is the potentially inefficient public infrastructure spending that explains why we find a rather neutral role of this type of spending on economic growth.

There are other related papers in the broad literature of fiscal policy and growth. For instance, Gupta et al. (2005) show that while current spending such as that on wages has a negative impact on growth, capital spending is growth-enhancing.[11] Other relevant paper, Kneller et al. (1999), examines the effectiveness of tax-financed increases in government spending. Focusing on 22 OECD countries they show 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. Finally, several other works have focused on the role of government revenue in fostering economic growth (e.g., Mendoza et al. (1997), and Lee and Gordon

[10] Glomm and Ravikumar (1997) expertly summarizes the early literature on infrastructure expenditure and growth.

[11] Although this result may seem to contradict our rather neutral finding considering the economic classification of expenditure, there are a number of differences between our work and theirs. For instance, while their sample covers a large number of developing countries (39 countries), our coverage of developing countries is not that broad. Our dataset, however, spans a longer period of time: we take 40 years of fiscal data whereas they only focus on a 10-years time frame.

(2005)). Among them, our paper is closest to Arnold et al. (2011) in terms of the specification of fiscal variables in the empirical model.[12] Particularly, they also focus on compositional effects while specifying the compensating factors in their analysis.[13] They find that corporate income taxes are particularly growth-reducing relative to other taxes such as consumption and property taxes.

The rest of the paper is structured as follows. Section 2 describes the new dataset. Section 3 conducts the regression analysis and, finally, Section 4 presents some concluding remarks.

2 The dataset

2.1 Construction of the dataset

2.1.1 Merging GFSM1986 with GFSM2001

To study the compositional effects of changes in public expenditure on growth, we first assemble a new dataset using the IMF's GFS yearbook. To explain the novelty of the dataset, we first note that in principle this database contains all detailed fiscal data covering a wide set of countries from 1970 onwards needed for our empirical analysis. However, a major methodological change that took place with the introduction of GFSM2001 (from mid 1990s to early 2000s) makes the series after the change somewhat incomparable with those of the previous methodology. Facing this issue, yet hoping to have a long dataset covering the whole 40 years, we bridge these methodological changes to construct *comparable* data series. In what follows, we briefly describe two of the major changes that took place with the introduction of GFSM2001 and how we handled them.

First, expenditures are classified differently in GFSM2001 relative to the older GFSM1986 (see Wickens (2002) for details). For instance, in terms of the economic classification, the important change is that although both GFSM2001 and GFSM1986 can be roughly divided into 'current' and 'capital' expenditures, the exact definition of current and capital spending differs. That is, the capital expenditure concept under GFSM2001 (denoted as 'net acquisition of non-financial assets') adopts a net concept in the sense that the government revenue from the sales of fixed capital assets are taken into account. In contrast, capital expenditure under GFSM1986 adopts a gross concept, in which case the revenue from capital sales is not deducted. Besides, capital transfers,

[12] Notice, however, that their estimation technique is different from ours. Whereas they use the pooled mean group estimator developed by Pesaran et al. (1999), we use instead dynamic GMM panel estimators.

[13] That is, when they study the growth effects of an increase in consumption taxes, for instance, they always clarify which other tax components (e.g., income taxes) offset such increase to keep total tax revenue unchanged.

which were part of capital expenditure under GFSM1986, are part of the current expenditure concept under GFSM2001 (denoted as 'expense'). Regarding the functional classification, while GFSM2001 divides expenditures into 10 functional categories, GFSM1986 divides them instead into 14 categories. Second, the form in which governments report statistics have also changed. Under GFSM1986 reporting is only on a cash basis, whereas under GFSM2001 this is mainly on accrual basis. To explain the difference, under accrual basis flows are recorded at the time when a transaction accrues, independently of the flow of cash. Instead, under cash basis, transactions are recorded when cash effectively flows. Thus, the two recording bases inevitably coexist in our series. What is more, for some countries data for the different subcategories are reported in different accounting bases even within a given year under GFSM2001.

Facing these challenges, we first retrieved all historical expenditure data available for all countries that have reported data to the IMF's GFS yearbook from 1970 to 2010. Regarding the different categorizations, we followed Wickens (2002) and converted all expenditure items under the GFSM1986 classification into the concepts defined by the GFSM2001 classification, so that in the unified series capital expenditure is defined as a net concept while the functional components are divided into 10 categories. As for the accounting issue, given that our focus is on the composition of expenditures, the difference in the timing of recording appears to be less of a problem as long as all the expenditure items are reported on the same accounting basis within a given year. We thus ensure that we take data under the GFSM2001 classification only when all the expenditure components of our interest (clarified below) are reported on the same basis within the same year. This way, we avoid potential biases in calculating expenditure shares driven by differences in the timing of reporting across subcomponents. Further, whenever data are available for all the expenditure components on the more economically-relevant accrual basis, we use that data.[14]

2.1.2 Subcomponents of expenditure in the dataset: economic and functional classification

While our dataset follows the categorization under GFSM 2001, it does not attempt to cover all the detailed classification provided in the manual. As for the economic classification, our main interest is the distinction between expense and net acquisition of non-financial assets. Additionally, given the frequent interest in the 'wages' component of the former category in the literature (e.g., Gupta et al. (2005)), we separate compensation of employees (as a proxy for wages) from the rest of

[14]However, if all the expenditure components are available only on cash basis, we use that data instead.

expense.[15] The dataset thus have the three items in the economic classification: wages (proxied by compensation of employees), the rest of expense, and net acquisition of non-financial assets. Turning to the functional classification, while total expenditure is grouped into 10 categories we only cover 8 of them in the paper, leaving out public order and safety, and environmental protection.[16] The reason for this selection is due to the limited availability of these 2 subcomponents throughout our sample period of 1970 to 2010. In particular, the latter category is only available under GFSM2001.

2.1.3 Government level in the dataset

Another important element to clarify about the assembled dataset is the institutional coverage level of the government. While under GFSM1986 countries report at most at the consolidated central government (CG), under GFSM2001 they also provide data for the consolidated general government (GG). Although some countries provide fiscal data also at lower government levels (i.e., state and/or local governments) under the former, the availability of such data is limited. We thus use the consolidated CG level for our main analysis.[17]

However, when the degree of fiscal decentralization (measured by the share of spending at the CG level relative to that of the GG level) differs across subcomponents, the use the CG level data may not accurately capture the share of those components at a national level. This actually appears to be the case, because although some subcomponents such as defense tend to be centralized in most countries, others such as health and education tend to be more decentralized.[18] Moreover, when the trend of fiscal decentralization differs across those components over time, using the CG level data can be more problematic in a panel data analysis.[19]

[15] Rest of expense consists of 'use of goods and services'; 'consumption of fixed capital'; 'interest'; 'subsidies'; 'grants'; 'social benefits'; and 'other expense'.

[16] The 10 functional categories defined in GFSM2001 are: 1) general public services; 2) defense; 3) public order and safety; 4) economic affairs; 5) environmental protection; 6) housing and community amenities; 7) health; 8) recreation, culture, and religion; 9) education; and 10) social protection.

[17] The consolidated CG level can be further divided based on whether the institutional unit is financed by the legislative budget or by extrabudgetary sources. The central government unit based on the legislative budget is called budgetary central government. Some works on fiscal policy such as Devarajan et al. (1996) use the budgetary CG data along with consolidated CG in an attempt to increase the number of observations. However, we often find non-trivial discrepancies between the consolidated CG and the budgetary CG data in some expenditure components such as social protection. We thus rely only on the consolidated CG data in our dataset.

[18] For instance, Wyss and Lorenz (2000) discusses the vastly decentralized nature of the health sector in Switzerland.

[19] Dziobek et al. (2011) report that in some countries (e.g., Spain and Switzerland), the level of fiscal decentraliza-

Recognizing these limitations in the use of CG data, we will later check if our main results are robust when considering instead the GG level. Specifically, our robustness check will be based on a limited sample in which both CG-level and GG-level data coexist under GFSM2001. Using this restricted sample, we will present evidence suggesting that results obtained with the CG-level and GG-level data are statistically the same, thus providing certain justification to our analysis.

