The impact of government size and composition on growth in EU15 countries

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Abstract

The goal of this paper is to investigate the long-run effect of government size and composition on growth. Unlike previous studies, this paper employs an improved dataset and a more adequate econometric technique. Using pooled mean group (PMG) estimation approach, which is particularly suitable because it allows short-term adjustments and convergence speeds to vary across countries while imposing cross-country homogeneity restrictions on the long-run coefficients, we empirically test the relationship between growth and government size and its composition in developed European economies, over the period 1970 to 2010. The obtained results indicate that high aggregate spending levels are an impediment for growth in developed economies, while the single most important government expenditure item is - Education.

JEL classification: C33, H1, H50, O4

Key words: government size, GDP growth, PMG estimation, EU

1. Introduction

For decades there has been an intense debate on whether or not a large government sector hinders economic performance. The existing literature suggests that it is rather difficult to identify an unambiguous connection between economic performance, generally measured by GDP growth rates, and the extent of government involvement in the economy, generally measured by government expenditure shares in GDP. Much of the current dissatisfaction with the alleged large government size stems from concerns about the long-term sustainability of public finances. Proponents of limited governments complain that government has grown so big that is has become a pervasive fact of everyday life. They are worried that the financing of such a "leviathan" is becoming an unbearable burden placed on the backs of citizens; thus advocating an inevitable retrenchment of the government sector. On the other side are those who claim that the increasing complexity and insecurity of modern economic and social life inevitably calls for the increase in the scope of governmental activities.

The global financial crisis of 2008/09 has put the issue of government size in the economy at the centre of political debate. Whatever the causes of this global crisis, the reaction of many developed economies' governments has been to step in to offset substantially shrunken private-sector demand, and to rescue potentially insolvent financial institutions and other companies that were judged too important to fail. Consequently, due to bail-outs, fiscal stimuli, tax cuts and recession many countries have witnessed a significant increase in the share of government in the economy coupled with large government deficits and debts. Concerned with these unfavourable fiscal positions, as well as with possible adverse effects of government size on economic growth, many economists and policy makers vigorously insist on downsizing the government sector. They insist on rigorous checks of government programs, strict lending proposals, balanced budgets, and even suggest imposing ceilings of government expenditure shares in GDP. But which component of government expenditure should be cut? The answer lies in, among other, the contribution of these components to economic growth (Devarajan et al., 1996). Economic literature is, hence, increasingly paying attention to the impact of the composition of government expenditures on long-term economic growth, and recommendations to change the composition of public outlays towards items considered as productive are gaining more and more importance. A central idea is that production of private goods and services depends on private capital and on a flow of government services that improve private productivity, such as education, law enforcement, national defence, infrastructure, and so on. Investments in knowledge and human capital, in research and development and in public infrastructure, therefore, play an important role in this regard. The provision of certain public goods and services is assumed to increase the overall efficiency of the economy, contributing to the long-run economic growth. Based on these ideas, European institutions are encouraging the rise in the share of some of these expenditures, like education, public investments, research and development, health, defence, public order etc. Among the listed expenditures by function, our special attention in this paper will be devoted to public spending on education.

Against this background, the main purpose of this paper is to contribute to the empirical literature on growth effects of government size and composition by employing a sophisticated empirical method, particularly suited for tackling some important methodological issues which impair the findings of previous empirical studies. In particular, we employ Pooled Mean Group (PMG) estimator which fits growth model assumptions well, and is particularly suited for dimension of our panel which consists of annual observations for 15 EU countries from 1970 to 2010. A consistent estimation of the long-run relationship between economic growth and the government sector size and structure requires that both dynamics and parameter heterogeneity are allowed for in the model. Since the evolution of economic growth is likely to be a dynamic process, necessity to introduce dynamics in the model is apparent. Apart for dynamics, this estimator also allows short-term adjustments and convergence speeds to vary across countries, while imposing cross-country homogeneity restrictions only on the long-run coefficients. There are good reasons to believe that the long-run coefficients are common across EU countries, given that they have access to common technologies and have intensive intra-trade and foreign direct investment (Bassanini et al., 2001). On the other hand, due to a country's unique institutional, political and cultural history, there is no reason to assume that short-term adjustments and the speeds of convergence to the steady state should be the same across countries.

The rest of this paper proceeds as follows. Section 2 reviews the relevant theory linking the size of government, its composition and economic growth. Section 3 gives literature overview while Section 4 presents our empirical approach. Section 5 gives the results of the basic growth model exploring the conditional effects of government size and composition on economic growth during a long time period. Finally, Section 6 concludes and points out avenues for further research.

2. The role of government in affecting growth

Theoretically, there are many ways in which government policies can influence the economy. The increase in the share of GDP accounted for by government may have negative, zero or positive growth effects, according to the attained level and composition of government shares and the growth model used to analyse it (Nijkamp and Poot, 2004).

Growth theories are typically divided into neoclassical theories, developed by Robert Solow (1956), and theories of endogenous growth, which refer to a diverse body of work that emerged in the 1980s, pioneered by Romer (1986) and Lucas (1988). Within the neoclassical framework, increases in the share of government expenditures are assumed to exert negative effects on the level of investment and output. This is because an increase in the size of government crowds out resources that could have been used for the more efficient private investments. Neoclassical growth models, however, assume that long-run growth rates depend solely on the exogenous technological change. Hence, in this context, the share of government expenditures in GDP may not be relevant for the long-run growth rates. Contrary to the neoclassical theory, endogenous growth theories imply that government policies can have large effects on growth in the long-run. In particular, these models highlight the possible effects of government sector on long-run growth through its impact on investment in physical, human and knowledge capital. A potentially positive linkage between government expenditures and economic growth lies in productive government services that are an input to private production (Barro, 1990).

As explained by Colombier (2004), endogenous growth theory assumes that the acquisition of knowledge and thus the accumulation of human capital causes a rise in the productivity of the labour force. In addition, spill-overs of human capital accumulation to the other producers are assumed. The innovations are embodied in new capital goods, which enhance the productivity of a given amount of capital goods. Thus the incentive to engage in research and development activities is also important for long-term growth. The existence of spill-overs indicates that private returns to the hiring of skilled labour, for example, are lower than social returns. This may lead to insufficient private investment in human capital. Besides, education is viewed as a public good, which also causes a market failure. Since more than one person can use a public good simultaneously, unit costs decrease with the number of students in a single school. Additionally, the more well-educated people work for example in a single firm, the more positive externalities such as a general improvement in industrial organisation and, in all likelihood, more innovations generated within this firm which can spill over to other firms. Thus, government expenditure for education can be growth-enhancing by increasing labour productivity.

