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The impact of productive and non-productive government expenditure on economic growth: an empirical analysis in high-income versus low- to middle-income economies

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Abstract
This paper examines the relationship between the compositions of government expenditure and economic growth. It develops an endogenous growth framework drawing on variables from existing models, and separates government expenditure into productive and non-productive forms. Using panel data from 37 high-income and 22 low- to middle-income countries covering 1993–2012, our findings are based on OLS fixed effects and GMM techniques. We challenge much of the existing empirical literature in relation to developing economies by showing that a shift in government expenditure away from non-productive government expenditure and towards productive forms of expenditure are associated with higher levels of growth in both high-income and low- to middle-income economies. Moreover, we identify the differing components of government expenditure that are most associated with increased long-run output levels in both high-income and low- to middle-income economies.

Keywords Economic growth · Government expenditure · High-income countries · Low- to middle-income countries

JEL Classification E62 · H50 · O40

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1 Introduction

Recent studies on determining economic growth have been dominated by endogenous growth models (Cyrenne and Pandey 2015; Ghosh and Gregoriou 2008; Petrakos et al. 2007). In these models it is assumed that any policy encouraging factor input accumulation results in enhanced economic growth, thereby offering governments a broad range of effective growth policies. Beginning with Barro (1990) and King and Rebelo (1990), a number of papers have helped develop the analysis of public spending and growth, highlighting the effect of the compositions of government spending has on growth (Afonso and González Alegre 2011; Agénor and Neanidis 2011; Ghosh and Roy 2004; Fuente 1997; Monteiro and Turnovsky 2008). Researchers have differentiated between productive and non-productive government expenditure and have shown how a country can increase its economic growth by changing the mix between these alternative forms of expenditure. Kneller et al. (1999) underlined that productive government spending influences private sector productivity and hence has a direct impact on growth, while non-productive expenditure, which normally has an effect on citizens' welfare, is likely to have a zero or negative growth impact. Devarajan et al. (1996) was one of the first to introduce a model that expresses the difference between productive and non-productive expenditures by how a change in the proportion of total expenditure dedicated to either one impacts on long-run economic growth. They stated that a country's desire to reach a more optimal growth rate can be achieved by increasing the proportion of total government expenditure dedicated to productive areas.

If the theory linking various components of government expenditure to economic growth appears reasonably clear, the results from related empirical research are not, especially when distinguishing between the effects of changes in the absolute level of government expenditure and changes in relative amount of productive and non-productive expenditures. In term of absolute levels of expenditure compositions (as a share in GDP), empirical results have consistently reported a positive relationship between productive government expenditure and economic growth, and either a negative or no-impact relationship between non-productive expenditure and economic growth for high-income economies (Afonso and González Alegre 2011; Bleaney et al. 2001; Kneller et al. 1999). However, findings on the relationship between the level of public spending and economic growth in low- to middle-income economies are mixed. Gupta et al. (2005) used a panel of 39 low-income countries and found that productive government spending enhances growth, while non-productive expenditure fails to do so. Christie (2012) revealed an inverse relationship between productive government spending and real GDP per capita for developing economies. Regarding the relative division of total expenditure between productive and non-productive uses, Devarajan et al. (1996) found that diverting expenditure from productive to non-productive can promote economic growth by using 43 developing countries. They subsequently re-tested their regressions with a sample of 21 developed countries for the same period and found that the results are reversed. Ghosh and Gregoriou (2008) also found similar results with Devarajan et al. (1996) in 15 developing countries, where a greater proportion of current (non-productive) spending was found to have a positive effect on the growth rate. Given these inconsistencies in empirical findings, it is surprising

that relatively little attention has been given to comparing and contrasting the impact of government expenditure composition on economic growth in countries at different stages of development.

Previous efforts to examine the above issues have also been affected by limitations in data availability and estimation methods (Barro 1990; Easterly and Rebelo 1993). More recent empirical studies have had access to data of improved quality and as a result developed more useful variables and estimation methods (Ghosh and Gregoriou 2008; Gemmell et al. 2016). Nevertheless, there remains a need for more research to address two specific limitations that persist in current economic growth regressions: the possible endogeneity of fiscal variables and the consequences of relying on the period-averaging process to capture long-term growth rates (Bleaney et al. 2001; Kneller et al. 1999).

This paper addresses these gaps in existing literature and thereby makes three distinct contributions to the body of knowledge. Firstly, the paper examines the growth effects of government expenditure compositions for a panel data of 37 high-income and 22 low- to middle-income countries for the period 1993–2012, thus providing insights on the role that differing levels of economic development play in moderating the relationship. In both groups of countries, we find increased levels of government expenditure has a negative impact on growth, while a change in the expenditure mix towards productive forms of expenditure and away from non-productive forms of expenditure enhances economic growth rate. Secondly, by regressing economic growth on budgetary economic categories[1] and a set of other relevant variables, this paper contributes to a growing debate on variations between productive and non-productive forms of government expenditure. The results show that budget deficit variables encourage growth for both sets of countries, while tax revenue and non-tax revenue variables have different effects on growth. Thirdly, this paper contributes to overcoming the methodological issues commonly found in similar studies. We compute a 5-year moving average for all variables instead of the traditional 5-year average to smooth over some of the cyclical features of the data. Moreover, based on previous analysis studies and the developments in econometrics theory (Arellano and Bover 1995; Blundell and Bond 1998), we apply a dynamic panel Generalise Methods of Moments (GMM) system approach to deal with the issue of growth and fiscal variables not always being strictly exogenous.

The remainder of the paper is progressed as follows. Section 2 provides a review of literature on the composition of public expenditure and growth. Section 3 presents the model specification, description of the data and empirical methodology used in the analysis. Our main empirical results and the tests for robustness are then discussed in Sects. 4 and 5, respectively. Section 6 links the theoretical results with the empirical analysis, and finally Sect. 7 summarises the results and draws some policy implications.

[1] Adam and Bevan (2005), Afonso and González Alegre (2011) and Gemmell et al. (2016) discuss how disregarding the financing assumption of government budget constraint when building a growth model could bring systematic bias into regression equation, so we take into account variables on the financing side more fully (tax revenue, non-tax revenue and budget deficit variables).

2 Literature review

The classification of government expenditures into productive and non-productive is an important issue for this study. Empirical results relating productive and non-productive government expenditure to economic growth have produced inconsistent results. While there are a number of studies that focus on the impact of productive and non-productive public spending level (as percentage of GDP) on economic growth, few researchers have tried to examine whether changes in the proportion of total expenditure dedicated to these two expenditures is associated with higher growth. Starting with the impact of these two expenditure levels, Aschauer (1989) found that US productive expenditure in the form of core infrastructure expenditure between 1949 and 1985 increased the productivity of private capital, thereby leading to higher economic growth. Similarly, Easterly and Rebelo (1993) found that public investment in transport and communications had a positive impact on economic growth, but expenditure on education and health (other components of productive expenditure) were not found to be significant. Barro (1991) denoted defence and education as productive spending and found a positive impact on growth. He believed that spending on education was investing in human capital, while expenditure on defence supports the protection of property rights, which raises the probability of receiving the marginal product of capital. Kneller et al. (1999) and Bleaney et al. (2001) used a sample set of 22 OECD countries (1970–1995) and concluded that productive government expenditure, a sum of expenditure on education, health, defence, housing, economic affairs and general public services, enhances economic growth. Meanwhile, non-productive government expenditure in the form of social security and recreation expenditure hinder growth. Using 14 EU countries, Benos (2009) found that an increase in government productive spending, such as infrastructure and human capital, can enhance growth. Similar, Afonso and González Alegre (2011) identified a positive impact of government investment expenditure (productive) and a negative impact of government consumption expenditure (non-productive) on economic growth using data for 15 EU countries for the period 1971–2006.