2.1.4 Additional macro variables in the dataset

Our dataset also contains a few macroeconomic variables including GDP and exchange rates. They have been obtained mainly from either the World Economic Outlook (WEO) or the International Financial Statistics (IFS) databases of the IMF.[20] Other macro variables are also included since they are used as control variables in our regressions. One key control variable used in our reference regressions is the average years of schooling between ages 25 and 64 (as a proxy for human capital accumulation) from the Barro and Lee (2010) dataset. The other controls used in our robustness checks include inflation rates, openness of a country (calculated as the value of imports and exports relative to GDP), population growth, and the terms of trade growth.

2.2 Graphical description of the dataset

All in all, the assembled dataset is unique and itself can reveal simple yet new facts on government expenditure over the last 40 years for a large set of countries. Therefore, before turning to our formal regression analysis on public expenditure composition and growth, we first describe the dataset from various angles. First, pooling together all countries and ordering the data according to their income level we can examine how total expenditure and the associated subcomponents vary as countries become more developed. To better understand this relation, Figure 1 divides the whole sample into deciles according to the countries' GDP per capita level (PPP prices).[21] Each

tion in total expenditure has been unstable over time. Although their report does not cover the different expenditure subcomponents (except 'compensation of employees' in the economic classification), those unstable trends may be caused by the decentralization of some particular subcomponents such as health and education.

[20]GDP information is used to create the ratio of total expenditure over GDP, which is required to control for level effects in our regressions. Exchange rates are necessary to convert GFS data reported in national currency into US dollars, since nominal GDP in current prices is taken from WEO in US dollars.

[21]In terms of the economic classification, the figure covers 86 countries which have reported all relevant components (explained above) at least once in the period 1970 to 2010. As for the functional classification, the number of countries (again which have reported all the relevant components at least once) is 102. The transport and communication

point in the figure corresponds to the median value for each decile's income level and the associated median value of the expenditure-related component.[22]

The first four panels show all expenditure items associated with the economic classification of expenditure, in which total expenditure is the sum of expense and net acquisition of non-financial assets. It follows that countries increase the overall expenditure envelope (as a share of GDP) as they become richer until the GDP per capita reaches around 20,000 US dollars (PPP prices), in line with the so-called Wagner's law.[23] However, after that, the size of the government flattens out and then slightly decreases, thus showing a non-monotonic relation. Importantly, this behavior of total expenditure is essentially driven by the expense subcomponent. Wages (to be precise, compensation to employees), one of the key subcomponents within the expense category, tends to show a relatively more stable pattern. In fact, the general increasing pattern of expense is rather associated with an upward trend in the social benefits subcomponent (not shown). Finally, those outlays associated with the net acquisition of non-financial assets decrease noticeably as countries become richer. Turning to the classification of expenditure by function, note that those outlays associated with health and social protection—the combination of which is often referred to as public social spending—are increasing in the level of development of the economy. Observe, however, that spending on education and transport and communication (a proxy economic infrastructure) do not appear to increase when countries increase their income level.

subcomponent within economic affairs is slightly limited to 101 countries, since this is not always available even when the latter category is reported.

[22] Easterly and Rebelo (1993) undertake a similar exercise.

[23] Wagner's law states that the size of the government rises as the associated country's income level increases. See Ram (1990) for details.

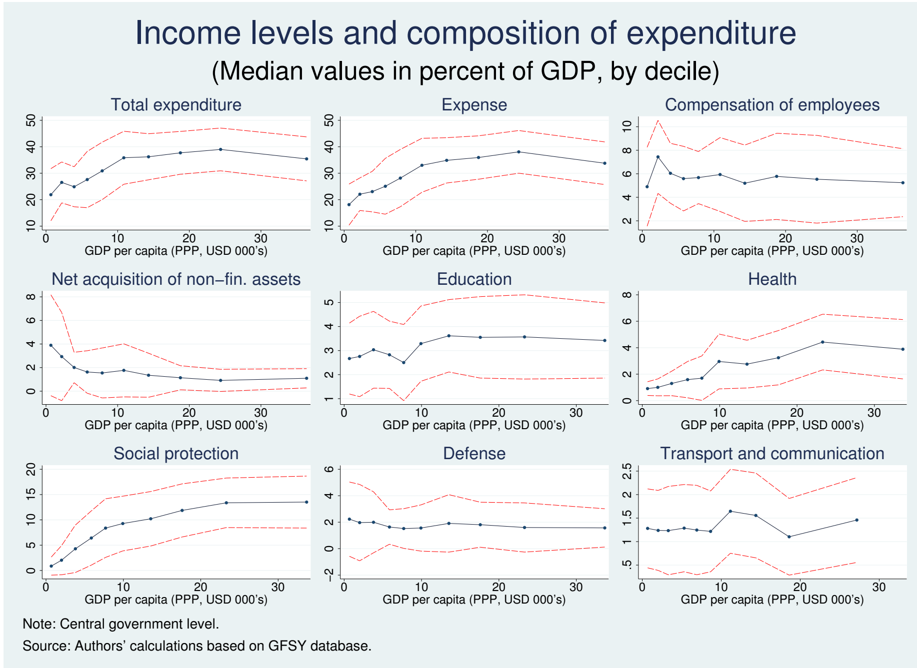

Figure 1: Economic Development and Composition of Expenditure

Figure 2 describes the evolution of the different expenditure components considering an unweighted average of all items as percent of GDP by decades and for two broad country groups: low and medium-income countries combined (LICs and MICs) and high-income countries (HICs).[24] Consistent with the previous figure, both total expenditure and expense are higher for countries with higher income levels. There is, moreover, an upward trend over time until the 1990s and a slight fall during the 2000s in the case of HICs. In contrast, the net acquisition of non-financial assets exhibits a downward trend over the 40-years period in both groups. Particularly in the case of HICs, a similar pattern is present when observing the transport and communication subcomponent. This makes sense because a large portion of transport and communication is devoted to the acquisition of physical capital, which as noted above had a downward trend. Turning to education, despite certain fluctuations across time in both groups, spending on this component relative to GDP has been relatively similar and stable across groups and time. However, when focusing on those categories directly related to social spending, it follows that for both health and social

[24]The figures only contains countries which have reported all the economic (or functional) components for all 4 decades. Therefore, the number of countries featured in the figure is limited. In terms of the economic classification, the figure contains unweighted averages for 19 HICs, and 7 MICs and LICs. Regarding the functional classification, there are 14 HICs, and 6 MICs and LICs (for the reason clarified above, the availability of transport and communication data is limited to 7 HICs, and 7 MICs and LICs.)

protection the spending envelope has generally increased in both groups over time, though the level is significantly higher for HICs. In contrast, defense spending exhibits a clear downward pattern in both groups. Notably, the large fall during the 1990s coincides with the end of the Cold War.

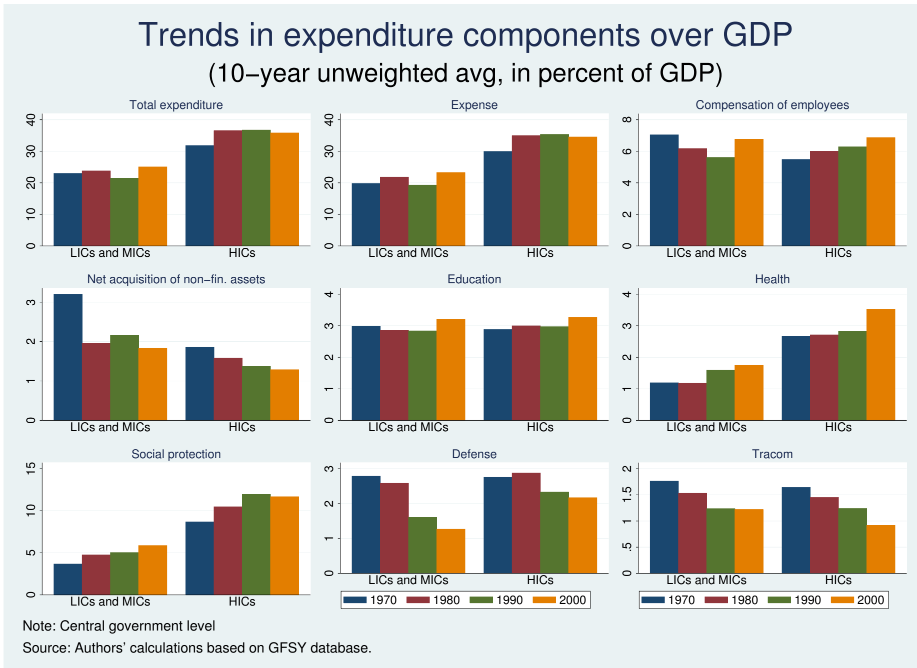

Figure 2: Long-Run Trends in Expenditure

We finally look at the evolution of each component by focusing on the composition of total expenditure, which is the subject of the regression analysis below (Figure 3).[25][26] Regarding the functional classification, being consistent with Figure 2, we observe a rapid increase in the shares of spending in social protection and health, yet the shares are significantly smaller in the case of LICs and MICs. In both groups, these upward trends are accommodated by the lowering spending trends in the remaining categories including transport and communication and defense. However, in line with the previous figure, the share of education spending has not changed much over the last 40 years in the HICs group. In the case of the economic classification, a notable downward

[25]In terms of the economic classification (not shown), the number of countries included in the figure is the same as in Figure 2. As for the functional classification, since we only focus on the case where transport and communication data are available, the number of countries are 7 HICs, and 7 MICs and LICs.