Not only education but also those labour market measures, which improve the professional abilities of unemployed people in order to facilitate taking up of employment, can raise labour efficiency. Among other government growth promoting expenditures, expenditures for healthcare play an important role. A good healthcare system can reduce absenteeism and illness. This increases the capacity of the labour force for education and for learning new skills. Other governmentally provided goods that can be used directly by private firms and can enhance private factor productivity include infrastructure services and the outcomes of governmentally financed research and development activities. As in the case of human capital, research and development activities are thought to be public goods and create positive externalities. Therefore research and development policies may improve growth performance either by patent law, own research or by subsidisation. As for the infrastructure expenditures, empirical literature mainly focuses on tangible publicly provided goods, which are called "core infrastructure", since there is no well-defined delimitation of infrastructure in economic theory. The services of transport networks, energy facilities, water and sewer lines, communication systems and development planning, for example the development of industrial estates, are included in core infrastructure. Finally, social transfers are mainly thought of as growth promoting in a sense that those government expenditures contribute to social security, as well as social and political stability, which are important for economic growth. Social transfers can reduce the risk of social and political unrest by mitigating income differences. In the same manner, social stability produces a creative and productive atmosphere. This atmosphere is favourable for the economic activity of each individual and thus for the whole economy.

On the other hand, while government expenditures can stimulate private sector productivity by the provided public goods and services, the taxes required to finance them work in the opposite direction and are assumed, as in the neoclassical model, to crowd out private investments and production. With higher taxes individuals retain a smaller fraction of their returns from investment. Consequently, they have less incentive to invest, and the economy tends to grow at a lower rate (Barro, 1990). The detrimental growth effect of taxes is particularly pronounced if they are used to finance the so-called non-productive government expenditures which, unlike productive expenditures, have no direct positive effect on private-sector productivity[1]. On the negative side of increased government size, apart from distortionary effect of taxation, we should also mention the negative growth effect stemming from interest groups and rent-seeking activities which are assumed to be proportional to the size of government (Olson, 1965).

3. Literature review

While the endogenous growth literature establishes a clear positive relationship between government expenditures and long-term growth, the empirical support for the link is mixed

[1] On a practical note, there are no operational rules on how to distinguish appropriately between productive and non-productive government expenditures. Kneller et al. (1999), for instance, treat expenditures with a substantial (physical or human) capital component as "productive" and show that such expenditures, unlike non-productive ones, enhanced growth rates in a sample of 22 OECD countries over the 1970-1995 period.

(Blankenau et al., 2007). As pointed by Colombier (2004), the main conclusion is that a stable or robust relationship cannot be empirically identified. An early sensitivity analysis of Levine and Renelt (1992) suggests that in linear regressions, no robust relationship between fiscal indicators and growth could be determined. Sala-i-Martin (1997), who concentrates on government spending, comes to the same conclusion in his sensitivity analysis. This vagueness can be exemplified by a study of Fölster and Henrekson (2001). Whereas Fölster and Henrekson's (2001) analysis shows a significant negative relationship between government size and total taxes and economic growth, Agell et al. (2006), using the same data set, come to the conclusion that the correlations are highly unstable and insignificant. The difficulty in grasping the connection between public finances and growth is explained by several reasons such as measurement errors, influential outliers, heterogeneity of the samples, endogeneity problems, model uncertainty, etc. (e.g. Temple, 1999).

As for the impact of government expenditures composition (and spending on education in particular) on growth, the results are also diverse. In a sample of 43 developing countries over the period 1970-1990, Devarajan et al. (1996), for instance, find that education, together with other types of productive government expenditures, has either negative or insignificant relationship with economic growth. Easterly and Rebelo (1993), using a broader sample, find that government education expenditures have a positive but non-robust effect on economic growth. They also find that inequality affects education spending; countries with greater initial inequality prior to 1970 implement higher levels of public expenditure in education as a fraction of GDP in the period from 1970 to 1988. Using a somewhat large sample consisting of 119 countries over the period 1960-1989 Levine and Renelt (1992) find that government education expenditures are not robustly correlated with growth rates. Using data for Turkey over the period 1973-2009, Yildirim et al. (2011) explore the direction of relationship between government educational expenditures and economic growth. Their results indicate that that causality runs only from economic growth to educational spending and not the other way around. Blankenau et al. (2007), on the other hand, using a panel of 23 developed countries over the period 1960-2000, find a positive relationship between public education expenditures and long-term growth only when controlling for the government budget constraint. Colombier (2011) uses ARDL model with an error-correction representation to test whether Swiss public expenditure impacts labour productivity, using those government expenditure items that might, in theory, affect productivity growth. He concludes that public expenditure on education not only stimulates labour productivity, but that labour productivity also impacts educational expenditure. Government expenditures on education are, furthermore, found to exert statistically significant and positive impact on growth in a variety of settings. More precisely it is found that a one percentage point increase in education spending is associated with an increase in growth of 1.4-2 percentage points depending on the time period and set of countries under analyses (see, for example Baldacci et al., 2004; Bose et al., 2007 and Gemmell et al., 2014). A number of papers find education expenditures to be growth-enhancing without providing exact estimates of this impact (see, for example, Afonso and Gonzalez Alegre, 2008 and Afonso and Jalles, 2014). Sanz (2011), on the other hand, investigates which components do governments cut first when faced with fiscal adjustments, and finds that reductions in government expenditures actually increase the share of education and transport and communication in GDP. Acosta-Ormaechea and Morozumi (2013), interestingly, explore the impact of changes in the composition of government expenditures on long-run growth and find that a one percentage point increase in education spending leads to 0.22 percentage points increase in growth if it is offset by a one percentage point fall in social protection spending, and 0.31 increase in growth if it is offset by a one percentage point fall in health spending.