On the other hand, fewer studies have examined the case of low- to middle-income countries and those that have been conducted have produced mixed results. Consistent with results from developed economies, Adam and Bevan (2005) found that higher productive expenditure (health, education, infrastructure, defence and public administration) is growth-enhancing for 45 developing countries (1970–1999), whereas higher non-productive expenditure (public order, social protection, recreation and culture) are growth-obstructing. Similar to Adam and Bevan (2005), Gupta et al. (2005) found that reducing selected non-productive expenditure can have positive impact on economic growth rate, while boosting productive expenditure does the same in a study with a panel data of 39 low-income countries between 1990 and 2000. However, Christie (2012) study showed that productive public spending has a negative impact on economic growth with a panel data of 108 developing countries over the period 1971–2005.

Regarding the effects of the relative division of government expenditure between productive and non-productive uses (as a proportion of total expenditure) on economic growth, Devarajan et al. (1996) used panel data of 43 developing countries from 1970

through 1990 with capital expenditure classified as productive expenditure, while current expenditure (net of interest payments) was considered non-productive expenditure. Contrary to expectations, their paper found that allocating public spending in favour of productive expenditure at the expense of non-productive expenditure have a significant negative impact on economic growth. They subsequently re-tested their regressions with a sample of 21 developed countries for the same period and found that the results are reversed, with shifting towards productive government expenditure encouraging economic growth and non-productive expenditure failing to do so. Ghosh and Gregoriou (2008) arrived at conclusions similar to those of Devarajan et al. (1996), in which greater non-productive rather than productive government expenditure has contributed to economic growth for 15 developing countries over 28 years (1972–1999). Gemmell et al. (2016), based on an extension of the Bleaney et al. (2001) dataset, examined the long-run growth impacts of changes in the shares of different spending categories in total expenditure. They found a robust positive effect on growth for productive expenditure compositions (such as, transport, communications, education, health, etc.) and negative effects for non-productive expenditure (social welfare and recreation) in 17 OECD countries from early 1970s to 2007.

In sum, there have been conflicting findings in recent empirical literature, especially when comparing developed to developing countries. This paper will focus on examining whether the relative proportion of productive and non-productive spending (as a share of total government expenditure) is linked with higher economic growth, with particular attention on comparing high-income and low- to middle-income countries.

3 Model specification, data and empirical methodology

3.1 Model specification

Recent growth in work on endogenous growth has generated a number of models linking government expenditure with the long-term growth rate. Devarajan et al. (1996) was one of the first to put forward a theoretical framework in which there are two types of government expenditure, productive (g_1) and non-productive (g_2). In this section we first present the key equation of the Devarajan et al. (1996) model.

Both forms of government expenditure have an impact on the rate of growth through the marginal production of capital; however their influence varies upon the relative productivity of g_1 and g_2, and their relative budget shares, $\emptyset$ and $(1-\emptyset)$. If g_1 has a greater elasticity value than g_2 ($\gamma < \beta$, as β and γ are the output elasticities of g_1 and g_2 respectively) then the rate of growth may still not increase if the expenditure shares of g_1 to g_2 be currently too high. In the special case of Cobb–Douglas technology, the condition for the two types of government expenditure is:

$$\frac{\emptyset}{1-\emptyset} < \frac{\beta}{\gamma} \tag{1}$$

In the model, a government's expenditure decision is taken as a given rather than deriving from some optimising framework. As an optimising framework requires spec-

ifying the government's objective function and the results will depend on this function. Therefore, similar to Devarajan et al. (1996) work, we do not attempt to exercise this extension in this paper. The importance of this model is to create insights into what makes particular components of government spending productive. The answer depends on the relationship between the coefficient and the actual share in the budget rather than the sign of the exponent in the production function. We attempt to answer this question by examining empirically how the growth performance was affected by the composition of government expenditures with differing levels of economic development. Like Devarajan et al. (1996) and Ghosh and Gregoriou (2008), we do not classify government spending as being productive and non-productive to begin with, but let the data direct us. As we shall see, if the regression results show that expenditures which are sum of public expenditure on education, health, general public services, etc.; show themselves to have more growth effects, then we can say that this type of expenditures is indeed more productive than expenditures that are perhaps in the form of public order and safety, recreation and social protection.

To see the implication of this for empirical testing, real output per capita growth is modelled as a function of government size (productive and non-productive government spending) and control variables. This paper draws together variables from a number of existing endogenous growth models in order to create a more robust model in capturing the relationship between components of government expenditure and growth. The set of control variables includes initial GDP per capita, labour force growth, investment (gross capital information as percentage of GDP), the inflation rate, and openness to trade (sum of exports and imports to GDP). Initial GDP, investment ratio and labour force growth conditioning variables are found in the usual Barro-type regression. The initial level of GDP is a logarithm to control for the convergence effect mentioned in the Solow–Swan model (Adam and Bevan 2005; Christie 2012; Kneller et al. 1999). Investment is an important determinant of the growth rate and expected to express the positive effects of physical capital accumulation (Ghosh and Gregoriou 2008; Gupta et al. 2005). Labour force growth is one of the production factors related to economic growth and has therefore been added by previous researchers (Afonso and González Alegre 2011; Bleaney et al. 2001; Gupta et al. 2005). The latter variables (inflation rate and openness variables) capture macroeconomic policy. The inflation rate is believed to have an adverse effect on growth rates when it is high. High inflation is associated with increased price variability and an uncertainty about future profitability of investment projects, then this lead to lower levels of investment and economic growth (Christie 2012; Pushak et al. 2007). Rodrik (1998) stated that openness to international trade has a higher rate of industrial concentration and it is therefore an important variable in empirical models testing fiscal policy and growth.

The first set of regression model specifications for capturing the relationship between productive government expenditure and economic growth, which is based on the Devarajan et al. (1996)'s model is:

$$G_{it} = a_i + b_t + \beta_1 \left(\frac{g_{\text{pro,it}}}{g_{\text{pro,it}} + g_{\text{nonpro,it}}} \right) + \gamma_1 \left(\frac{g_{\text{pro,it}} + g_{\text{nonpro,it}}}{y_{it}} \right) + \sum_{l=1}^{k} \sigma_l I_{\text{ilt}} + \mu_{it} \tag{2}$$

The second set of regression model specifications for capturing the non-productive government expenditure is:

$$G_{it} = a_i + b_t + \beta_2\left(\frac{g_{\text{nonpro,it}}}{g_{\text{pro,it}} + g_{\text{nonpro,it}}}\right) + \gamma_2\left(\frac{g_{\text{pro,it}} + g_{\text{nonpro,it}}}{y_{it}}\right) + \sum_{l=1}^{k}\sigma_l I_{\text{ilt}} + \mu_{it} \tag{3}$$

where i and t denote the cross-sectional and time series dimensions respectively, capturing the time-invariant unobserved country-specific fixed effects and the unobserved individual-invariant time effects. G is the per capita real GDP growth rate. $g_{\text{pro}}/\left(g_{\text{pro}} + g_{\text{nonpro}}\right)$, $g_{\text{nonpro}}/\left(g_{\text{pro}} + g_{\text{nonpro}}\right)$ are productive and non-productive expenditure as a proportion of total government expenditure. $\left(g_{\text{pro}} + g_{\text{nonpro}}\right)$/y is the public expenditure-to-GDP ratio. y is GDP and I_{ilt} is a vector of non-fiscal independent variables (initial GDP per capita, inflation, labour force growth, investment and openness).

Kneller et al. (1999), Bleaney et al. (2001), Bose et al. (2007) and Gemmell et al. (2016) have cautioned that by not taking full account of the government budget constraint (GBC) in growth models, the coefficient estimates tend to be non-robust. Therefore, when one evaluates the effect of fiscal policy on growth it should ideally take into account both the sources and the uses of funds. We assess whether our empirical results in regression Eqs. (2) and (3) with the inclusion of this feature that is not present in the Devarajan et al. (1996)'s model.

Since the GBC describes a closed system, total government expenditure must be financed by revenues (TR + NTR) and/or a budget surplus/deficit (Def or sur).[2] To control for this view, this paper adds components from the revenue side of the government budget to the model, including tax revenue, non-tax revenue and budget surplus or deficit variables.