[26]Note that 'total' expenditure in case of the functional classification is not exactly total because it does not include 2 of the 10 functional subcomponents (i.e., 'public order and safety', and 'environmental protection'). However, (as indicated below) since the shares of those expenditures are relatively small, the total of the remaining 8 components is almost equal to the actual total expenditure.

trend in the share of net acquisition of non-financial assets is observed in both groups (not shown).

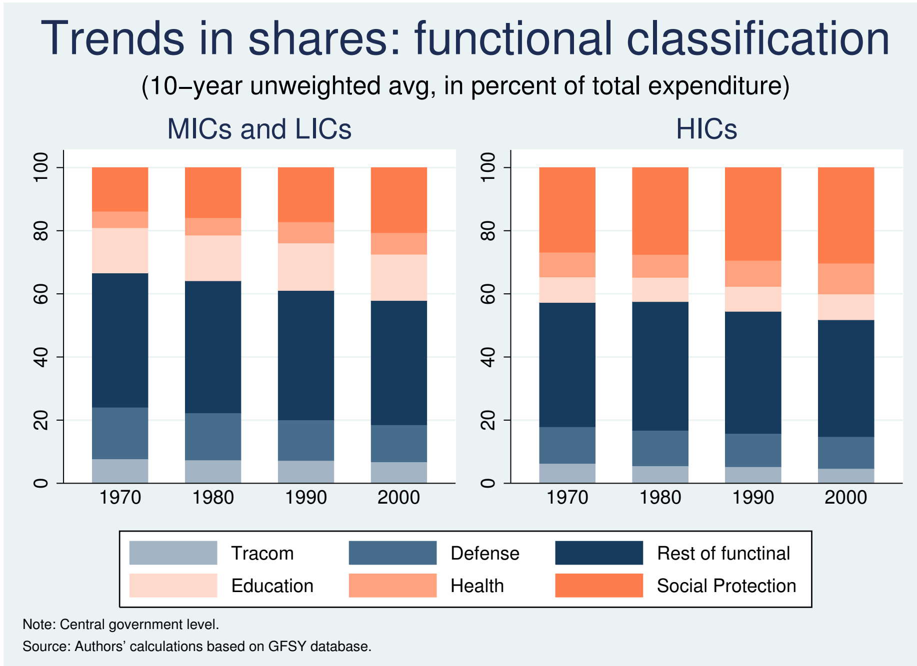

Figure 3: Composition of Expenditures: Functional classification

2.3 Descriptive statistics

Table 1 summarizes the descriptive statistics for the fiscal variables relevant for the subsequent regression analysis. As in similar growth regressions, we use 5-year non-overlapping averages to abstract away from the effects of the business cycle, thus leading to a maximum of 8 observations per country (i.e., 1971-75, 1976-1980...2006-2010). However, since our dataset is an unbalanced panel, we need to choose how many observations we require to calculate each 5-year average observation. For instance, although allowing just one observation to form a 5-year average maximizes the number of observations, this choice clearly does not handle possible business cycle fluctuations. Meanwhile, requiring full 5 observations severely reduces the sample and thereby potentially useful information could be lost. Therefore, in the following table (and in the regression analysis presented below), we take the 5-year average if the number of observations is at least 3 within each 5-year period.[27]

The table shows that our sample countries grew, on average, around 11.9% in per capita terms

[27] This choice is somewhat ad-hoc, but it turns out that choosing 4 as a threshold critically reduces the number of countries available in the regressions. On the other hand, choosing 2 would leave too much room for the observations to be affected by the business cycles.

over the 5-year period. Looking at the fiscal variables in the economic classification, the share of total public expenditure in GDP is about 33%. While the share of expense accounts for more than 90% of the total, the wage share (proxied by compensation of employees) takes about 20%. The total expenditure share in the functional classification is obtained at the slightly lower value of 28.4%. The reason why this is different from the total expenditure under the economic classification is twofold. First, the samples are different (under the economic classification, the sample size is 190, while under the functional, it is 151). Second, even when the same sample is used, total expenditure under the functional is not larger than the one under the economic by definition. This is because we left out two components of the former (i.e., public order and safety and environmental protection). Note, however, that the shares taken by these components are relatively small, thus the total of the remaining 8 is almost equal to the actual total expenditure.[28] In terms of the shares under the functional classification, while education spending represents about 11.4% of the total, the share of transport and communication is notably lower, at about half of it (5.7%). Social protection accounts for more than a quarter of the share of total functional expenditure (27%). When health is combined with social protection, the total (i.e., social spending) represents more than a third of total spending (35.5%).

[28] For instance, if we focus on the 75 observations (out of 151) in which we also observe the actual total functional spendings, the difference is rather small: the total of the 8 components (relative to GDP) is 28.35% while the total of the 10 components is 29.66%.

Table 1: Summary statistics

Variable	Mean	Standard deviation	Minimum	Maximum
Growth rate of real GDP pc (over 5 years)	0.119	0.096	-0.242	0.4
Economic classification				
Total Exp/GDP	33.025	8.895	13.047	53.874
Comp. of Employees/Total Spend.	20.203	9.468	5.854	54.044
Rest of Expense/Total Spend.	72.555	14.051	33.827	92.465
Nonfin. Assets/Total Spend.	7.242	6.499	1.241	36.474
Functional classification				
Total exp/GDP	28.391	9.721	10.434	52.882
Defense/Total Spend.	9.579	7.004	1.981	33.057
Transport and communication/Total Spend.	5.69	2.799	1.259	13.722
Health/Total Spend.	8.408	4.787	0.830	20.287
Education/Total Spend.	11.385	5.532	1.817	23.34
Social Prot./Total Spend.	27.112	15.432	1.326	54.838
Rest/Total Spend.	37.826	11.189	16.636	76.759

3 Regression analysis

3.1 Empirical specification and methodology

Our empirical specification is motivated by neoclassical growth models such as that of Solow-Swan.[29] The model relates the real GDP per capita growth to two kinds of variables: state and control/environmental variables. The former variables give the initial position of the economy, whereas the latter determine the steady-state. As is well known, the first important implication of the model is that when the steady state is controlled for, an equiproportional increase in the state variables reduces growth, thus implying the existence of 'conditional' convergence. The second is that an increase in the steady state output level leads to higher growth rates during the (seemingly) long adjustment period towards the steady-state growth rate.[30] Based on this second prediction, we examine how changes in the different shares of expenditure components affect growth. Formally, our empirical specification is given by:

$$y_{i,t} - y_{i,t-1} = (\alpha - 1)\, y_{i,t-1} + \beta x_{i,t-1} + \overline{f'}_{i,t}\phi + \nu_i + \epsilon_{i,t}. \qquad (1)$$

[29] Barro (2004) (chapter 12) also studies the empirical determinants of growth based on these models.

[30] The steady state growth rate is determined exogenously in neoclassical growth models.

The left hand side (LHS) is the growth rate of output per capita, where $y_{i,t}$ is log of output in country i at time t. Consistent with the descriptive statistics above, t designates one of the 5-year averages. Explanatory variables in the right hand side (RHS) include $y_{i,t-1}$, the initial real GDP per capita and $x_{i,t-1}$, and the initial years of schooling as state variables. The former variables are meant to be a proxy for physical capital, while the latter variables are used as proxies for human capital accumulation. The RHS also contains a vector of control/environmental variables, $\overline{f'}_{i,t}$. Given that these variables affect the steady state of the economy during the period spanning $t-1$ and t, $\overline{f'}_{i,t}$ is obtained as an average of those variables between these two periods, i.e., $\left(f'_{i,t} + f'_{i,t-1}\right)/2$. ν_i represents fixed effects (i.e., unobserved country-specific effects). Finally, the RHS also contains time dummies (though not explicitly shown in Eq.1).