According to a comprehensive survey by Nijkamp and Poot (2004), which comprises 123 meta-observations, the majority of studies included in the analysis (77%) is based on cross-country or panel data. None of the studies reviewed, apart from Romero-Ávila and Strauch (2008), Sanz (2011) and Gemmell et al. (2014), however, takes into account a problem known in the econometric literature as "parameter heterogeneity". The problem results from the fact that different countries differ from each other in many respects, such as their political-economic systems, their respective cultures, history and geographical features and so on. If not corrected for, the parameter heterogeneity problem can lead to inconsistent estimates, thus leading to incorrect results. Besides parameter heterogeneity, empirical studies in this field seem to ignore some other crucial econometric issues - such as dynamics and endogeneity - both of which can render their findings unreliable. Our approach, discussed in the methodological part of this proposal, straightforwardly addresses these issues; hence, improving the quality of analysis and reliability of findings.

4. Methodological issues and data

The main goal of this part of the paper is to establish the direction of the impact of government size on growth in a set of 15 developed EU countries during the period 1970-2010, and then to analyse which government expenditure items are growth enhancing, paying special attention to spending on education. Given that our data set consists of annual observations spanning 15 countries from 1970 to 2010, the number of time series observations, *T*, is relatively large compared to the number of countries, *N*. Such dimensions of the data set allow us to address some important methodological issues, while aiming to consistently estimate the long-run relationship between economic growth and the size of government.

The recent literature on panel estimation in which both *N* and *T* are relatively large suggests several approaches. On the one end, there are static fixed-effect estimators (SFE) or dynamic fixed-effect estimators (DFE), which normally assume homogeneity of all slope coefficients, allowing only the intercepts to vary across countries. If, however, the slope coefficients are heterogeneous, as is often the case in reality, then the fixed-effect approach could produce inconsistent and potentially misleading results (see, for example, Pesaran and Smith, 1995 and Baltagi, 2008). On the other end of the spectrum there is the mean group (MG) estimator proposed by Pesaran and Smith (1995), whereby the model is estimated separately for each individual state, and a simple arithmetic average of the coefficients is calculated. With this estimator the intercepts, slope coefficients, and error variances are all allowed to differ across states. While it might be reasonable to assume that parameters vary across countries in the short run, however, it is less likely that there are no common features in the long-run relationships. An important disadvantage of the MG estimator is that it does not allow for the efficiency gains that could arise if some coefficients are common across countries. This insight is exploited by an intermediate estimator - the Pooled Mean Group (PMG) estimator more recently developed by Pesaran et al. (1999), which allows for slope heterogeneity in the short run (like the MG estimator), but imposes common long-run coefficients (like the fixed-effects estimator).

In this paper we employ the PMG estimator as this technique addresses important methodological issues, relatively rarely discussed in other empirical studies in this field. In particular, this technique allows a researcher to distinguish between the long-run effects and short-run dynamics, to accommodate the joint occurrence of dynamics and parameter heterogeneity as well as to address the problem of endogeneity. Namely, one of the main methodological issues that may lead to biased estimates of how the public sector impacts growth is the problem of endogeneity resulting from simultaneous determination of variables. The assumption of exogeneity of the government expenditure variable in a growth regression is theoretically questionable. According to Wagner's law, the size of government in the economy is expected to increase with the level of income. However, this seems not to be problem in estimation of the long-run parameters in the context of PMG modelling. Augmenting the specification with an adequate number of lags makes the estimation of the long-run coefficients immune to endogeneity problems, irrespective of whether the regressors are stationary or not (Pesaran et al., 1999 and Pesaran and Shin, 1999).

In addition to being appropriate for our panel dimension, this technique is particularly adequate because it allows short-term adjustments and convergence speeds to vary across countries, and imposes cross-country homogeneity restrictions on long-run coefficients only. Namely, EU countries are likely to have common long-run coefficients, as they have access to common technologies and have extensive mutual trade and FDI flows. The speeds of convergence to the steady states, on the other hand, need not be the same, as the proximity of each country to its respective balanced growth path may vary. These assumptions, inherent to PMG, also fit the characteristics of our sample as well as growth facts well.

Specification of the model

The Pesaran et al. (1999) approach is, essentially, a panel equivalent to the time-series error correction re-parameterisation of an autoregressive distributed lag (ARDL) model. In the manner of Devarajan et al. (1996) endogenous growth model, we assume that the long-run relationship between GDP growth rate and a set of explanatory variables is given by:

$$Y_{it} = \alpha_{0i} + \theta_{1i}G_{it} + \sum_{s=1}^{9} \theta_{si} \left({}^{G_s}/_{Gc} \right)_{it} + \theta_{ki}(Z_k)_{it} + u_{it} \quad (1)$$

where the number of countries is *i=1, 2, …, N*; the number of periods is *t=1, 2, …, T*; the number of explanatory variables is *k=1, 2,…, K*; Y_{it} is the GDP growth rate, G_{it} is the size of government, measured as a share of total general government expenditures in GDP, $\left({}^{G_s}/_{Gc} \right)_{it}$ is a set of S (s=1,2,...,9) shares of individual categories of government expenditures in total general government final consumption, $(Z_k)_{it}$ is a set of *K* (*k=1,2,…,K*) control variables, α_{0i} is a country-specific intercept, θ_{1i} is the parameter on our variable of interest - government size, θ_{si} are the parameters on the shares of *s* individual categories of government expenditures in total government expenditure, θ_{ki} are the parameters on the set of explanatory variables and u_{it} is the error term. To introduce dynamics, we transform this long-run equation into an ARDL $(p,q_1,..,q_k)$ model and re-parameterise it so as to derive a formulation in which the long-run equilibrium appears explicitly as the so-called error correction (EC) term:

$$\Delta Y_{it} = \phi_i \left[Y_{it-1} - \theta_{0i} - \theta_{1i}G_{it} - \sum_{s=1}^{9} \theta_{si} \left({}^{G_s}/_{Gc} \right)_{it} - \theta_{ki}(Z_k)_{it} \right] + \delta_{11i}\Delta G_{it} + \sum_{s=1}^{9} (\delta_s)_{1i} \Delta \left({}^{G_s}/_{Gc} \right)_{it} + (\delta_k)_{1i}\Delta(Z_k)_{it} + \varepsilon_{it} \quad (2)$$

where $\phi_i = -(1 - \lambda_i)$ is the error-correction parameter, $\theta_{0i} = \frac{\gamma_i}{1-\lambda_i}$ is a country-specific constant, One would expect ϕ_i to be statistically significant and negative, if the variables exhibit a return to the long-run equilibrium, i.e. if they are cointegrated. In our case this would mean that any deviation of actual GDP growth rate from the value predicted by the long-run relationship with the hypothesised explanatory variables triggers a change in the opposite direction. The parameters on the differenced explanatory variables, δ_{11i} , $(\delta_s)_{1i}$and $(\delta_k)_{1i}$ are impact multipliers (short-run effects) that measure the immediate impact that a change in $\Delta\left({G_s}/{G_C}\right)_{it}$and $(Z_k)_{it}$ have on a change in Y_{it}.