The third set of regression model specifications for capturing the relationship between productive government expenditure and economic growth in the presence of three revenue-side variables in the GBC is:

$$\begin{aligned} G_{it} = a_i + b_t + \beta_3\left(\frac{g_{\text{pro,it}}}{g_{\text{pro,it}} + g_{\text{nonpro,it}}}\right) + \gamma_4\left(\frac{TR_{it}}{y_{it}}\right) \\ + \gamma_5\left(\frac{NTR_{it}}{y_{it}}\right) + \gamma_6\left(\frac{\text{Def or sur}_{it}}{y_{it}}\right) + \sum_{l=1}^{k}\sigma_l I_{\text{ilt}} + \mu_{it} \end{aligned} \tag{4}$$

The fourth set of regression model specifications for capturing the relationship between non-productive government expenditure and economic growth in the presence of three revenue-side variables in the GBC is:

[2] With each potential output effects, $\frac{\text{Def or sur}_{it}}{y_{it}} = \left[\left(\frac{\text{TR}_{it}}{y_{it}} + \frac{\text{NTR}_{it}}{y_{it}}\right) - \frac{g_{\text{pro,it}}+g_{\text{nonpro,it}}}{y_{it}}\right]$.

$$G_{it} = a_i + b_t + \beta_4 \left(\frac{g_{\text{nonpro,it}}}{g_{\text{pro,it}} + g_{\text{nonpro,it}}} \right) + \gamma_7 \left(\frac{\text{TR}_{it}}{y_{it}} \right) + \gamma_8 \left(\frac{\text{NTR}_{it}}{y_{it}} \right) + \gamma_9 \left(\frac{\text{Def or sur}_{it}}{y_{it}} \right) + \sum_{l=1}^{k} \sigma_l I_{\text{ilt}} + \mu_{it} \quad (5)$$

where TR is tax revenue, NTR is non-tax revenue and Def or sur is budget surplus or deficit to GDP ratios.

3.2 Data and empirical methodology

The data used consist of a panel of 59 countries (37 high-income and 22 low- to middle-income) covering the period from 1993 to 2012 (see "Appendix 1"). The classification of high- and middle- to low-income countries is based on the World Bank's classification using gross national income per capita.[3] We classify productive government spending as the sum of expenditure on education, health, defence, housing, economic affairs and general public services expenditure, while non-productive expenditure consists of expenditure on public order and safety, recreation and social protection. This classification is based upon those applied by Adam and Bevan (2005), Bleaney et al. (2001), Park (2006) and Christine (2012).

Data on each fiscal variable is taken from either consolidated central government or general government records, dependent on the availability for each country, and is collected from the IMF's Government Finance Statistics (GFS).[4] An advantage of this data source is that it also includes sectoral decompositions of total government expenditures and total government revenues, which allows the separation of productive and non-productive elements of government spending, as well as tax and non-tax elements of government revenue (sum of social contributions, grants and other revenues). The remaining data are obtained from the World Bank's Development Indicators (WDI).

Traditionally, to capture the long-run relationship between economic growth and fiscal variables, while eliminating business cycle effects, data is expressed in long-frequency periods—usually 5 years. While some previous studies apply 5-year average for all variables (see for example: Adam and Bevan 2005; Bleaney et al. 2001; Christie 2012) or decade average values for all variables (see for example: Bose et al. 2007); others used 5-year forward moving averages of GDP growth on yearly fiscal variables (Devarajan et al. 1996; Ghosh and Gregoriou 2008). However, both of these period-averaging processes have some drawbacks. Using a 5-year moving average for dependent variables could lead to the possibility of reverse causality, as governments could predict the increase in the growth rate up to 5 years into the future and raise productive government expenditure today. Meanwhile, using 5-year average for growth

[3] As of 1 July 2013, low-income economies are defined as those with a GNI per capita, calculated using the World Bank Atlas method, of $1025 or less in 2012; middle-income economies are those with a GNI per capita of more than $1026 but less than $12,476; high-income economies are those with a GNI per capita of $12,476 or more.

[4] Devarajan et al. (1996) rerun their regression on a subset of countries which have data available for both central and general government and found that the results for both kinds of data are consistent.

regressions tends to produce biased results. The reason for these biased results may be the absence of automatic stabilisers. Developed economies normally achieve macroeconomic stability, so changing between 5-year average and 5-year moving average is unlikely to affect the relationship between components of government spending and long-run economic growth. Meanwhile, for developing economies, 5-year average for pre-stabilisation countries may lead to bias results as their governments set up several 5-year Socio-Economic Development Plans to achieve development and economic growth. Therefore, any study which uses the wrong 5-year average period between the two 5-Year Plans may generate incorrect estimates. This paper will use 5-year forward moving averages for all variables,[5] as we believe this will remove business cycle effects, increase the number of time series observation in our panel data, minimise the reverse causality argument holding in our model and account for endogeneity.[6,7]

Table 1 lays out some descriptive statistics for the data set. It can be seen high-income economies have a lower average growth rate than low- to middle-income economies, at 2.6% and 3.3% respectively. It has been observed that countries with bigger governments tend to allocate a larger share of total government spending to social welfare and transfer payments (Gray et al. 2007). In the estimation sample, high-income countries use approximately 39% of total expenditure on non-productive spending, compared to 21% on low- to middle-income countries. However, total government expenditure as a percentage of GDP in high-income countries is 39%; meanwhile it is approximately 26% in low- to middle-income countries.

An issue that is encountered in panel data estimation is the presence of unobserved country-specific effects (Easterly et al. 1997). Excluding unobservable country-specific effects could lead to serious biases in the econometric estimates, especially when these effects are correlated with other covariates. The OLS fixed effects, also known as the Least Squares Dummy Variable (LSDV) are often applied to panel estimations and address this concern (Bleaney et al. 2001; Gupta et al. 2005). Pooled OLS regression, two-way random effects and two-way fixed effects estimations are considered. Based on the log likelihood and the adjusted R^2 for the pooled OLS and a rejection of the null hypothesis in the Hausman test between fixed effects and random effects,[8] the two-way fixed effects which control both time-invariant individual country characteristics and time fixed effect is chosen as the main method of estimation for this paper.

[5] Regarding to the autoregressive behaviour of economic growth, fiscal variables may have an influence on economic growth distributed across several periods. Some categories of government spending may induce a certain effect in the period in which they are actually realised and a different impact later on. Other variables could have the same impact.

[6] We tried 5-year average for our growth regression models and found that there is no significant effect of productive and non-productive expenditure on economic growth for low- to middle-income countries. This is due to a small number of observations for low- to middle-income economies and pre-stabilisation period in these countries. Meanwhile, the finding did not change significantly for high-income countries. These results (not reported) are available upon request.

[7] We also run the regression with annual data and it presents same results with the benchmark specification but with higher coefficients as it ignores the business cycle effect for long-run economic growth effects. The seven or decade year average, however, reduces the number of data points to test the model. These results (not reported) are available upon request.

[8] These results are not reported here, but are obtainable upon request.