Highlighting the fiscal variables among $\overline{f'}_{i,t}\phi$, we have

$$\overline{f'}_{i,t}\phi = \delta\overline{e}_{i,t} + \sum_{j=1}^{m}\gamma_j\overline{s}_{i,j,t} + \sum_{j=1}^{k}\eta_j\overline{z}_{i,j,t}. \tag{2}$$

In the RHS, $\overline{e}_{i,t}$, the share of total public expenditure to GDP, is included to control for the level effect of total expenditure. Next, $\overline{s}_{i,j,t}$, represents the share of the different expenditure components in total expenditure. Finally, $\overline{z}_{i,j,t}$ represents the rest of the control/environmental variables. They include the inflation rate, a proxy for trade openness, population growth, and terms of trade growth. These control variables are selected considering their availability in order to preserve the coverage of our dataset to the largest possible extent.

To proceed, however, notice in Eq.2 that $\sum_{j=1}^{m} s_{i,j,t} = 1$ by construction. Thus, to avoid exact multicollinearity, we need to leave out at least one component, say component 'm'. Doing this yields

$$y_{i,t} - y_{i,t-1} = (\alpha - 1)\,y_{i,t-1} + \beta x_{i,t-1} + \delta\overline{e}_{i,t} + \gamma_m + \sum_{j=1}^{m-1}(\gamma_j - \gamma_m)\,\overline{s}_{i,j,t} + \sum_{j=1}^{k}\eta_j\overline{z}_{i,j,t} + \nu_i + \epsilon_{i,t}. \tag{3}$$

We can further rewrite this expression to have a dynamic equation in which the lagged dependent variable appears in the RHS. By simply adding $y_{i,t-1}$ to both sides, we obtain:

$$y_{i,t} = \alpha y_{i,t-1} + \beta x_{i,t-1} + \delta\overline{e}_{i,t} + \gamma_m + \sum_{j=1}^{m-1}(\gamma_j - \gamma_m)\,\overline{s}_{i,j,t} + \sum_{j=1}^{k}\eta_j\overline{z}_{i,j,t} + \nu_i + \epsilon_{i,t}. \tag{4}$$

Observe that the coefficients on the expenditure components are now interpreted as the effects of a rise in those components on growth when they are compensated by a fall in the factor that is left out. In short, they represent reallocation effects among the different spending components.

We estimate this dynamic model using a GMM approach. There are various reasons for this choice. First, the GMM framework is flexible enough to accommodate our unbalanced panel. Second, it allows us to deal with country fixed effects. Third, it enables us to handle the potential endogeneity of all explanatory variables through the use of internal instruments (i.e., instruments based on lagged values of those variables). This is important because endogeneity issues appear to be non-trivial concerns in our context. In addition to the reverse causality issue mentioned in the introduction, omitted variable problems are also likely to be present. For example, Mauro (1998) finds that corruption reduces spending on education, while Mauro (1995) also shows that corruption reduces growth by lowering investment. Further, while aging societies tend to increase social spending, this demographical change, possibly lowering overall productivity by reducing the fraction of the population in the prime age category of 15-65 (e.g., Barro (2004)), can also affect growth negatively.

However, while the GMM approach yields consistent estimators, the original 'difference' GMM estimators developed by Holtz-Eakin et al. (1990) and Arellano and Bond (1991) may suffer from finite sample biases. These biases arise if the time series are persistent, which in turn let instruments become weak. In fact, Bond et al. (2001) point out that these biases are likely to be large in the context of empirical growth models since output tends to be a largely persistent variable. They thus recommend the alternative 'system' GMM estimators developed by Arellano and Bover (1995) and Blundell and Bond (1997), which augments 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.[31] We use this system procedure in what follows.

To be specific, the difference part of our system includes the following moment conditions: $E\left[y_{i,t-s}\left(\epsilon_{i,t}-\epsilon_{i,t-1}\right)\right] = 0$ and $E\left[x_{i,t-s}\left(\epsilon_{i,t}-\epsilon_{i,t-1}\right)\right] = 0$, where $s \geq 2; t = 3, ..., T$. The rest of this part consists of the analogous relations for the other explanatory variables $\overline{e}_{i,t-s}$, $\overline{s}_{i,j,t-s}$, and $\overline{z}_{i,j,t-s}$. Regarding the level part of the system, where the instruments used are the lagged differences of the variables, the moment conditions are given by: $E\left[\left(y_{i,t-1}-y_{i,t-2}\right)\left(\nu_i+\epsilon_{i,t}\right)\right] = 0$ and $E\left[\left(\overline{x}_{i,t-1}-\overline{x}_{i,t-2}\right)\left(\nu_i+\epsilon_{i,t}\right)\right] = 0$, where $t \geq 3$. Again, the rest of the conditions consist of the analogous relations for $\overline{e}_{i,t-1}-\overline{e}_{i,t-2}$, $\overline{s}_{i,j,t-1}-\overline{s}_{i,j,t-2}$, and $\overline{z}_{i,j,t-1}-\overline{z}_{i,j,t-2}$. In what follows, however, to reduce the number of instruments generated in the system, we combine instruments through

[31] Revisiting Caselli et al. (1996), who use difference GMM estimators in growth regressions, Bond et al. (2001) show that the use of system GMM can improve on the finite sample biases present in that paper. Other papers using system GMM estimators in growth regressions include Levine et al. (2000) and Rodrik (2008).

additions to smaller sets. Particularly, this can be done by asking the estimator to minimize the magnitude of empirical moments only for each lag length rather than for each lag length and time.[32] We take this measure because as Roodman (2009b) emphasizes, having too many instruments (relative to the number of countries) makes estimation results unreliable.

Finally, to ensure the validity of this system approach in our context, we conduct a number of specification tests. The first is the Arellano-Bond test. Its purpose is to examine the hypothesis that the error term is not serially correlated, which is assumed to draw all the orthogonality conditions. The second is the Hansen test, which checks the overall validity of the the various instruments of the system. The third is the difference Hansen test, which examines the validity of the different sets of instruments used in the level part of the system.

3.2 Results

3.2.1 Economic classification

We now present the results on the reallocation effects in terms of the economic classification. As mentioned, our focus is on the following three items under this classification: compensation of employees, the rest of expense, and net acquisition of non-financial assets (for brevity, non-financial assets). Table 2 presents the estimation results. The first two columns show the reallocation effects between expense and non-financial assets. In column (1), the compensating component is set to be expense. Thus, as Eq.3 indicates, the coefficients of non-financial assets represent the effect of a rise in this spending when compensated by an equal fall in expense. Given that each period spans 5 years, the coefficient of 0.002 means that a rise in non-financial assets by 1 percentage point, offset by an equal fall in expense, increases growth by about 0.2 percentage points over the 5 years period (thus roughly 0.04 percentage points increase per annum). However, the effect is statistically insignificant. Next, the share of total expenditure to GDP has a negative effect (with statistical significance at 1 % level), which happens probably because a corresponding rise in tax revenues (to finance the increase in expenditure) can often be distortionary. The coefficient on initial GDP, a proxy for initial physical capital, is negative, being consistent with the presence of conditional convergence. Meanwhile, the average years of schooling has a positive effect on its own.

In terms of specification tests, the Arellano-Bond tests indicate that the error term is not serially

[32] Practically, we do this by using the 'collapse' option available in Roodman's 'xtabond2' Stata command (Roodman (2009a)).

correlated, thus supporting the use of GMM in the estimation of this dynamic equation. Next, the Hansen test validates the instruments used both in the difference and level parts of the system as a whole. We further conduct two difference Hansen tests to focus on the validity of particular subsets of instruments. The first test examines the validity of the exogeneity of the extra instruments used in the level part of the system as a whole; the second difference test checks the exogeneity of the lagged output used as an instrument in the level part.[33] Overall, the corresponding p-values (0.37 and 0.88) validate the use of system (instead of difference) GMM estimators.