At this point we draw attention to yet another specification problem related to defining the set of control variables $(Z_k)_{it}$. Namely, there is up to now no clear-cut theory that would dictate the list of variables that should be included in growth regressions, in spite of vast and growing literature on economic growth. The lack of consensus regarding the theoretical framework to guide empirical work on growth determinants and the variety of conclusions reached by various studies, has led to examination of the robustness of a wide set of variables used in empirical growth literature. The most prominent papers in this field encompass Levine and Renelt (1992) and Sala-i-Martin (1997). Levine and Renelt (1992) use a variant of Leamer's (1983) Extreme Bound Analysis (EBA) to determine which coefficients of the explanatory variables used in the existing cross-country studies on growth determinants are robust and which are non-robust to small changes in the conditioning information set. Levine and Renelt (1992) demonstrate that the sign of the coefficient on the share of total government expenditures in GDP remains negative but becomes insignificant with the inclusion of only one additional variable. Likewise, Agell et al. (1997) illustrate, with a simple cross-country growth regression, that the relation between growth and government expenditure reverses from negative to positive when additional control variables are introduced. Sala-i-Martin (1997) moves away from 'extreme tests' and, instead of labelling variables just as either robust or non-robust, assigns some level of confidence to each of them. In both approaches the tested model includes a variable of interest (that is tested for robustness), a vector of fixed variables that always appear in growth regressions, and a vector of up to three variables taken from the pool of the remaining variables usually used in the literature. The fixed variables that Levine and Renelt use are the initial level of income per capita, the investment rate, the secondary school enrolment rate and the rate of population growth, while Sala-i-Martin includes initial level of income, life expectancy and the primary school enrolment rate. These vectors of fixed variables dictate our choice of core variables $((Z_k)_{it})$ to include in baseline growth specification. Our initial specification, therefore, includes government expenditure shares in GDP and other basic determinants of growth, namely GDP gap[2], investment rate, population growth and secondary school enrolment rates. This specification is consistent with the core variables proposed by Levine and Renelt (1992) and Sala-i-Martin (1997).

Given that our sample consists of developed economies, we expect to find a negative growth effect of our main variable of interest; namely, government shares in GDP, suggesting that the disincentive effects of increased government sector may have surpassed the positive effects stemming from productivity-enhancing government activities. As for the expected signs on various items of government expenditures, we expect a positive direction stemming from "productive expenditures", especially those devoted to the production of human capital accumulation, such as expenditures on education and health. It is difficult to anticipate, on the other hand, the growth effects of other expenditure items, given that their role for economic growth is theoretically ambiguous. We expect to find a negative sign on GDP gap, which would suggest the existence of conditional convergence. The impact of investment on growth should be positive, as this is one of the

[2] In the empirical growth literature the initial level of income is used to account for conditional convergence, which is taken to hold if the coefficient on this variable is negative. Since we will be using annual data and not averages, using initial GDP is impractical as there would be no variation in this variable over the years. We, therefore, following Ghosh and Phillips (1998) and Harris, Gillman and Matyas (2001), use the ratio of country *j*'s GDP per capita to USA's GDP per capita (USA serves as a benchmark) for each year in the sample.

key growth determinants. Moreover, if investment is not included in the model, then it is unclear whether the other explanatory variables affect growth directly or through incentives to save and invest. As for population, a high population growth presumably lowers GDP because the existing amounts of human and physical capital have to be divided over the, now larger, population. Finally, an increase in human capital per worker (measured by secondary school enrolment rates) is expected to lead to increased output per worker. Better educated and trained workers perform their tasks better and learn new tasks and adopt new production techniques faster.

Data description

Table 1 describes the variables used in terms of definition, construction and data source, while Table A.1 in Appendix 1 gives their descriptive statistics. The available data is annual and the time period covered is from 1970 to 2010. As for the cross-sectional dimension of the panel, it includes 15 EU countries. The dimensions of our unbalanced panel are mainly driven by the constraints imposed by data availability.

Table 1 Definitions and sources of the variables

Variable	Indicator(s)	Source
GDPgr	GDP per capita growth (annual %)	World Bank (2013)
GinGDP	Total nominal general government expenditure (% of GDP)	OECD (2001; 2015)
Serv	Percentage of expenditures on General public services in general government final consumption	United Nations Statistics Division (2015)
Def	Percentage of expenditures on Defence in general government final consumption	United Nations Statistics Division (2015)
Ord	Percentage of expenditures on Public order and safety in general government final consumption	United Nations Statistics Division (2015)
Econ	Percentage of expenditures on Economic affairs in general government final consumption	United Nations Statistics Division (2015)
Hous	Percentage of expenditures on Housing and community amenities in general government final consumption	United Nations Statistics Division (2015)
Health	Percentage of expenditures on Health in general government final consumption	United Nations Statistics Division (2015)
Env	Percentage of expenditures on Environment protection in general government final consumption	United Nations Statistics Division (2015)
Recr	Percentage of expenditures on Recreation, culture and religion in general government final consumption	United Nations Statistics Division (2015)
Educ	Percentage of expenditures on Education in general government final consumption	United Nations Statistics Division (2015)
SProt	Percentage of expenditures on Social protection in general government final consumption	United Nations Statistics Division (2015)
INV	Gross fixed capital formation (% of GDP)	World Bank (2013)
PoPg	Population growth (annual %)	World Bank (2013)
Edu2	School enrolment, secondary (% gross)	World Bank (2013)
GAP	Ratio of country j's GDP per capita (constant 2000 US$) and USA's GDP per capita (constant 2000 US$)	World Bank (2013)

At this point, we draw attention to practical problems related to definition and measurement of individual government expenditure items. In our analysis, we use The Classification of the Functions of Government (COFOG). COFOG is used for the classification of government outlays - i.e. government expense and the net acquisition of non-financial assets. COFOG is a classification of transactions; all outlays for a particular function are collected in one category of COFOG. Government expenditures are divided into ten main categories known as Divisions: general public services; defence; public order and safety; economic affairs; environmental protection; housing and community affairs; health; recreation, culture and religion; education; social protection. We intended to employ an appropriate measure for the aforementioned expenditure items; namely, each of those items expressed as a share in *total general government expenditure*. However, due to lack of data, we used a less satisfactory measure - the percentage of each of these items in the general government *final consumption* expenditure.