Table 1 Descriptive statistics

Variable	High-income countries		Low- to middle-income countries	
	Mean	SD	Mean	SD
GDP p.c. growth (% p.a)	2.141	3.337	3.343	3.424
Productive government expenditure (% TGE)	60.599	10.996	78.040	12.718
Non-productive government expenditure (% TGE)	39.401	10.965	21.960	12.574
Total government expenditure (% of GDP)	39.803	11.329	25.658	9.074
Log Initial p.c. GDP (constant 2005 US$)	10.055	0.641	7.346	1.013
Investment (gross capital formation as % of GDP)	23.376	5.761	23.600	6.219
Inflation rate (%)	3.419	4.638	13.784	48.940
Labour force growth (p.a)	1.280	2.091	1.926	1.888
Openness (sum of exports and imports as % of GDP)	100.024	64.453	77.617	33.188
Deficit or surplus (% of GDP)	− 2.843	4.765	− 0.859	4.214
Tax revenue (% of GDP)	23.268	8.266	15.007	4.803
Non-tax revenue[a] (% of GDP)	14.818	6.409	7.716	5.959

[a]It can be seen that around 38% and 30% of total revenues of high-income and low- to middle-income economies respectively are non-tax revenues. While most of these non-tax revenues come from social contributions (social security contributions, employee and employer contributions) in high-income countries; other revenues, such as: property income, sales of goods and services, fines, penalties, and forfeits, contribute most weight on this revenues in low- to middle-income group

4 Results

Table 2 presents the estimated effects of productive and non-productive government expenditure on economic growth in high-income and low- to middle-income economies by using a two-way fixed effects method. The main variables of interest is share of productive and non-productive expenditure on total government spending, which have a respective positive and negative statistically significant coefficient effect on economic growth for high-income economies (column [1] and [2]). For high-income economies, a one percentage point shift in the ratio of government expenditure away from non-productive areas and towards productive areas of spending will increase per capita real GDP growth by 0.05 percentage points. These results are unsurprising and consistent with previous findings for high-income economies (see for example: Devarajan et al. 1996; Gemmell et al. 2016).

Meanwhile, Column [3] and [4] display the regression results of growth against the ratio of productive and non-productive expenditure in low- to middle-income economies. However, no statistically significant relationship is found between com-

Table 2 Productive and non-productive government spending with FE technique

Estimation technique: 5-year moving average—two-way fixed effect				
Dependent variable: per capita growth				
	High income		Low- to middle-income	
	(1)	(2)	(3)	(4)
Productive expenditure	0.0513**		0.0289	
	(0.0265)		(0.0354)	
Non-productive expenditure		−0.0510*		−0.0237
		(0.0294)		(0.0366)
Total government expenditure	−0.1136***	−0.1145***	−0.1344*	−0.1390*
	(0.0403)	(0.0405)	(0.0921)	(0.0919)
Log initial GDP	−2.4789	−2.4123	−0.3023	−0.2821
	(2.6749)	(2.6965)	(2.0513)	(2.0714)
Investment	0.1219**	0.1223**	0.1747**	0.1740**
	(0.0591)	(0.0591)	(0.0658)	(0.0655)
Inflation	−0.0304	−0.0308	−0.0028	−0.0025
	(0.0443)	(0.0444)	(0.0050)	(0.0049)
Labour force growth	0.0717	0.0689	−0.2096	−0.2129
	(0.1531)	(0.1530)	(0.2674)	(0.2700)
Openness	0.0427**	0.0420**	−0.0053	−0.0053
	(0.0163)	(0.0163)	(0.0202)	(0.0202)
Constant	22.7369	27.3148	2.8611	4.2648
	(23.547)	(25.387)	(15.669)	(13.564)
Observations	591	591	344	344
No. of countries	37	37	22	22
Adjusted *R*-squared	0.5612	0.5605	0.5022	0.5011

Robust standard error in parentheses. Country and time dummies included but not reported
***$p < 0.01$, **$p < 0.05$, *$p < 0.1$

position of government expenditure and growth in this group of countries. These findings differ from those of Devarajan et al. (1996) and Ghosh and Gregoriou (2008), who in similar work found significant impacts. The reason for this may be due to the absence of the GBC variables in their studies, as criticised by other authors (Kneller et al. 1999; Bleaney et al. 2001; Adam and Bevan 2005; Afonso and González Alegre 2011; Gemmell et al. 2016). Devarajan et al. (1996) did not include this feature in their model, while Ghosh and Gregoriou (2008) compared their main results with and without the presence of GBC and found there is not much difference for the main variables of interest. We shall see the vital role of GBC in our main results in Table 3.

Regarding total government expenditure as a ratio to GDP, it can be seen that it has a negative and significant impact on economic growth for both high-income and low- to middle-income group. This is the level effect of total government expenditure on

Table 3 Productive and non-productive government spending with FE technique in the presence of three revenue-side variables in the GBC

Estimation technique: 5-year moving average—two-way fixed effect				
Dependent variable: per capita growth				
	High income		Low- to middle-income	
	(1)	(2)	(3)	(4)
Productive expenditure	0.0507*		0.0648*	
	(0.0282)		(0.0334)	
Non-productive expenditure		−0.049*		−0.0602*
		(0.0307)		(0.0336)
Log initial GDP	−2.6191	−2.5341	0.4827	0.4977
	(2.4902)	(2.5067)	(1.4092)	(1.4181)
Investment	0.0936*	0.0935*	0.1956***	0.1935***
	(0.0595)	(0.0601)	(0.0607)	(0.0609)
Inflation	−0.044	−0.0442	0.0004	0.0004
	(0.0445)	(0.0449)	(0.0047)	(0.0046)
Labour force growth	0.0963	0.0935	−0.0883	−0.0862
	(0.1332)	(0.1342)	(0.2524)	(0.2575)
Openness	0.0424***	0.0415***	0.0058	0.0052
	(0.0148)	(0.0148)	(0.0186)	(0.0183)
Non-tax revenue	−0.1465***	−0.1476***	0.0069	0.0031
	(0.0529)	(0.0532)	(0.0757)	(0.0764)
Tax revenue	0.1359	0.1339	−0.2321**	−0.2315**
	(0.0978)	(0.0984)	(0.0843)	(0.0836)
Surplus or deficit	0.2053***	0.2060***	0.2202***	0.2262***
	(0.0644)	(0.065)	(0.0696)	(0.0702)
Constant	3.524	24.1057	−6.6917	−0.2553
	(1.5661)	(22.894)	(11.6589)	(8.8435)
Observations	591	591	344	344
No. of countries	37	37	22	22
Adjusted *R*-squared	0.6077	0.6065	0.5677	0.5655

Robust standard error in parentheses. Country and time dummies included but not reported
***$p < 0.01$, **$p < 0.05$, *$p < 0.1$

per capita growth, which has been found to be positive but insignificant by Devarajan et al. (1996) and positive significant by Ghosh and Gregoriou (2008) for developing countries. So this results of ours is somewhat different from their findings, but consistent with previous studies for developed countries (Romero-Ávila and Strauch 2008; Afonso and González Alegre 2011; Christie 2012). Increases in government expenditure might increase the tax burden on citizens—either now or in the future—which leads to a reduction in private spending and investment (crowding-out effect) and thus retards economic growth (Barro 1990; Bose et al. 2007). With a negative effect of

total government spending on growth, it is important for governments to reallocate government expenditure in a more optimal way and thereby to increase economic growth within a given government expenditure decision.

Turning our attention to other variables, the positive coefficient attached to investment for both sets of countries follows standard economic theory, in which an increase in the investment results in increase in production, and conforms to previous studies (Adam and Bevan 2005; Bose et al. 2007; Afonso and González Alegre 2011; Christie 2012). The same effect is expected to apply for the labour force growth variable, but we cannot report any statistically significant effect. This may indicate that growth in endogenous growth models could be influenced by fiscal policy rather than the rate of labour force growth. Unlike Christie (2012), we find that neither log initial GDP nor inflation has a significant impact on growth (indeed the inflation coefficient is negative). Therefore, there is no conditional convergence hypothesis for this initial GDP variable. The openness variable in terms of trade is normally positive for low- and middle-income countries since trade is assumed to be growth-enhancing, but we observe no relationship between them for our low- to middle-income economies sample (similar to Ghosh and Gregoriou 2008). However, in our sample of high-income economies, international trade has a positive and significant impact on economic growth.

As an alternative procedure, we estimate growth regression by including three revenue-side variables in the GBC instead of total government expenditure in Eqs. (4) and (5). This will enable us to compare our new results with the benchmark specification, where total government expenditure was assumed as the only variable to represent the revenue side in Devarajan et al. (1996)'s model. An issue worth noting is if we included all the budget components in the regression we can create perfect collinearity (Gupta et al. 2005; Bose et al. 2007). This paper avoids this by including productive and non-productive government expenditure in separate regressions.