Turning to Column (2), it has non-financial assets as the compensating factor. As expected, the result on the composition effect is opposite in sign to the one in column (1).[34] Meanwhile, the other effects (i.e., the level effect of total expenditure and the effects of the proxies for physical and human capital) are largely similar to the ones in column (1). Finally, column (3) shows the compositional effects when expense is further divided into compensation of employees and the rest of expense, where the compensating factor is again set to be non-financial assets. Note that while both subcomponents have a negative sign, they are again not statistically significant. Overall, our results suggest that the reallocation among the different expenditure components, as defined by the economic classification of expenditures, is unlikely to affect economic growth.

[33] This second test is recommended by Roodman (2009a), who points out that a lagged dependent variable is often problematic among the sets of instruments used in the level part.

[34] This is expected because if increasing item A and decreasing item B promotes growth, decreasing A and increasing B should reduce it.

Table 2: Expenditure composition and growth: economic classification

Dependent variable: GDP per capita growth over 5 years			
Regressors	(1)	(2)	(3)
Total exp/GDP	-0.0142***	-0.0141***	-0.0115***
	(0.00519)	(0.00486)	(0.00435)
Expense/Total Exp		-0.00424	
		(0.0100)	
Comp. of Employees/Total Exp			-0.0114
			(0.0128)
Rest of Expense/Total Exp			-0.00966
			(0.00933)
Nonfin Assets/Total Exp	0.00227		
	(0.00889)		
Initial GDP pc	-0.0373*	-0.0410*	-0.0472*
	(0.0216)	(0.0232)	(0.0277)
Initial Human Capital	0.0491***	0.0543***	0.0485***
	(0.0184)	(0.0194)	(0.0171)
Constant	0.491	0.886	1.471
	(0.386)	(0.840)	(1.032)
Compensating factor	Expense	Nonfinancial assets	Nonfinancial assets
Observations	190	190	190
No. of countries	52	52	52
No. of instruments	33	33	39
Arellano-Bond AR(1), p-value	0.0157	0.0220	0.0225
Arellano-Bond AR(2), p-value	0.162	0.197	0.173
Hansen, p-value	0.543	0.463	0.536
Diff Hansen 1, p-value	0.374	0.600	0.171
Diff Hansen 2, p-value	0.878	0.802	0.910

Robust standard errors in parentheses. Time dummies are not shown.

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Diff Hansen 1 tests the exogeneity of the instruments used in the level part (of the system) as a whole.

Diff Hansen 2 tests the exogeneity of the lagged level of output used as an instrument in the level part.

3.2.2 Functional classification

We now turn to the functional classification of government expenditure. Among the 8 functional categories covered in the dataset, we focus on the reallocation effects among the following 5 components: defense, transport and communication, health, education, and social protection. Our interest in these components is based on the fact that their effects on growth have been often studied in the literature. As reviewed in the introduction, a number of papers examine the effects of government spending in education and infrastructure, although they have focused mostly on the level (rather than composition) effects on growth. Besides, various works indicate that defense and health expenditures may also affect growth. For instance, Barro (2004) points out that defense can promote investment and thus growth by enhancing entrepreneurs' property rights, while Agénor (2010) suggests that public health spending can influence growth by affecting labor productivity and individuals' discount factors. Further, social protection spending is often argued to be rather unproductive (e.g., Kneller et al. (1999)), which appears to be intuitive due to the re-distributive nature of this spending. Then, given that the first 4 components can potentially enhance growth on their own, one may expect that growth-enhancing reallocations should involve an increase in these expenditure outlays compensated with a fall in social protection. However, the bottom line here is that formally detecting a growth-enhancing reallocation among them (if any) requires a rigorous empirical investigation.

Table 3 summarizes the results on the reallocation effects among those 5 functional components. (Full estimation results are left to the Appendix). Each of the five columns in the table designates the expenditure component that is increased in the reallocation, whereas each row indicates the associated component that is decreased to offset the change. Although the 5 different components yield 25 cells, only 20 are relevant for the analysis. Further, as clarified in the previous case with the economic classification, the symmetric nature of the analysis prompts us to highlight only 10 cases. When an enhancing/reducing effect is statistically significant, a star superscript is attached to the coefficient. Specifically, 1, 2, and 3 stars indicate significance at the 10 %, 5 % and 1 % levels, respectively.

Table 3: Reallocation effects according to the functional classification: summary of results

		Component increased				
		Defense	Health	Education	Soc. prot.	Tracom
	Defense	n/a	Insignificant	Insignificant	Insignificant	Insignificant
	Health		n/a	Enhancing**	Insignificant	Insignificant
Component decreased	Education			n/a	Reducing**	Insignificant
	Soc. prot.				n/a	Insignificant
	Tracom					n/a

First and foremost, notice that the table indicates that only education spending has growth-enhancing effects that are statistically significant. This happens specifically when an increase in education spending is financed by a fall in health or social protection spending. None of the other reallocations, even when involving a rise in economic infrastructure, produces statistically-significant effects on growth. This result highlights the particular importance of education spending as a growth-enhancing component.

Given this summary result, Table 4 elaborates on the effects of a rise in education spending financed by a fall in each of the other spendings components.[35] To explain, Column (2) estimates the regression in which fiscal components include (apart from the ratio of total expenditure to GDP) the ratio of education spending (to total expenditure) and the ratio of the addition of all the remaining 6 spending items but education and defense. Defense spending is thus treated as a compensating factor in this column. Columns (3) to (5) can be seen in a similar way except that the compensating factors are health, social protection, and transport and communication, respectively.[36] Lastly in Column (1), the only fiscal component included is education spending, implying that the compensating factor consists of all the remaining 7 components. Although this exercise does not provide a precise interpretation (since it does not clarify how exactly other spendings fall), this still gives information about the general usefulness of education spending relative to all the other categories.

[35]As explained, since the economic affairs component of the functional classification is not always available at a more disaggregated level, the composition effects involving transport and communication, a subcomponent of it, are considered based on a smaller sample.

[36]When transport and communication is a compensating factor, spending excluding education and transport and communication includes the rest of the economic affairs spending category as well.

Table 4: Effects of public education spending on growth

Dependent variable: GDP per capita growth over 5 years					
Regressors	(1)	(2)	(3)	(4)	(5)
Total exp/GDP	-0.00369	-0.00375	-0.00532*	-0.00463	-0.0106*
	(0.00382)	(0.00357)	(0.00297)	(0.00347)	(0.00557)
Educ/Total exp	0.0110*	0.00539	0.0155**	0.0109**	-0.00816
	(0.00646)	(0.00903)	(0.00747)	(0.00411)	(0.0225)
Spend. excl. Defense and Educ/Total exp		-0.00357			
		(0.00506)			
Spend. excl. Health and Educ/Total exp			0.00262		
			(0.00730)		
Spend. excl Educ and Soc Prot/Total exp				0.00191	
				(0.00253)	
Spend. excl Educ and Tracom					-0.00880
					(0.0186)
Initial gdp pc	-0.000665	-0.00569	-0.0216	-0.0155	-0.0158
	(0.0267)	(0.0257)	(0.0269)	(0.0184)	(0.0197)
Initial human capital	0.0564***	0.0522***	0.0413**	0.0496***	0.0235*
	(0.0186)	(0.0189)	(0.0195)	(0.0141)	(0.0137)
Constant	-0.467	-0.00963	-0.294	-0.317	1.207
	(0.444)	(0.773)	(1.010)	(0.384)	(1.675)
Compensating factor	All the rest	Defense	Health	Social Prot	Tracom
Observations	175	175	175	175	151
No. of countries	56	56	56	56	55
No. of instruments	33	39	39	39	37
Arellano-Bond AR(1), p-value	0.00620	0.00801	0.00767	0.00801	0.0339
Arellano-Bond AR(2), p-value	0.187	0.189	0.204	0.186	0.269
Arellano-Bond AR(3), p-value	0.613	0.646	0.686	0.640	0.685
Hansen, p-value	0.262	0.452	0.312	0.534	0.557
Diff Hansen 1, p-value	0.421	0.770	0.770	0.706	0.483
Diff Hansen 2, p-value	0.680	0.590	0.590	0.477	0.229

Robust standard errors in parentheses. Time dummies are not shown.

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Diff Hansen 1 tests the exogeneity of the instruments used in the level part (of the system) as a whole.