5. Results

Our starting point, as emphasised before, is specification outlined in equation (3) whereby vector Z_k includes: GDP gap, population growth rate, investment rate and secondary school enrolment rate. As for the estimation of growth effects of various government expenditure items, in line with Gemmell et al. (2014), each regression includes one of the s = 1…S expenditure share items, G_s/G_C, where the included s^{th} expenditure category is rotated across the S different categories. Including each expenditure share in turn (rather than all S-1 expenditure shares simultaneously) saves on degrees of freedom in our model which requires a large number of parameters to be estimated due to the assumption of short-run parameter heterogeneity across countries.

We first present the estimation results for our baseline specification without government expenditures items. Table 2 reports estimates obtained from PMG - our preferred estimator, as well as from DFE and MG estimators - the two estimators used as a robustness check of the obtained results.

Table 2: Baseline estimates (dependent variable: ΔGDPgr)

Estimator	PMG	MG	DFE
EC	-0.700***	-0.892***	-0.850***
	(0.121)	(0.0958)	(0.0633)
Variable		Long-run coefficients	
GinGDP	-0.294***	-0.0903	-0.106**
	(0.0715)	(0.190)	(0.0466)
GAP	-0.0312	-0.693***	-0.0207
	(0.0268)	(0.176)	(0.0302)
PoPg	0.0683***	0.0129	0.0304*
	(0.0230)	(0.0800)	(0.0183)
INV	0.645	-1.194	-0.0673
	(0.429)	(1.550)	(0.397)
Edu2	-0.0754***	-0.0126	-0.0533***
	(0.0170)	(0.0858)	(0.0148)
		Short-run coefficients	
ΔGinGDP	-0.0340	-0.0372	-0.174**
	(0.0971)	(0.186)	(0.0851)
ΔGAP	0.876***	1.167***	1.090***
	(0.196)	(0.210)	(0.108)
ΔPoPg	-0.0785	-0.124	-0.0571*
	(0.0581)	(0.0950)	(0.0317)
ΔINV	1.725**	2.788**	-0.490
	(0.824)	(1.296)	(0.634)
ΔEdu2	0.0727	0.140	0.00846
	(0.0500)	(0.114)	(0.0732)
Cons	2.547***	30.51***	3.469*
	(0.895)	(6.382)	(1.953)
N	249	249	249
No of countr.	15	15	15

Notes: First-order ARDL is used. A country-specific constant term is included. Numbers reported in parentheses are standard errors, while *, ** and *** denote significance at the 10, 5 and 1 percent, respectively. Δ denotes first differences.

Although we report both the long-run and short-run coefficients, we only discuss the long-run coefficients of interest and abstract from further elaborating the short-run coefficients. The results from PMG estimation (column (1)) indicate firstly that, as expected, the convergence coefficient (EC) is negative and statistically significant, which implies that variables are cointegrated, i.e. that they tend to return to the long-run equilibrium. The results, furthermore, indicate that GDP gap variable exerts a negative impact on growth. However, this impact is statistically significant only in the case of MG estimation. This result is in line with our expectations as it implies the existence of conditional convergence. More precisely, under the assumption of other things (basic structural characteristics captured by INV, PoPg and Edu2) being equal, the higher the value of GAP variable the relatively more developed a country in comparison to the USA, and the lower its growth rate. Population growth exerts a positive and, for the most part, significant growth effect, while the growth impact of investment changes its sign from positive (PMG estimation) to negative (MG and DFE estimation) but remains statistically insignificant in all cases. Education, improperly, seems to impact growth negatively. This finding is not in line with expectations, as we would normally expect the better educated workforce to be more productive and influence growth positively. The negative finding is probably due to the fact that Edu2 is a poor proxy for capturing the influence of human capital on growth, as the flow from current post-compulsory secondary enrolments has little impact on the quality of the stock of the current workforce, because the effects of this variable on growth are not felt in the same year, but maybe 5-10 years later. It should be noted at this point, however, that although school enrolment rates are often used as a measure of the stock of human capital, this measure has a drawback in that a person's effectiveness (i.e. his/hers ability to perform tasks better) can be recognised only after participating in production activities.

Finally, as for our variable of interest - government size, the results indicate that it has remarkably stable negative influence on GDP growth (statistically insignificant only in the MG specification of the model). This means that, ceteris paribus, larger government is associated, on average, with lower rates of growth. To illustrate the size of the estimated effect, increasing shares of government expenditure in GDP by 10 percentage points lowers annual growth by 2.94 percentage points. In a sample of developed economies, such as the one at hand, this finding is not surprising. Theoretically, the additional government spending arguably increases the distortionary effect of taxation which, in turn, hinders growth. Also, with the additional growth of government size more efficient private production and investment are likely to be crowded out, while the scope for growth-retarding rent-seeking activities is likely to increase.

In what follows we present the estimated growth effects of various government expenditure items. In line with Gemmell et al. (2014), each regression includes one of the $s = 1,\dots,S$ expenditure share items, *Gs/GC*, where the included s^{th} expenditure category is rotated across the S different categories (Table 3). Compared to our baseline specification Model 1 additionally includes variable for General public services (*Serv*), Model 2 for Defence (*Def*), Model 3 for Economic affairs (*Econ*), Model 4 for Health (*Health*), Model 5 for Education (*Educ*) and finally Model 6 for Social protection (*SProt*). Due to computational difficulties, however, models with variables for certain types of government expenditures; in particular, Public order and safety (*Ord*), Environment protection (*Env*), Housing and community amenities (*Hous*) and Recreation, culture and religion (*Rec*) proved to be inoperable within the PMG framework. All additional variables are measured as shares in general government final consumption.