Table 3 reports the results of the new set of regressions where clearly the main sources of funds are included as three separate variables. It can be seen that the economic growth effects of productive and non-productive expenditure are similar to those in Table 2 for high-income economies. However, both of these expenditures show a significant impact on economic growth in low- to middle-income group. The result is stronger for low- to middle-income economies with per capita real GDP rising by 0.06 percentage points in response to reallocating one percentage point away from non-productive spending and towards productive expenditure. Though this result opposes the result of Devarajan et al. (1996) and Ghosh and Gregoriou (2008) for developing countries, it is similar to some previous empirical findings for developing countries (Adam and Bevan 2005; Gupta et al. 2005; Park 2006), despite quite different samples and approaches to estimation.

As previous research focused on either high-income or low-income countries, but never both together, it is difficult to directly compare and contrast results. By using the same period of analysis and methodology, this study can for the first time directly compare countries effects. Our findings show that an increase in the absolute level of total government expenditure has a crowding-out effect and thus obstructs economic growth. However, by shifting the mix of spending way from non-productive forms of expenditure and towards productive forms, countries can move closer to a more optimum growth level for both high-income and low- to middle-income groups.

These results are consistent with the theoretical framework and the empirical strategy used in previous studies, which predict that the coefficients estimated for government expenditure components (productive and non-productive) should be of similar size but different signs.

Concerning the GBC variables, we find that increased tax revenue in low- to middle-income countries has a negative and significant impact on economic growth. The result is consistent with previous empirical studies for developing countries (Bose et al. 2007; Lee and Gordon 2005). Tax rate cuts encourage individuals, businesses and shareholders to work, save, invest, and build capital; thereby directly impacting economic growth. We expected the same effect of tax revenue on economic growth for high-income countries (Arnold et al. 2011; Gemmell et al. 2011), but this expectation is not supported by our findings. To fully examine the impact of taxation on economic growth for high-income countries, we may need to decompose total tax revenue into different types of taxes as previous studies have done. For example; Arnold et al. (2011) found that corporate taxes are most damaging to economic growth over the long-run, followed by taxes on personal income, consumption and property. In the scope of this paper, we do not focus on this aspect of government revenue. On the other hand, non-tax revenue is found to be negative and significant effect on growth in high-income economies, while it is not significant in low- to middle-income countries.

In addition, greater budget surplus or reduced deficit estimated coefficients indicate a positive and significant effect on long-term growth for both sets of countries. Previous research on this same relationship has produced mixed results. Afonso and González Alegre (2011) and Kneller et al. (1999) found a positive coefficient effect of budget surplus on economic growth for a panel of 15 EU and 22 OECD countries. Meanwhile, Bose et al. (2007) and Gupta et al. (2005) found the budget deficit adversely affects growth in their panels of developing countries. Adam and Bevan (2005) found that budget deficits could be growth-enhancing in their 45 developing sample economies. The financing assumptions may help explain these different results. If greater budget surplus or reduced deficit is a result of an increase in public investment or a decrease in tax, it should promote economic growth. However, Tables 2 and 3 suggest that as the coefficients estimated for budget surplus are positive and significant while the coefficients estimated for revenue side are negative (on non-tax revenue or tax revenue from high-income and low- to middle-income respectively), the level of total public expenditure may be at or beyond its optimum and increasing it further would hinder economic growth. Therefore, governments should consider reducing total government spending and focus on reallocating funds towards productive and away from non-productive spending to achieve a closer to optimum growth level.

The results in Table 3 also suggest that not incorporating full GBC into the analysis could tend to make the coefficient estimates biased which have been warning by some researchers, e.g. Kneller et al. (1999), Bleaney et al. (2001), Bose et al. (2007), Afonso and González Alegre (2011) and Gemmell et al. (2016). The coefficients on the other important variables remain strikingly similar to what is obtained in Table 2.

5 Robustness

In this section, we assess the robustness of our baseline results by conducting the following two exercises. A critical econometric issue arising in estimating our empirical model is that the right-hand side variables in Eqs. (4) and (5) may not be exogenous. They can be determined by each other, by the growth rate, or by other variables that are not controlled for in the empirical specification. The system GMM dynamic panel is used to provide more reliable and precise results as it offers more rigorous treatment of the endogeneity of fiscal variables on growth. The estimates are obtained using the one-step procedure as the two-step system procedure has been found to yield biased downward standard errors for small samples (Afonso and González Alegre 2011). Furthermore, the definitions of productive and non-productive government expenditure are also tested.

5.1 Robustness test 1: testing for endogeneity

Traditionally, empirical research on economic growth models have applied pooled OLS, random effects and fixed effects (Devarajan et al. 1996; Bose et al. 2007; Ghosh and Gregoriou 2008). However, since the Generalised Method of Moments (GMM) technique was first improved by Arellano and Bond (1991) it has become a common method to apply and compare to other techniques. Ghosh and Gregoriou (2008) applied GMM technique to tackle possible endogeneity of the explanatory variables in the panel. Recently, Christie (2012) re-estimated productive public spending variable using dynamic GMM to account for endogeneity and found that the results are consistent with her main result using Fixed Effect Method. Our model also applies the dynamic panel system GMM estimation (Arellano and Bover 1995; Blundell and Bond 1998) to address those concerns. The reason for using panel system GMM instead of difference GMM is that system GMM overcomes the problem of weak correlation between the regressors and the instruments, and it performs better (less bias and more precision) compared to difference GMM (Blundell and Bond 1998). We adopt a one-step system GMM as one-step GMM estimator is efficient when the errors are homoscedastic and not correlated over time. This is often too restrictive. However, the one-step results are consistent, and robust standard errors that adjust for heteroskedasticity and autocorrelation are easily obtained. The consistency of the Arellano and Bond estimator depends on the assumption that the errors are not serially correlated. It is therefore crucial to test for the presence of serial correlation. Arellano and Bond's test reports for first and second order serial correlation of the differenced residuals. Hence, there should be first order but not second order correlation (Roodman 2009b). Furthermore, Arellano and Bover (1995) and Blundell and Bond (1998) suggest a Sargan or Hansen test for over-identifying restrictions, which tests the overall validity of the instruments when applying GMM technique.[9] Bleaney et al. (2001) and Bose et al. (2007) found substantial lagged effects of growth for a set of 21 OECD countries and 40 developing countries respectively, and suggested that long-run effects

[9] The null hypothesis for Hansen J test is that the instruments are valid in the sense that they are not correlated with the errors in the first differenced equation (Roodman 2009a).

of fiscal policy may take more than one interval to be effective. To account for this, we apply dynamic model with lagged growth as an explanatory variable for both group samples.[10] Fiscal variables enter as endogenous, whereas all other variables with time dummies are assumed to be exogenous (Gupta et al. 2005; Bose et al. 2007).[11]

The results for the dynamic panel GMM one-step system technique for productive and non-productive expenditures on both group countries sample are presented in Table 4. These results also report Arellano–Bond's test for autocorrelation and the Hansen J test of over-identifying restriction. Moreover, Roodman (2009a) mentioned that an underappreciated problem often arises in the application of system GMM when using too many instruments, so this paper tries to minimise number of instruments to capture the possible endogeneity of regressors.