Diff Hansen 2 tests the exogeneity of the lagged level of output used as an instrument in the level part.

This table suggests that the growth-enhancing effects of education may be quantitatively important, particularly when the rise in this spending component is compensated by health or social protection. Specifically, a 1 percentage point increase in education spending offset by a 1 percentage point fall in health spending causes a 1.55 percentage points increase in growth over the 5-year period (i.e., about 0.3 percentage points increase per annum). Though the effect is slightly smaller with social protection, the reallocation still causes an increase in growth of 1.09 percentage points over the 5-years period (i.e., roughly 0.2 percentage points rise per annum). Finally, column (1) indicates that education is in general growth enhancing relative to all the other functional components. Turning to the remaining variables, the results are all in line with the ones obtained in the case of the economic classification. First, the effect of an increase in the level of total expenditure has a negative effect on growth, possibly due to the corresponding (un-modeled) rise in distortionary taxes. Next, initial GDP per capita has a negative effect on growth, supporting the presence of conditional convergence, while initial human capital has a positive effect on its own. Again, all the specification tests support the use of a system GMM approach for the estimation of the dynamic model.

Finally, Table 5, being parallel to Table 4, presents detailed results on the reallocation effects involving an increase in spending on transport and communication.[37] This is done to simply highlight its effect compared to that of education. As the table shows, none of the coefficients on the share of transport and communication to total spending has a statistically significant effect. Notice particularly that this is still the case even when a rise in this spending is offset by a fall in health and social protection outlays.

[37] In fact, this table is a subset of the table presented later in the Appendix.

Table 5: Effects of public infrastructure spending on growth

Dependent variable: GDP per capita growth over 5 years					
Regressors	(1)	(2)	(3)	(4)	(5)
Total exp/GDP	-0.00952*	-0.00478	-0.0142***	-0.0111**	-0.000757
	(0.00508)	(0.00508)	(0.00441)	(0.00549)	(0.00654)
Tracom/Total exp	0.0125	-0.0110	0.00414	0.00241	0.0142
	(0.0194)	(0.0135)	(0.0149)	(0.0224)	(0.0188)
Spend. excl. Defense and Tracom/Total exp		-0.0115**			
		(0.00436)			
Spend. excl. Health and Tracom/Total exp			0.0167**		
			(0.00745)		
Spend. excl. Educ and Tracom/Total exp				-0.00102	
				(0.00878)	
Spend. excl Tracom and Soc Prot/Total exp					0.00932
					(0.00576)
Initial GDP pc	-0.0123	-0.0249	-0.0440	-0.0205	-0.0113
	(0.0206)	(0.0171)	(0.0307)	(0.0223)	(0.0290)
Initial Human capital	0.0234*	0.0287*	0.0207	0.0211	0.0590*
	(0.0133)	(0.0153)	(0.0147)	(0.0131)	(0.0345)
Constant	0.247	1.346***	-0.603	0.534	-0.952
	(0.401)	(0.460)	(0.726)	(0.890)	(0.914)
Compensating factor	All the rest	Defense	Health	Education	Soc Prot
Observations	151	151	151	151	151
No. of countries	55	55	55	55	55
No. of instruments	33	37	37	37	37
Arellano-Bond AR(1), p-value	0.0259	0.0119	0.149	0.0383	0.0113
Arellano-Bond AR(2), p-value	0.223	0.364	0.325	0.326	0.434
Hansen, p-value	0.693	0.534	0.586	0.632	0.856
Diff Hansen 1, p-value	0.525	0.175	0.134	0.410	0.960
Diff Hansen 2, p-value	0.438	0.840	0.350	0.268	0.382

Robust standard errors in parentheses. Time dummies are not shown.

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Diff Hansen 1 tests the exogeneity of the instruments used in the level part (of the system) as a whole.

Diff Hansen 2 tests the exogeneity of the lagged level of output used as an instrument in the level part.

3.3 Robustness

The main results from the above analysis are threefold. First, a simple reallocation of public spending between current and capital expenditures is unlikely to affect growth. This is the case even when current spending is divided into public workers' wages and the rest. Second and most importantly, a reallocation involving an increase in education spending has a scope for enhancing growth to a quantitatively significant extent. This growth-enhancing effect is particularly observed when its spending is financed by a fall in social spending components such as health and social protection. Third, none of the other possible reallocations among key functional components seems to promote growth. This includes reallocations involving a rise in spending on economic infrastructure compensated by a fall in social spending. In what follows, we mainly check the robustness of our most important results on the effectiveness of education spending as a growth-enhancing component.

3.3.1 Lagged fiscal variables

We first check the robustness of these results by changing the timing at which fiscal policy affects growth. We assumed previously that fiscal policy, by changing the steady state of the economy simultaneously, affects growth without a delay (see Eq.3). However, one may instead assume that fiscal policy affects the economy only with lags. To gauge the potentially delayed effect of public education expenditure, it is useful to acknowledge that the channels through which this spending affects the economy can be diverse. For instance, Aghion et al. (2009) show that increasing education spending on research universities promotes growth through technological innovation (particularly in technologically advanced areas). Regarding this channel, it may be more sensible to consider that the enhancing effect of education spending emerges only with a delay. Turning to spending on transport and communication, it may take a while for a local community (including businesses) to take full advantage of the improved economic infrastructure such as roads, bridges, and airports. This again delays the effect on growth of fiscal policy. In light of this discussion, we now assume in Eq.3 that the steady state of the economy during the period spanning $t-1$ and t is affected solely by a fiscal policy change taking place in period $t-1$ (rather than the average over periods $t-1$ and t).

Table 6 presents the results only highlighting the coefficients on the share of education spending to total spending for brevity. The table reconfirms the importance of education spending as a growth-enhancing component. In particular, the coefficients on education spending with health and social protection as compensating components are similar to the ones in Table 4, although the reallocation with health is not statistically significant in this specification. Though not shown in the table, the coefficients on the rest of variables (i.e., initial GDP, initial human capital, the share of total expenditure to GDP, and the other expenditure share variables) are also in line with those reported in Table 4.

Table 6: Robustness check with lagged fiscal variables

Dependent variable: GDP per capita growth over 5 years					
Regressors	(1)	(2)	(3)	(4)	(5)
Educ/Total exp	0.0128*	0.00761	0.0142	0.0123**	0.00785
	(0.00683)	(0.00826)	(0.00959)	(0.00552)	(0.0124)
Compensating factor	All the rest	Defense	Health	Social Prot	Tracom
Observations	175	175	175	175	151
No. of countries	56	56	56	56	55
No. of instruments	33	39	39	39	37
Arellano-Bond AR(1), p-value	0.00303	0.00381	0.00328	0.00285	0.00344
Arellano-Bond AR(2), p-value	0.240	0.260	0.218	0.215	0.378
Hansen, p-value	0.273	0.429	0.457	0.318	0.642
Diff Hansen 1, p-value	0.471	0.650	0.616	0.390	0.684
Diff Hansen 2, p-value	0.153	0.184	0.275	0.735	0.432

Robust standard errors in parentheses. Time dummies are not shown.

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Diff Hansen 1 tests the exogeneity of the instruments used in the level part (of the system) as a whole.

Diff Hansen 2 tests the exogeneity of the lagged level of output used as an instrument in the level part.

3.3.2 Different development levels of countries

We next run regressions focusing on a smaller set of countries. Given that the reallocation effects may differ depending on the development level of a country, it would be ideal to run separate regressions for country groups with different income levels (e.g., LICs, MICs, and HICs as defined above). However, having a smaller sample quickly makes estimation results unreliable, because the number of instruments become too many relative to the number of samples (countries). It is thus difficult to restrict drastically the number of countries. As a compromise, we examine the results based on the reference regression (as in Table 4) when the G20 advanced countries are excluded.[38] While not entirely satisfactory, this check is meant to examine the robustness of the results to the subset of countries with a lesser degree of development.

Table 7 again only presents coefficients on the share of education to total spending. Although it is true that the coefficients on this variable with social spendings as the compensating factors are somewhat smaller than those of Table 4, the importance of education spending remains in this smaller sample. The coefficients on the other variables, though again not shown in the table, are

[38] The G20 advanced countries group (G20-advanced) includes: Australia, Canada, France, Germany, Italy, Japan, Korea, United Kingdom and the United States. Since we do not have sufficient data for Germany and Japan, in practice this country group includes the remaining 7 economies.

again in line with Table 4.