Table 3: PMG estimates (dependent variable: ΔGDPgr)

Model	(1)	(2)	(3)	(4)	(5)	(6)
EC	-0.491***	-0.618***	-0.579***	-0.564***	-0.575***	-0.584***
	(0.116)	(0.131)	(0.134)	(0.163)	(0.140)	(0.111)
Variable			**Long-run coefficients**			
GinGDP	-0.724***	-0.353***	-0.545***	-0.640***	-0.725***	-0.578***
	(0.116)	(0.0866)	(0.0957)	(0.113)	(0.109)	(0.0931)
GAP	-0.0455	0.0912**	0.0463	0.0374	-0.106**	0.0184
	(0.0458)	(0.0410)	(0.0430)	(0.0357)	(0.0492)	(0.0318)
PoPg	0.0831***	0.0805***	0.102***	0.0828***	0.0373	0.117***
	(0.0309)	(0.0272)	(0.0301)	(0.0275)	(0.0247)	(0.0288)
INV	1.817***	-0.729	0.886	0.0816	1.990***	0.535
	(0.688)	(0.644)	(0.756)	(0.541)	(0.629)	(0.480)
Edu2	-0.0671***	-0.0536***	-0.0666***	-0.0863***	0.0153	-0.0616***
	(0.0155)	(0.0155)	(0.0177)	(0.0188)	(0.0204)	(0.0172)
Serv	-29.99***					
	(7.674)					
Def		9.724				
		(8.139)				
Econ			-20.14			
			(16.40)			
Health				21.44**		
				(10.25)		
Educ					77.21***	
					(15.74)	
SProt						-39.04***
						(11.20)
			Short-run coefficients			
ΔGinGDP	-0.725**	-0.213	-0.282	-0.421	-0.162	-0.0218
	(0.368)	(0.394)	(0.477)	(0.353)	(0.313)	(0.482)
ΔGAP	0.415*	0.596***	0.560***	0.532***	0.641***	0.692***
	(0.235)	(0.210)	(0.174)	(0.176)	(0.183)	(0.217)
ΔPoPg	-0.0486	-0.121**	-0.117**	-0.0644	-0.0270	-0.0973**
	(0.0949)	(0.0547)	(0.0476)	(0.0647)	(0.0623)	(0.0447)
ΔINV	-0.722	0.652	-1.021	-1.206	-0.792	-0.518
	(2.131)	(2.530)	(2.511)	(2.531)	(2.626)	(2.187)
ΔEdu2	0.0797	0.177**	0.157***	0.0945*	0.142	0.136**
	(0.0719)	(0.0736)	(0.0552)	(0.0509)	(0.0994)	(0.0683)
ΔServ	-15.77					
	(40.01)					
ΔDef		4.073				
		(31.89)				
ΔEcon			-13.51			
			(27.81)			
ΔHealth				19.07		
				(37.54)		
ΔEduc					-39.02	
					(24.99)	
ΔSProt						58.64*
						(34.24)
Cons	6.145***	-3.041***	0.157	-0.228	-2.790***	1.807*
	(1.808)	(0.864)	(0.902)	(0.713)	(0.915)	(1.052)
N	188	202	186	188	202	202
No of countr.	15	15	15	15	15	15

Notes: First-order ARDL is used. A country-specific constant term is included. Numbers reported in parentheses are standard errors, while *, ** and *** denote significance at the 10, 5 and 1 percent, respectively. Δ denotes first differences.

The results presented in Table 3 confirm a (slightly stronger) negative and statistically significant growth effect of the total government sector size (*G in GDP*). The variable on *GAP* alters both the sign and significance, depending on model specification. The effect of population growth (*PoPg*) is positive throughout all specifications. With the exception of Model 5, the estimated effect of population growth is statistically significant at conventional levels of significance in all specifications. Compared to our baseline specification, the effect of the investment variable (*INV*) is now mostly positive (excepting Model 2); however, its statistical insignificance varies across different models. The estimated coefficients on the education variable (*Edu2*) are positive in all specifications, and are also statistically significant for the most part. The error correction coefficient remains negative.

For the growth effects of various types of government expenditures, it seems that General public services (*Serv*) and Social protection (*SProt*) are an impediment to economic growth. The estimated coefficients on both variables are statistically highly significant. Government expenditures on Economic affairs (*Econ*) seem to also exert and negative growth effect, but this effect has no statistical significance. The remaining items of government expenditures; namely, Defence (*Def*), Health (*Health*) and Education (*Educ*) have positive growth effects. While the estimated coefficient of the Defence variable is statistically insignificant, the estimate coefficients on the Health and Education are significant. Further, the results indicate that the single most important item of government expenditure that has the strongest effect on economic growth is - Education. This finding is in line with endogenous growth models endogenous growth theories which imply that government policies can have large effects on growth in the long-run, particularly through its impact on investment in human and knowledge capital.

Robustness checks

In order to check the robustness of our findings we alter the above specifications in several ways. First we use logarithms for government expenditures items (results reported in Appendix 2 Table A.2). In this specification, the estimated coefficients on General public services (*Serv*), Social protection (*SProt*) and Economic affairs (*Econ*) remain negative, but only the General public services variable (*Serv*) stays statistically significant. Defence (*Def*), Health (*Health*) and Education (*Educ*) all have positive growth effects. However, it is only Education that exerts a statistically significant growth effect. Table A.3 and A.4 in Appendix 2 present the estimation results obtained by employing alternative estimation techniques; namely, MG and DFE. Bothe the MG and the DFE estimated growth effects of government expenditure items (reported in Appendix 2 Table A.3 and Table A.4, respectively) suggest that none of the examined items exerts a statistically significant effect.

6. Conclusion

The relationship between government size and growth is probably one of the mostly debated topics in economics and the global financial crisis of 2008/09 has certainly put it back on the agenda. Despite recent advances in the field of public sector economics, there is still much more to be learnt and much more work to be done to improve our understanding of the nature and growth effects of the size of government in the economy, and more importantly, of its structure. This paper aims to contribute to the literature by examining how strong growth rates respond to government expenditure changes and which expenditure items have the strongest impact.