When the model is estimated only for low- to middle-income economies, the results closely align with those of the fixed effects model for both productive and non-productive government spending. This implies that the main results for those economies are not purely an object of endogeneity biases. The coefficients of those main interests (productive and non-productive variables) are smaller under GMM than fixed effect model, but the standard errors are also smaller. While the coefficients on the control variables are of different magnitudes and signs. On the other hand, GMM estimation for the high-income group does not appear to be valid. While the Hansen J test for over-identifying restrictions does not reject the null hypothesis that our instruments are uncorrelated with the residuals for both samples, we only fail to reject the null hypothesis of no second order serial correlation at the 10% level. Notably, lagged growth appears significant for both sets of samples as foreseen by Bleaney et al. (2001) and Bose et al. (2007), but with 5-year moving average data this dynamic specification presents high value (approximately 0.90) of lagged growth. One of the reasons for the invalidity of GMM technique in high-income countries may be common characteristics among macro data sets.[12]

5.2 Robustness test 2: classification of fiscal variables

The next change we make to the regression equation is to re-test the classification of productive and non-productive variables. The aggregation of the functional classification in the data source into theory-based categories has been a controversial issue. To highlight this concern we separate out productive and non-productive government spending into their individual components, then rerun the OLS two-way fixed effects

[10] The estimated dynamic models with lagged growth as an explanatory variable are: $G_{it} = a_i + b_t + \alpha_1 G_{it-1} + \beta_2\left(\frac{g_{\text{pro,it}}}{g_{\text{pro,it}}+g_{\text{nonpro,it}}}\right) + \gamma_1\left(\frac{\text{TR}_{it}}{y_{it}}\right) + \gamma_2\left(\frac{\text{NTR}_{it}}{y_{it}}\right) + \gamma_3\left(\frac{\text{Def or sur}_{it}}{y_{it}}\right) + \sum_{l=1}^{k}\sigma_l I_{\text{ilt}} + \mu_{it}$ and $G_{it} = a_i + b_t + \alpha_1 G_{it-1} + \beta_3\left(\frac{g_{\text{nonpro,it}}}{g_{\text{pro,it}}+g_{\text{nonpro,it}}}\right) + \gamma_1\left(\frac{\text{TR}_{it}}{y_{it}}\right) + \gamma_2\left(\frac{\text{NTR}_{it}}{y_{it}}\right) + \gamma_3\left(\frac{\text{Def or sur}_{it}}{y_{it}}\right) + \sum_{l=1}^{k}\sigma_l I_{\text{ilt}} + \mu_{it}$ where G_{it-1} is the first lag of the growth variable.

[11] To capture the effect of lagged growth and to be consistent with the approach of Bose et al. (2007), we exclude log initial GDP from our regressions.

[12] The dynamic panel data models, which were applied by Arellano and Bond (1991), Blundell and Bond (1998) or Bond et al. (2001), have focused mainly on those applicable to micro data sets, which normally have a large cross-section dimension with a small time-series dimension.

Table 4 Productive and non-productive government spending with GMM technique in the presence of three revenue-side variables in the GBC

Estimation technique: 5 years moving average—GMM one-step system				
Dependent variable: per capita growth				
	High income		Low- to middle-income	
	(1)	(20	(3)	(4)
Productive expenditure	−0.0308*		0.0299**	
	(0.0208)		(0.0135)	
Non-productive expenditure		0.0314		−0.0323**
		(0.0266)		(0.0155)
Lagged growth	0.9314***	0.9216***	0.9445***	0.9356***
	(0.0712)	(0.0757)	(0.0335)	(0.0384)
Investment	0.0406	0.0551	0.0045	0.0116
	(0.0557)	(0.0568)	(0.0179)	(0.0192)
Inflation	−0.0161	−0.0062	0.0023	0.0026
	(0.0536)	(0.0569)	(0.0023)	(0.0023)
Labour force growth	0.08483	0.1047	−0.0431	−0.0410
	(0.0824)	(0.0918)	(0.0673)	(0.0697)
Openness	0.0022	0.0028	−0.0014	0.0025
	(0.0036)	(0.0038)	(0.0050)	(0.0050)
Non-tax revenue	0.0440	0.0531	0.0146	0.0084
	(0.0434)	(0.0401)	(0.0434)	(0.0444)
Tax revenue	0.0314	0.0464	0.0253	0.0389
	(0.0602)	(0.0623)	(0.0510)	(0.0515)
Surplus or deficit	−0.0183	−0.0122	0.0448	0.0574
	(0.0551)	(0.0549)	(0.0724)	(0.0665)
Constant	−0.1490	−4.1736	−2.773*	0.0995
	(3.6369)	(3.6784)	(1.5056)	(0.9932)
Observations	554	554	323	323
No. of countries	37	37	22	22
No. of instruments	44	44	37	37
AR(1) test (p value)	0.014	0.018	0.02	0.018
AR(2) test (p value)	0.027	0.027	0.154	0.178
Hansen test (p value)	0.540	0.900	0.983	0.935

Robust standard error in parentheses. Country and time dummies included but not reported
***$p<0.01$, **$p<0.05$, *$p<0.1$

analysis.[13] This allows us to determine the robustness of our main results and the results are displayed in "Appendix 2". Almost all components of productive government spending for each group have a positive (either significant or insignificant) impact on growth, while expenditure on social protection (major percentage of non-productive spending) is opposed.[14,15] In high-income economies group, expenditure on education, general public services and housing (productive components) are found to have a positive and significant impact on growth, while expenditure on health and economic affairs in low- to middle-income countries are found to have the same results. Surprisingly, defence spending in low- to middle-income countries is found to be significant and negative compared to other components of productive expenditure. Reallocating spending towards social protection may be associated with negative effects on the long-run output levels.

6 Discussion

The basis of our model is the paper of Devarajan et al. (1996), which studies the impact of the composition of public expenditure as a proportion of total expenditure on long-run economic growth. Our paper extends the work of Devarajan et al. (1996) by including GBC variables. The same approach was also followed by Ghosh and Gregoriou (2008) and Gemmell et al. (2016), while alternative empirical studies examined the relationship between economic growth and government expenditure compositions as a percentage of GDP. The rationale for expressing productive expenditure as a ratio of total government expenditure is that under this measure a unit increase in the budgetary share of productive expenditure has to be matched by a unit decrease in non-productive expenditure, as the size of total spending remains fixed. Under the alternative approach of measurement (i.e. expenditure as a ratio of GDP), a unit increase in the share of productive government expenditure in GDP does not necessarily mean that other expenditure items are decreasing. This may lead to varied findings for different sets of data.

Our empirical results show that the share of productive government expenditure has a positive impact on economic growth for both sample groups (high-income and low- to middle-income economies), while the share of non-productive spending has an opposite effect. This result is contrary to the findings of Devarajan et al. (1996) and Ghosh and Gregoriou (2008) in the case of developing countries. This may be explained by the time period and sample data used. Devarajan et al. (1996) and Ghosh and Gregoriou (2008) are both using the data sample period 1971–1999. The popular view in this period was that low- to middle-income countries lacked the basic infrastructure and other type of public goods and therefore increased productive spending may not bring

[13] Expenditure on recreation (non-productive spending) to total government spending ratio is too small, so it is excluded from our analysis.

[14] Kneller et al. (1999) found similar results to our study with a negative effect relationship between expenditure on social protection and economic growth for 22 OECD countries.

[15] Public order expenditure, a non-productive expenditure component, has a positive impact on growth, but its share of non-productive spending is much smaller than expenditure on social protection, therefore does not change the substantial effect of non-productive expenditure on growth.

increased economic growth. The average productive government expenditure (as a ratio of total expenditure) was 21% for nine developing countries during period in the Devarajan et al. (1996) study. Furthermore, countries that have allocated fund towards productive spending and away from non-productive spending in this period have often done so for other reasons other than productivity considerations, and this is where the role of corruption assumes importance. As Tanzi and Davoodi (1997) have noticed that private companies often get contracts for large public investment projects by paying a "commission" to government officials. However, for our samples from 1990 to 2012, low- to middle-income countries spent a much larger proportion of public spending on productive expenditure components (78% in total government expenditure) which helps to develop infrastructure, create innovation and improve labour productivity. This may have boosted GDP per capital growth and achieved fruitful sustained development economics during our sample period. Non-productive expenditure (mainly on social protections) is found to have a negative impact on economic growth in our analysis, as this spending contributes to the standard of living for countries' residents instead of impacting growth directly. This is especially true for high-income countries, which spend 39% of total government spending on non-productive components. Our empirical results show that low- to middle-income countries have been following the approach of high-income countries in allocating government expenditure in favour of productive government spending at the expense of non-productive expenditure, with the aim to enhance economic growth. However, this approach still depends on the size of the government. While low- to middle-income countries have small governments (average total spending is about 26% of GDP) and tend to concentrate spending on productive government spending, high-income countries that have a large government size (40% of GDP) tend to spend more on non-productive government compositions.