Table 7: Effects of public education spending on growth without G20-advanced countries

Dependent variable: GDP per capita growth over 5 years					
Regressors	(1)	(2)	(3)	(4)	(5)
Educ/Total exp	0.00741	0.00811	0.0115	0.00804*	-0.00601
	(0.00528)	(0.0100)	(0.00756)	(0.00446)	(0.0211)
Compensating factor	All the rest	Defense	Health	Social Prot	Tracom
Observations	142	142	142	142	125
No. of countries	49	49	49	49	48
No. of instruments	33	39	39	39	35
Arellano-Bond AR(1), p-value	0.0399	0.0482	0.0370	0.0409	0.0389
Arellano-Bond AR(2), p-value	0.118	0.110	0.124	0.111	0.175
Hansen, p-value	0.407	0.821	0.762	0.744	0.767
Diff Hansen 1, p-value	0.424	0.869	0.519	0.609	0.718
Diff Hansen 2, p-value	0.349	0.719	0.969	0.802	0.381

Robust standard errors in parentheses. Time dummies are not shown.

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Diff Hansen 1 tests the exogeneity of the instruments used in the level part (of the system) as a whole.

Diff Hansen 2 tests the exogeneity of the lagged level of output used as an instrument in the level part.

3.3.3 Additional explanatory variables

Third, we check the sensitivity of the results on education spending by adding an extra control/environmental variable. The additional variables considered here are the inflation rate, the degree of openness, population growth, and terms of trade growth. All of them have often been discussed as potential determinants of growth in the related literature (e.g., Barro (2004)).[39] We treat these variables as endogenous as is most likely the case in growth regressions. However, while the dynamic GMM framework allows us to deal with these additional endogeneity issues with internal instruments, adding more endogenous controls would again quickly make estimation results unreliable if the number of instruments becomes too many. We thus consider only a specification in which the compensating factors are not individually specified while adding these extra control variables one by one.

Results are summarized in Table 8, which only presents the coefficients on the share of education

[39] Since our dataset covers a long time and contains a large number of countries including many LICs, the potential set of control/environmental variables to choose from tends to be limited. For instance, while we would like to also consider some institutional variables such as the degree of corruption as a control variable, it cannot be included in our regressions since it reduces our sample dramatically.

and the added control variables. For comparison, Column (1) of the table replicates the result from the basic specification (without any added control variables) given in Column 1 of Table 4. We see that in all cases education spending appears to be growth enhancing. The effects are in fact statistically significant in all but the case with the openness variable as an additional control. The added controls also have coefficients that are in line with those generally found in the literature (e.g., inflation having a negative impact on growth). Finally, as in the previous two checks, all the other key coefficients are consistent with the reference case without extra controls.

Table 8: Robustness check with additional variables: effects of education spending on growth

Dependent variable: GDP per capita growth over 5 years					
Regressors	(1)	(2)	(3)	(4)	(5)
Educ/Total exp	0.0110*	0.0142**	0.00594	0.0138***	0.0156***
	(0.00646)	(0.00580)	(0.00601)	(0.00515)	(0.00557)
Inflation		-0.00673*			
		(0.00379)			
Openness			0.00100		
			(0.00106)		
Population growth				-0.0134	
				(0.0372)	
Terms of trade growth					0.00516
					(0.00782)
Compensating factor			All the rest		
Observations	175	150	158	165	153
No. of countries	56	50	53	52	50
No. of instruments	33	39	39	39	39
Arellano-Bond AR(1), p-value	0.00620	0.0595	0.0129	0.00561	0.0717
Arellano-Bond AR(2), p-value	0.187	0.150	0.150	0.277	0.180
Hansen, p-value	0.262	0.644	0.292	0.443	0.624
Diff Hansen 1, p-value	0.421	0.972	0.243	0.549	0.894
Diff Hansen 2, p-value	0.680	0.858	0.842	0.365	0.468

Robust standard errors in parentheses. Time dummies are not shown.

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Diff Hansen 1 tests the exogeneity of the instruments used in the level part (of the system) as a whole.

Diff Hansen 2 tests the exogeneity of the lagged level of output used as an instrument in the level part.

3.4 Central vs general government spending

The final robustness check is related to the government level used in the analysis. So far this has been based on the consolidated CG level. As explained, this is due to the limited availability of GG level data. However, given that it is the GG which more accurately captures the state of public finances at a country level, it becomes important to examine whether our main results on education spending still hold when considering this more aggregate government level.

For this purpose, we now focus on a smaller sample under GFSM2001 in which expenditure composition information is available at both the CG and GG consolidated levels. Discarding the GFSM1986 yearbook dataset entirely and looking only at a limited number of countries under GFSM2001, the sample is inevitably restricted. Specifically, the data now cover three 5-year periods at most (i.e., 1996-2000, 2001-2005, and 2006-2010) and often only 2 periods (2001-2005 and 2006-2010), depending on the year at which a country migrates towards GFSM2001. Using this more limited sample, we conduct again a panel data analysis. However, this shorter panel with a smaller coverage of countries implies that it is not feasible to use the dynamic GMM approach with internal instruments. As a compromise, we study a static fixed effects model without using those instruments, in which the dependent variable is now the average of the annual growth rate of real GDP per capita over 5 years, and the independent variables are the same as in the reference case presented before (see Eq.1).[40]

Before turning to the results, however, we briefly compare the fiscal variables under the two government levels. Table 9 presents the summary statistics for the 5-year averaged fiscal data used in the static panel regression below.[41] The number of countries covered is 32 (20 HICs, 9 MICs, and 3 LICs). For simplicity, we focus on the reallocation effects between education and social spending (as a combination of health and social protection). Further, to focus on this effect, we do not isolate defense spending and merge this subcomponent with the rest of spending. First, as for the mean of the share of total spending to GDP, the table indicates the obvious fact that when looking at the same sample, spending at the GG level is larger (40%) than the one at the CG level (33%).[42] Turning to the spending composition, notice that the share of education spending is actually larger with the GG level data, implying that this spending is relatively more decentralized than the other subcomponents. However, when considering social spending, these shares are roughly the same between CG and GG. Also, though not shown in the table, when social spending is divided into

[40] That is, the independent variables contain initial real GDP per capita (as the real GDP per capita in the first year of the five years), initial human capital (as the average schooling years between aged 25 and 64 in the first year), relevant fiscal variables, fixed effects, and time dummies.

[41] To be consistent with our main regression analysis conducted above, we calculate the 5-year average if we have 3 observations or more (of all the expenditure subcomponents of our interest) out of the maximum of 5.

[42] As before, total expenditure is calculated as the addition of the 8 functional subcomponents out of 10. That is, public order and safety and environmental protection are excluded (due to the data availability issue).

health and social protection, we observe that spending on health is also relatively more decentralized (the share of 11.39% at the CG level and 13.50% at the GG level).

Table 9: Government expenditure composition: CG and GG levels

Variable	Mean	Standard deviation	Minimum	Maximum
Total exp/GDP (CG)	33.479	7.035	15.733	44.286
Total exp/GDP (GG)	40.24	7.454	20.522	57.657
Educ/Total exp (CG)	9.745	3.956	2.321	20.439
Educ/Total exp (GG)	13.599	2.768	6.350	19.687
Social/Total exp (CG)	49.929	9.622	8.221	63.191
Social/Total exp (GG)	48.922	8.114	26.227	59.736
Rest/Total exp (CG)	40.326	9.995	26.365	86.242
Rest/Total exp (GG)	37.479	7.374	26.385	55.316

We now compare the results from the static panel analysis (Table 10). As mentioned, our purpose now is not to obtain accurate estimates of the reallocation effects of public expenditures but rather to compare the results obtained at the different CG and GG levels.[43] Specifically, we check if the difference between these results about reallocation effects involving education spending is statistically significant. If the difference is insignificant, this would suggest that the coefficients on the reallocation effects are statistically the same in both cases.