While the early studies in this field are rather inconclusive, recent studies mostly suggest that there is a negative relationship between total government size and growth in developed economies. The main findings of our study lie within that strand of the empirical literature - we find that in developed EU countries, *ceteris paribus*, larger government sector is associated, on average, with lower rates of growth. Moreover, our findings suggest that government expenditures on education have the strongest, positive growth effect compared to other government expenditure items. To arrive at precise estimates of the growth effects of government size, from a methodological point of view, in comparison to other studies, our paper advances particularly in terms of addressing the issue of parameter heterogeneity. Namely, all of the mentioned studies, except for Romero-Ávila and Strauch (2008), Sanz (2011) and Gemmell et al. (2014), use models which impose cross-country parameter homogeneity. The failure to account for parameter heterogeneity in a dynamic panel model with relatively long time-series dimension, however, can produce inconsistent and potentially very misleading estimates of the average values of the parameters (Pesaran and Smith, 1995).

We employ pooled mean group estimation approach, which is particularly adequate given our sample characteristics, as it allows short-term adjustments and convergence speeds towards the balanced growth path to vary across countries, and imposes cross-country homogeneity restrictions on the long-run coefficients only.

With reference to possible future line of investigation, it would be interesting to examine whether the identified negative effect found for developed economies reverses sign in a sample of transitional economies. This is where we envisage a potential extension of our research. We do foresee, however, some practical problems related to the non availability and poor quality of the data for transitional countries. In the best-case scenario, one could hope to obtain the data starting from the beginning of 1990s. This was the period when the majority of transitional countries, at least the more developed ones in Central and Eastern Europe, gained their independence and established their official bureaus of statistics. From the statistical point of view, such a relatively short time span implies that there would not be enough time observations to capture the long-run relationship between government size and economic growth. From the economic policy point of view, however, this division of countries according to the attained stage of economic development and the attained size of government sector is very important.

Appendix 1 Table A.1

	Obs	Mean	SD	Min	Max
GDPgr	613	2.180342	2.6865	-8.974979	13.61535
GinGDP	419	25.27794	15.07602	4.79005	62.15987
Serv	467	.1241336	.0709292	.0072548	.4264579
Def	487	.1099054	.0829508	.0126784	.5046148
Ord	422	.0704067	.0212697	.0299711	.1191897
Econ	460	.0788176	.0738616	.0041796	.8113375
Hous	458	.0373324	.087329	-.0020074	.4676507
Health	467	.2456587	.0592404	.0283748	.3678971
Env	300	.0176734	.0106136	.0015767	.0389083
Recr	438	.0299184	.0109304	.0090932	.0580623
Educ	487	.2259154	.0462091	.1155872	.3873719
SProt	487	.1058436	.0632788	.0099111	.2463893
INV	450	.5050113	.4776668	-.8862703	3.800414
PoPg	575	69.17722	46.19847	-.2653194	156.496
Edu2	469	45.70297	23.90461	7.22062	96.98669
GAP	615	64.9869	21.27054	25.2909	145.3991

Appendix 2 Table A.2: The estimated growth effects of the logarithms of gov. exp. items (dependent variable: ΔGDPgr)

Model	(1)	(2)	(3)	(4)	(5)	(6)
EC	-0.407***	-0.617***	-0.584***	-0.577***	-0.573***	-0.624***
	(0.110)	(0.128)	(0.140)	(0.156)	(0.137)	(0.119)
Variable			**Long-run coefficients**			
GinGDP	-1.012***	-0.368***	-0.537***	-0.593***	-0.720***	-0.506***
	(0.175)	(0.0917)	(0.0959)	(0.107)	(0.108)	(0.0866)
GAP	-0.252**	0.108*	0.0548	0.0464	-0.0980*	0.0488
	(0.0868)	(0.0501)	(0.0428)	(0.0348)	(0.0488)	(0.0328)
PoPg	0.0444	0.0798**	0.104***	0.0757**	0.0385	0.110***
	(0.0373)	(0.0284)	(0.0305)	(0.0275)	(0.0251)	(0.0278)
INV	3.341***	-0.293	0.624	0.130	1.917**	0.300
	(0.875)	(0.539)	(0.728)	(0.560)	(0.639)	(0.474)
Edu2	-0.0602***	-0.0494**	-0.0702***	-0.0761***	0.0135	-0.0758***
	(0.0166)	(0.0164)	(0.0171)	(0.0176)	(0.0204)	(0.0170)
lnServ	-6.460***					
	(1.481)					
lnDef		1.550				
		(1.532)				
lnEcon			-1.138			
			(0.890)			
lnHealth				3.506		
				(2.257)		
lnEduc					17.80***	
					(3.685)	
lnSProt						-1.056
						(0.742)
			Short-run coefficients			
ΔGinGDP	-0.792	-0.226	-0.435	-0.413	-0.262	-0.0937
	(0.547)	(0.384)	(0.367)	(0.373)	(0.252)	(0.473)
ΔGAP	0.280	0.592**	0.602**	0.570**	0.654***	0.606**
	(0.226)	(0.199)	(0.205)	(0.175)	(0.179)	(0.209)
ΔPoPg	-0.0153	-0.109*	-0.116**	-0.0686	-0.00877	-0.105*
	(0.113)	(0.0527)	(0.0440)	(0.0565)	(0.0737)	(0.0520)
ΔINV	-1.246	0.294	-1.065	-1.116	-0.669	-0.388
	(1.989)	(2.453)	(2.526)	(2.531)	(2.634)	(2.254)
ΔEdu2	0.118	0.157*	0.157**	0.103*	0.127	0.167*
	(0.0868)	(0.0757)	(0.0555)	(0.0472)	(0.103)	(0.0656)
ΔlnServ	1.162					
	(6.393)					
ΔlnDef		-2.307				
		(3.344)				
ΔlnEcon			0.934			
			(2.872)			
ΔlnHealth				1.820		
				(7.092)		
ΔlnEduc					-8.741	
					(5.777)	
ΔlnSProt						2.977
						(2.817)
Cons	4.857**	-0.688	-2.699*	5.253***	22.44***	-2.743**
	(1.860)	(0.726)	(1.063)	(1.587)	(5.652)	(0.994)
N	188	202	186	188	202	202
No of countries	15	15	15	15	15	15

Notes: First-order ARDL is used. A country-specific constant term is included. Numbers reported in parentheses are standard errors, while *, ** and *** denote significance at the 10, 5 and 1 percent, respectively. Δ denotes first differences.