In addition, as we found in Tables 2 and 3, an increase in total government expenditure has a crowding-out effect and thus has a negative impact on economic growth in both groups. Both sets of countries should not increase revenue by tax or non-tax means to have a greater government budget surplus (which enhances economic growth), as this increase would have a negative impact on economic growth. However, by reallocating the mix of existing spending away from non-productive forms of expenditure and towards productive forms, countries can move closer to a more optimum growth level. However, economic growth is assuredly not the only criteria a government considers when deciding how to allocate public spending. There are other crucial elements such as employment and income equality that should also be considered. Even when social protection spending may be an obstruction to greater growth, it may help promote income equality. Even though our results suggest that a rise the ratio of productive from non-productive expenditure raises economic growth, increasing this kind of productive expenditure compositions too much may be counter-productive.

The established empirical specifications in recent studies are to apply the components of public spending as a percentage of GDP and use a 5-year average. This paper also re-runs the regression equations with productive and non-productive government expenditure as a percentage of GDP using 5-year average, to see how our results compare with those of previous studies (the results describe in "Appendix 3"). It can be seen that the coefficient for productive expenditure is significant and positive

in the high-income sub-group, while the coefficient for non-productive expenditure is opposite. This result is similar to the main result of this analysis and consistent with previous studies, such as Kneller et al. (1999), Bleaney et al. (2001), Afonso and González Alegre (2011). Therefore, it provides support for the idea that the impacts of government expenditure components on growth in high-income countries do not depend on the time period, as these economies normally achieve macroeconomic stability and have good government effectiveness and bureaucracy quality. Meanwhile, neither the share of productive expenditure nor non-productive expenditure is found to have significant impact on growth in low- to middle-income countries. One possible explanation for these results is the selection of an inappropriate 5-year time period over which to average data. For low- to middle-income economies, 5-year average for pre-stabilisation countries may lead to bias results as their governments set up several 5-year Socio-Economic Development Plans to achieve development and economic growth. Furthermore, the effects of public spending components on growth in low- to middle-income economies differ between various studies due to the corruption and bureaucracy inefficiencies in these countries.

7 Conclusion

This paper examines the impact of fiscal policy on growth within an endogenous growth framework using two government spending components, productive and non-productive. The main added value of the analysis is to compare and contrast the effect of government expenditure on economic growth in high-income and low- to middle-income countries over a fixed time period and a given set of measures, therefore providing a consistent comparison. The empirical strategy applied OLS fixed effects methods to a panel of 59 countries during the period from 1993 to 2012. Additionally, potential biased problems in the relationship between growth and government structure were tackled using GMM system dynamic estimation techniques. A final important feature of our methodology is that we took into account both the sources and uses of government budget in assessing the effect of fiscal policy on growth.

Consistent with those existing studies using high-income country data, the findings show that a shift in government expenditure towards productive government expenditure and away from non-productive expenditure has a positive relationship with economic growth. In relation to low- to middle-income countries, we find a similar relationship, which runs contrary to the findings of other papers that examined developing countries. We also find that an increase in level of government expenditure has a crowding-out effect and thus negative effect on long-run economic growth. However, by shifting from non-productive to productive forms of public spending, countries can move closer to a more optimum growth level. These results support our conclusion that our low- to middle-income countries sample has followed the fiscal policy approach of high-income countries, in allocating government expenditure in favour of productive government spending at the expense of non-productive expenditure to enhance economic growth. In addition, our findings have implications for governments in deciding how to allocate their expenditures. For high-income countries, allocating more expenditure to education, housing and general public services

will enhance economic growth. Meanwhile spending more on health and economic affairs bring the same result for low- to middle-income countries. However, expenditure on social protection has a negative impact on economic growth for both sets of countries.

However, this line of inquiry raised several questions for further research to tackle. Our policy recommendations could be expanded if quality of government was introduced in the regression. This variable could further explain the observed differences in terms of the level of government expenditure and its component effects on growth between high-income and low- to middle-income economies. Not only can this aspect of government spending affect growth, but also the structure of taxation can affect the steady-state growth rate. Therefore, there is much more work needed in order to arrive at a more precise policy guidelines and this remains an essential area for further study.

Appendix 1

Country sets

High-income countries (37): High-Income non-OECD Bahamas, Bahrain, Croatia, Cyprus, Kuwait, Latvia, Malta, and Oman. *High-Income OECD*: Australia, Austria, Belgium, Canada, Chile, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Iceland, Ireland, Israel, Italy, South Korea, Luxembourg, Netherlands, Norway, Poland, Portugal, Slovak Republic, Slovenia, Spain, Sweden, Switzerland, and United Kingdom.

Low- to middle-income countries (22): Low Income Ethiopia, Kenya, and Nepal. *Lower-Middle Income*: Bolivia, Egypt, India, Indonesia, Philippines, Sri Lanka, Vietnam, and Zambia. *Upper-Middle Income*: Bulgaria, China, Costa Rica, Hungary, Iran, Jordan, Lebanon, Mauritius, Romania, Thailand, and Tunisia.

Appendix 2: Classification of fiscal variables with 5-year moving average

Estimation technique: 5 years moving average—two-way FE									
Dependent variable: per capita growth									
	HIC	LIC&MIC	HIC	LIC&MIC	HIC	LIC&MIC	HIC	LIC&MIC	HIC
Education exp	0.1055*	0.0036	–	–	–	–	–	–	–
	(0.0615)	(0.0808)	–	–	–	–	–	–	–
Defence exp	–	–	0.0143	− 0.2172**	–	–	–	–	–
	–	–	(0.0291)	(0.0836)	–	–	–	–	–
Health exp	–	–	–	–	− 0.0244	0.2139*	–	–	–
	–	–	–	–	0.0430	0.1428	–	–	–
Economic affairs	–	–	–	–	–	–	− 0.0021	0.0957**	–
	–	–	–	–	–	–	(0.0414)	(0.0417)	–
General pub sev	–	–	–	–	–	–	–	–	0.1066***
	–	–	–	–	–	–	–	–	(0.0341)
Housing	–	–	–	–	–	–	–	–	–
	–	–	–	–	–	–	–	–	–
Public order	–	–	–	–	–	–	–	–	–
	–	–	–	–	–	–	–	–	–
Social pro	–	–	–	–	–	–	–	–	–
	–	–	–	–	–	–	–	–	–
Log initial GDP	− 1.9586	− 0.1574	− 1.6595	− 1.4720*	− 1.5942	− 0.0201	− 1.6488	− 1.8370**	− 3.7471*
	(2.3130)	(1.2620)	(2.2959)	(0.8462)	(2.3373)	(1.1462)	(2.2628)	(0.7074)	(2.6427)
Investment	0.0790	0.1892***	0.0761	0.2472***	0.0746	0.2086***	0.0726	0.1900***	0.1388**
	(0.0581)	(0.0604)	(0.0621)	(0.0643)	(0.0587)	(0.0627)	(0.0613)	(0.0569)	(0.0652)
Inflation	− 0.0511	0.0019	− 0.0505	0.0045	− 0.0504	0.0049	− 0.0518	0.0013	− 0.0475
	(0.0462)	(0.0049)	(0.0463)	(0.0047)	(0.0457)	(0.0061)	(0.0493)	(0.0047)	(0.0488)
Labour force growth	0.1089	− 0.1470	0.1015	− 0.0876	0.0883	− 0.1162	0.1004	− 0.1554	0.0369