Column (1) in this table examines the effect of education spending on growth at the CG level when the compensating factor is not individually specified, whereas Column (2) does the same at the GG level. Notice that the coefficients on the share of education spending are positive in both columns, implying that education spending is generally growth-enhancing relative to the other subcomponents. Though we do not claim its reliability, the value of 0.29 implies that one percentage point increase in the share of education spending is associated with 0.29 percentage points increase in growth per annum.[44] Notice that the coefficient is actually much larger at the GG level, with a statistical significance at 10 % level. However, importantly, the paired t test indicates that the difference between these coefficients is not statistically significant. Regarding the coefficients on

[43]Because we do not deal with the potential endogeneity issue with instruments, the result is likely to be not consistent. Moreover, the limited sample used here should make the estimations less accurate than those presented previously.

[44]Remember that the dependent variable is now an (averaged) annual growth rate.

the other variables, the signs are the same as the ones in Table 4. Column (3) and (4), using the CG and GG level data respectively, consider the case in which the compensating factor is specified as social spending. Again, the crucial result here is that the coefficients on education spending are not statistically different between the two cases. Overall, a general implication of these exercises is that results on the reallocation effects between education and social spendings are likely to be robust to the different government level considered in the analysis.

Table 10: Effects of education spending at the CG and GG levels

Dependent variable: annual GDP per capita growth, averaged over 5 years				
Regressors	(1)	(2)	(3)	(4)
Total exp/GDP	-0.00240	-0.00350***	-0.00359***	-0.00364***
	(0.00162)	(0.00100)	(0.00129)	(0.000967)
Educ/Total exp	0.00286	0.00723*	0.00602	0.00712*
	(0.00432)	(0.00384)	(0.00522)	(0.00352)
Spend. excl. Social and Educ spend./Total exp			-0.00327	-0.00181
			(0.00300)	(0.00300)
Initial GDP pc	-0.0829**	-0.110***	-0.106**	-0.116***
	(0.0312)	(0.0321)	(0.0398)	(0.0408)
Initial human capital	0.00290	0.00431	-0.00762	0.00370
	(0.00998)	(0.0113)	(0.0156)	(0.0106)
Constant	0.916**	1.174***	1.412**	1.323**
	(0.341)	(0.360)	(0.616)	(0.540)
Level of government	CG	GG	CG	GG
Compensating factor	All the rest	All the rest	Social Spend.	Social spend.
Observations	59	59	59	59
R-squared	0.453	0.538	0.534	0.559
Number of countries	32	32	32	32

Robust standard errors in parentheses. Time dummies are not shown.

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Fixed effects model is used.

4 Concluding remarks

The results of this paper suggest that a government can indeed promote long-run growth by changing the composition of public expenditure, while keeping the total spending envelope unchanged. A government can do so, in particular, by reallocating social spending (such as spending on health and social protection) to education spending. We showed that this main result appears to be robust to the alternative assumption of delayed fiscal policy effects, the use of a smaller sample excluding the richest countries in the dataset, and to adding various extra control variables. Moreover, although our main analysis is conducted using the consolidated central government level, we showed that our main finding appears to also hold at the consolidated general government level.

This paper also offered two additional results. First, it seems to be difficult for a government to enhance growth by simply changing the allocation of spending between current and capital expenditure. This is the case even when current spending is further sub-divided into its public wage component and the remaining current spending envelope. Second, turning the attention back to the functional classification of expenditure, despite its intuitive appeal, a rise in spending on economic infrastructure compensated by a fall in other functional components does not appear to enhance growth. This is still the case even when this reallocation is financed by a fall in social spending.

These results are important for various reasons. As mentioned in the introduction, the ongoing fiscal austerity measures in many advanced countries (often triggered by the fiscal expansion to overcome the negative effects of the 2007-8 financial crisis on economic activity) are expected to stay for several years. Under these circumstances in which a government may not be able to raise 'total' expenditure for a long period of time, it is important to highlight the potential effects of possible 'reallocation' measure to still promote growth. Moreover, given that aging has become a worldwide economic issue in many countries, a further increase in social spending appears inevitable in the years to come. Again, our results suggest that when this additional spending is compensated by a fall in other expenditure items, education spending should not be sacrificed.

However, despite its undeniable importance, economic growth is surely not the only criteria a government wants to look at when deciding its overall expenditure composition. There are other potential elements such as employment and inequality of critical importance. In fact, examining the effects of the public expenditure composition on these two key elements appears to be a fruitful future research project.

Another pressing issue in terms of the link between fiscal policy and growth is related to the fiscal policy 'mix' between expenditure and revenue. Returning to the aging society and the particular government's policies to cope with this, the potential source of financing of the additional social spending is of course of particular and timely relevance. The crucial question in this regard is then 'which' revenue component a government may raise to compensate for the higher social spending, a question which again can be considered through the lens of its effects on growth.

As a final note, although this paper examined the expenditure composition effects on growth empirically, more theoretical work on this area is desirable. In fact, the literature appears to be thin on the theoretical front. As more theoretical works investigate the mechanisms behind the allocation effects of fiscal policy on growth, our understanding on this crucial policy question would surely deepen further.

A Estimation results behind Table 3

The following table provides the detailed estimation results required to produce Table 3. The way to interpret the results is analogous to Table 4, for instance.

Table 11: Effects of compositional changes on growth: functional classification

Dependent variable: GDP per capita growth over 5 years										
Regressors	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Total exp/GDP	-0.0105**	-0.00375	-0.00532*	-0.00706	-0.00828**	-0.00561	-0.00478	-0.0142***	-0.0111**	-0.000757
	(0.00416)	(0.00357)	(0.00297)	(0.00465)	(0.00348)	(0.00386)	(0.00508)	(0.00441)	(0.00549)	(0.00654)
Health/Total exp	-0.00502									
	(0.00919)									
Educ/Total exp		0.00539	0.0155**							
		(0.00903)	(0.00747)							
Soc Prot/Total exp				-0.00528	0.00120	-0.00864**				
				(0.00497)	(0.00868)	(0.00429)				
Tracom/Total exp							-0.0110	0.00414	0.00241	0.0142
							(0.0135)	(0.0149)	(0.0224)	(0.0188)
Rest/Total exp	-0.00397	-0.00357	0.00262	-0.00277	0.00473	-0.00554	-0.0115**	0.0167**	-0.00102	0.00932
	(0.00613)	(0.00506)	(0.00730)	(0.00691)	(0.00882)	(0.00576)	(0.00436)	(0.00745)	(0.00878)	(0.00576)
Initial gdp pc	-0.0121	-0.00569	-0.0216	-0.00343	-0.0141	-0.0106	-0.0249	-0.0440	-0.0205	-0.0113
	(0.0354)	(0.0257)	(0.0269)	(0.0247)	(0.0210)	(0.0203)	(0.0171)	(0.0307)	(0.0223)	(0.0290)
Initial human cap	0.0393	0.0522***	0.0413**	0.0556***	0.0560***	0.0555***	0.0287*	0.0207	0.0211	0.0590*
	(0.0273)	(0.0189)	(0.0195)	(0.0208)	(0.0173)	(0.0154)	(0.0153)	(0.0147)	(0.0131)	(0.0345)
Compensating factor	Defense	Defense	Health	Defense	Health	Educ	Defense	Health	Educ	Soc Prot
Observations	175	175	175	175	175	175	151	151	151	151
No. of countries	56	56	56	56	56	56	55	55	55	55
No. of instruments	39	39	39	39	39	39	37	37	37	37
Arellano-Bond AR(1), p-value	0.0141	0.00801	0.00767	0.00939	0.00951	0.00743	0.0119	0.149	0.0383	0.0113
Arellano-Bond AR(2), p-value	0.196	0.189	0.204	0.180	0.200	0.184	0.364	0.325	0.326	0.434
Arellano-Bond AR(3), p-value	0.762	0.646	0.686	0.663	0.628	0.628	0.479	0.175	0.559	0.538
Hansen, p-value	0.237	0.452	0.312	0.237	0.266	0.326	0.534	0.586	0.632	0.856
Diff Hansen 1, p-value	0.241	0.770	0.258	0.162	0.0576	0.0690	0.175	0.134	0.410	0.960
Diff Hansen 2, p-value	0.879	0.590	0.618	1.000	0.0898	0.653	0.840	0.350	0.268	0.382

Robust standard errors in parentheses. Time dummies are not shown.

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Diff Hansen 1 tests the exogeneity of the instruments used in the level part (of the system) as a whole.

Diff Hansen 2 tests the exogeneity of the lagged level of output used as an instrument in the level part.

Rest/Total exp differs across columns (e.g., In column (1), it is spending excluding defense and health).

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