Appendix 2 Table A.3: The MG estimated growth effects of of gov. exp. items (dependent variable: ΔGDPgr)

Model	(1)	(2)	(3)	(4)	(5)	(6)
EC	-0.707***	-0.859***	-0.896***	-0.571**	-0.977***	-0.762***
	(0.159)	(0.0984)	(0.224)	(0.283)	(0.209)	(0.196)
Variable			**Long-run coefficients**			
GinGDP	-1.131	0.0209	-0.0769	-1.560	1.523	14.90
	(0.806)	(0.515)	(0.676)	(2.316)	(1.550)	(12.61)
GAP	-1.265	-1.728***	-1.413***	-1.128*	-2.987	-20.45
	(0.982)	(0.414)	(0.423)	(0.588)	(2.328)	(17.78)
PoPg	-0.0702	-0.0644	0.352*	-0.611	-0.409	1.602
	(0.0917)	(0.169)	(0.196)	(0.503)	(0.474)	(2.490)
INV	-3.283	-2.810	8.755	-18.94	4.173	-251.1
	(2.725)	(3.991)	(9.137)	(20.53)	(6.432)	(227.9)
Edu2	-0.0326	-0.252	-0.363	0.486	-0.127	-1.328
	(0.323)	(0.153)	(0.261)	(0.598)	(0.157)	(2.015)
Serv	57.87					
	(85.46)					
Def		-190.6				
		(222.6)				
Econ			-269.7			
			(419.7)			
Health				40.10		
				(176.2)		
Educ					-363.8	
					(526.3)	
SProt						2460.1
						(3071.5)
			Short-run coefficients			
ΔGinGDP	0.0928	-0.449	-0.0490	-2.961	9.390	-1.337
	(0.443)	(0.540)	(0.304)	(2.507)	(9.906)	(1.244)
ΔGAP	1.211***	1.770***	0.0925	1.070**	2.209*	1.764***
	(0.392)	(0.358)	(0.790)	(0.460)	(1.251)	(0.683)
ΔPoPg	-0.0735	-0.216	-0.381**	-0.111	-1.865	-0.0308
	(0.132)	(0.169)	(0.187)	(0.0795)	(1.689)	(0.309)
ΔINV	4.388	3.279	9.289**	4.891	-15.56	0.250
	(4.668)	(4.053)	(4.355)	(4.463)	(16.11)	(4.012)
ΔEdu2	0.171	0.449**	0.873	-0.409	1.444	-0.126
	(0.407)	(0.203)	(0.697)	(0.526)	(1.251)	(0.643)
ΔServ	13.87					
	(68.44)					
ΔDef		63.32				
		(121.6)				
ΔEcon			-294.2			
			(218.6)			
ΔHealth				-1.573		
				(49.09)		
ΔEduc					428.0	
					(534.8)	
ΔSProt						1002.6
						(926.2)
Cons	108.3***	109.7***	25.89	-5.721	491.2	65.50
	(39.69)	(32.10)	(45.13)	(50.45)	(512.9)	(67.56)
N	188	202	186	188	202	202
No of countries	15	15	15	15	15	15

Appendix 2 Table A.4: The DFE estimated growth effects of of gov. exp. items (dependent variable: ΔGDPgr)

Model	(1)	(2)	(3)	(4)	(5)	(6)
EC	-0.795***	-0.781***	-0.821***	-0.811***	-0.788***	-0.789***
	(0.0729)	(0.0712)	(0.0748)	(0.0734)	(0.0706)	(0.0709)
Variable			**Long-run coefficients**			
GinGDP	-0.118**	-0.0679	-0.115**	-0.0516	-0.113**	-0.116**
	(0.0550)	(0.0645)	(0.0547)	(0.0697)	(0.0544)	(0.0529)
GAP	-0.0324	-0.0272	-0.0510	-0.0306	-0.0660	-0.0530
	(0.0505)	(0.0525)	(0.0517)	(0.0498)	(0.0517)	(0.0506)
PoPg	0.0186	0.0289	0.0283	0.0360	0.0259	0.0254
	(0.0224)	(0.0227)	(0.0216)	(0.0228)	(0.0216)	(0.0217)
INV	0.201	-0.297	0.458	0.134	0.296	0.0219
	(0.516)	(0.595)	(0.635)	(0.502)	(0.510)	(0.493)
Edu2	-0.0496***	-0.0424**	-0.0539***	-0.0402**	-0.0464***	-0.0457**
	(0.0171)	(0.0197)	(0.0172)	(0.0197)	(0.0177)	(0.0179)
Serv	-11.88					
	(7.337)					
Def		6.564				
		(7.312)				
Econ			-5.437			
			(17.16)			
Health				-11.20		
				(9.433)		
Educ					8.393	
					(5.787)	
SProt						-5.949
						(6.575)
			Short-run coefficients			
ΔGinGDP	-0.288***	-0.250**	-0.169	-0.275**	-0.202**	-0.200**
	(0.103)	(0.0980)	(0.108)	(0.112)	(0.0968)	(0.0967)
ΔGAP	1.191***	1.096***	1.099***	1.199***	1.110***	1.101***
	(0.126)	(0.121)	(0.129)	(0.130)	(0.122)	(0.121)
ΔPoPg	-0.0579*	-0.0617*	-0.0665**	-0.0717**	-0.0550*	-0.0523
	(0.0331)	(0.0331)	(0.0334)	(0.0342)	(0.0327)	(0.0331)
ΔINV	-1.001	-1.144*	1.359	-0.992	-0.833	-1.034
	(0.675)	(0.685)	(0.990)	(0.698)	(0.700)	(0.678)
ΔEdu2	0.0304	0.0332	0.0186	0.00133	0.0254	0.0377
	(0.0758)	(0.0759)	(0.0772)	(0.0789)	(0.0759)	(0.0760)
ΔServ	47.45***					
	(17.35)					
ΔDef		-14.52				
		(14.34)				
ΔEcon			-11.59			
			(21.25)			
ΔHealth				4.444		
				(20.16)		
ΔEduc					-21.00	
					(20.57)	
ΔSProt						26.98
						(20.29)
Cons	5.697	2.186	5.233	4.219	3.855	5.392*
	(3.177)	(3.662)	(3.166)	(2.888)	(3.081)	(2.830)
N	188	202	186	188	202	202
No of countries	15	15	15	15	15	15

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