Estimation technique: 5 years moving average—two-way FE									
Dependent variable: per capita growth									
	HIC	LIC&MIC	HIC	LIC&MIC	HIC	LIC&MIC	HIC	LIC&MIC	HIC
	(0.1257)	(0.2440)	(0.1334)	(0.2549)	(0.1303)	(0.2219)	(0.1348)	(0.2485)	(0.1268)
Openness	0.0359**	0.0038	0.0323**	0.0008	0.0312*	0.0049	0.0321**	0.0051	0.0440***
	(0.0154)	(0.0179)	(0.0164)	(0.0159)	(0.0166)	(0.0174)	(0.0162)	(0.0164)	(0.0144)
Non-tax revenue	−0.1424**	−0.0265	−0.1500**	−0.0144	−0.1503**	−0.0077	−0.1519**	−0.0108	−0.1678***
	(0.0573)	(0.0885)	(0.0631)	(0.0795)	(0.063)	(0.0740)	(0.0627)	(0.0773)	(0.0598)
Tax revenue	0.1223	−0.2098*	0.1529*	−0.1802**	0.1522*	−0.2436**	0.1529*	−0.1995**	0.1097
	(0.0981)	(0.1150)	(0.0961)	(0.0763)	(0.0952)	(0.1005)	(0.0949)	(0.0813)	(0.0893)
Surplus or deficit	0.1938***	0.2519***	0.2086***	0.2490***	0.2130***	0.2487***	0.2121***	0.2258***	0.2228***
	(0.0684)	(0.0676)	(0.0697)	(0.0582)	(0.0643)	(0.0675)	(0.0641)	(0.0647)	(0.0559)
Constant	16.3642	3.5864	14.3721	12.9589**	14.2875	1.1190	14.5484	13.258**	31.953*
	(20.2773)	(8.6106)	20.1051	(5.5098)	(20.277)	(8.071)	(19.835)	(4.2023)	(23.313)
Observations	591	344	591	344	591	344	591	344	591
No. of countries	37	22	37	22	37	22	37	22	37
Adjusted *R*-squared	0.6081	0.5501	0.5978	0.5845	0.5982	0.5613	0.5974	0.5847	0.6257

Estimation technique: 5 years moving average—two-way FE							
Dependent variable: per capita growth							
	LIC&MIC	HIC	LIC&MIC	HIC	LIC&MIC	HIC	LIC&MIC
Education exp	–	–	–	–	–	–	–
	–	–	–	–	–	–	–
Defence exp	–	–	–	–	–	–	–
Health exp	–	–	–	–	–	–	–
	–	–	–	–	–	–	–

Estimation technique: 5 years moving average—two-way FE							
Dependent variable: per capita growth							
	LIC&MIC	HIC	LIC&MIC	HIC	LIC&MIC	HIC	LIC&MIC
Economic affairs	–	–	–	–	–	–	–
	–	–	–	–	–	–	–
General pub sev	−0.0013	–	–	–	–	–	–
	(0.0199)	–	–	–	–	–	–
Housing	–	0.1499**	0.0281	–	–	–	–
	–	(0.0735)	(0.0934)	–	–	–	–
Public order	–	–	–	0.2859**	0.0504	–	–
	–	–	–	(0.1385)	(0.2051)	–	–
Social pro	–	–	–	–	–	−0.0420*	−0.0479*
	–	–	–	–	–	(0.0281)	(0.0330)
Log initial GDP	−0.1973	−1.3512	−0.2725	−1.1976	−0.0834	−2.3041	0.2742
	(1.1294)	(2.2529)	(1.1723)	(2.1230)	(1.0101)	(2.3910)	(1.2950)
Investment	0.1889***	0.0547	0.1946***	0.1018	0.1864***	0.0903*	0.1884***
	(0.0609)	(0.0568)	(0.0597)	(0.0662)	(0.0607)	(0.0571)	(0.0605)
Inflation	0.0019	−0.0471	0.0022	−0.0362	0.0022	−0.0432	0.0011
	(0.0048)	(0.0428)	(0.0044)	(0.0463)	(0.0048)	(0.0463)	(0.0046)
Labour force growth	−0.1482	0.0584	−0.1436	0.1208	−0.1529	0.0757	−0.0992

Estimation technique: 5 years moving average—two-way FE							
Dependent variable: per capita growth							
	LIC&MIC	HIC	LIC&MIC	HIC	LIC&MIC	HIC	LIC&MIC
	(0.2456)	(0.1401)	(0.2291)	(0.1157)	(0.2488)	(0.1342)	(0.2461)
Openness	0.0037	0.0316**	0.0057	0.0320*	0.0043	0.0398***	0.0059
	(0.0177)	(0.0146)	(0.0191)	(0.0164)	(0.0180)	(0.0140)	(0.0185)
Non-tax revenue	−0.0280	−0.1620***	−0.0185	−0.1013*	−0.0281	−0.1590***	0.0037
	(0.0833)	(0.0599)	(0.0900)	(0.0615)	(0.0825)	(0.0552)	(0.0753)
Tax revenue	−0.2086**	0.1741*	−0.2423	0.1241	−0.2061**	0.1440*	−0.2305**
	(0.0940)	(0.0907)	(0.1103)	(0.0976)	(0.0956)	(0.0985)	(0.0897)
Surplus or deficit	0.2522***	0.2152***	0.2542***	0.1879***	0.2493***	0.1963***	0.2276***
	(0.0723)	(0.0675)	(0.0771)	(0.0691)	(0.0704)	(0.0637)	(0.0688)
Constant	3.9698	11.2865	4.5253	7.8525	2.8271	21.4739	0.8688
	(7.8722)	(19.821)	(7.393)	(18.228)	(6.3011)	(21.511)	(8.1811)
Observations	344	591	344	591	344	591	344
No. of countries	22	37	22	37	22	37	22
Adjusted R-squared	0.5501	0.6054	0.5558	0.614	0.55	0.6051	0.5601

Robust standard error in parentheses. Country and time dummies included but not reported
***$p < 0.01$, **$p < 0.05$, *$p < 0.1$

Appendix 3: The level effect with 5-year average

Estimation technique: 5- year average—two- way fixed effect				
Dependent variable: per capita growth				
	High-income		Low- to middle-income	
	(1)	(2)	(3)	(4)
Productive expenditure	0.1465**		− 0.084	
	(0.0695)		(0.0901)	
Non-productive expenditure		− 0.1577*		− 0.0998
		(0.0819)		(0.1260)
Log initial GDP	0.2085	− 0.704	− 0.5936	− 0.4114
	(1.7832)	(2.0616)	(0.9072)	(1.085)
Investment	0.1694***	0.1954***	0.1919***	0.1910***
	(0.0575)	(0.0635)	(0.0584)	(0.0570)
Inflation	− 0.0558	− 0.055	0.007	0.003
	(0.0441)	(0.0508)	(0.0063)	(0.0064)
Labour force growth	0.2344	0.1681	− 0.1837	− 0.1297
	(0.1259)	(0.1268)	(0.2388)	(0.2412)
Openness	0.0247*	0.0366**	− 0.0106	− 0.011
	(0.0155)	(0.0146)	(0.0137)	(0.0136)
Non-tax revenue	− 0.2626***	− 0.1468**	− 0.0631	− 0.0656
	(0.0708)	(0.0673)	(0.0757)	(0.0930)
Tax revenue	0.0453	0.1838**	− 0.1058	− 0.1506*
	(0.0871)	(0.0873)	(0.0799)	(0.0836)
Surplus or deficit	0.1841***	0.0716**	0.1824*	0.1908*
	(0.0668)	(0.0673)	(0.0936)	(0.1197)
Constant	− 5.0344	2.607754	7.8376	6.159422
	(15.337)	(18.018)	(6.1693)	(7.9751)
Observations	147	147	84	84
No. of countries	37	37	22	22
Adjusted *R*-squared	0.6979	0.6966	0.6274	0.628

Robust standard error in parentheses. Country and time dummies included but not reported
***$p < 0.01$, **$p < 0.05$, *$p < 0.1$

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