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The Fiscal-Growth Nexus

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The Fiscal-Growth Nexus*

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Abstract

We assess the fiscal-growth nexus with a large country panel, accounting for the usually encountered econometric pitfalls. Our results show that revenues have no significant impact on growth whereas expenditures have negative effects. The same is true for the OECD with the addition that government revenue has a negative impact on growth. Taxes on income are usually detrimental to growth, as well as public wages, interest payments, subsidies and government consumption have a negative effect on growth. Social spending is detrimental to growth; spending on education and health boosts growth; and there is weak evidence supporting causality running from expenditures and revenues to output and TFP.

JEL: C23, E62, H50.
Keywords: budgetary decomposition, crises, panel analysis.

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"…history makes clear that countries that continually spend beyond their means suffer slower growth in incomes and living standards and are prone to greater economic and financial instability. Conversely, good fiscal management is a cornerstone of sustainable growth and prosperity." Ben Bernanke, Annual Meeting of the Rhode Island Public Expenditure Council, October 4, 2010.

1. Introduction

According to conventional wisdom, in most countries (particularly developing ones), larger budget deficits have coincided in the past with less efficient government spending, large bureaucracies, and other counterproductive economic policies. Hence, among the factors that determine economic growth, government spending and fiscal policies in general are of particular interest. Such fiscal-growth nexus is particularly important in situations of economic downturns, where tax revenues tend to flee rather quickly and the spending side of the budget adjusts slowly, notably in view of the effect of automatic stabilisers and of possible counter-cyclical discretionary fiscal policies, which implies the building up of larger budget deficits and possible increased fiscal sustainability problems.

Although large fiscal imbalances can impose an unwarranted burden on the economy, not all government spending is created equal. Therefore, and in order to inform notably policy decision making, the effects on economic activity of several spending and revenue budgetary components need to be assessed, which is the main objective of this paper.

The empirical analysis of the impact of government expenditure on long-run growth include the early works by Feder (1983), Landau (1983), Ram (1986), Grier and Tullock (1989), Romer (1990), Barro (1990), Derajavan et al. (1996) and Sala-i-Martin (1997). Such studies used cross-section data to link measures of government spending with economic growth rates.

However, traditional OLS regression analysis is not sufficient to determine the direction of causality. When economic growth is regressed on government spending, researchers tend to interpret this as an eventual confirmation of causality from the latter to the former. Nevertheless, a significant coefficient can be equally compatible with the Keynesian view (causality from government expenditure to growth), Wagner's Law (from growth to spending) and/or a bi-directional causality between the two variables.

We use cross-sectional/time series data for a large panel of developed and developing countries for the period 1970-2008. In the empirical estimations of growth specifications we address several of the econometric caveats that usually plague such analyses: outliers, simultaneity, endogeneity, cross-sectional dependence, causality, nonlinearities and threshold effects. Specifically, we examine the following issues: the influence of which budgetary components have a stronger influence in affecting (positively or negatively) per capita GDP and Total Factor Productivity

(TFP) growth rates; the change in coefficient signs (and magnitudes) with different government debt and budget deficit ratios thresholds; differences in these relationships between country groups and robustness to different econometric specifications; the direction of causality; is there evidence in favour of Keynesian (or non-Keynesian) effects or supporting the existence of Wagner's Law?

Therefore, the contributions of our paper include: i) the assessment of the fiscal-growth nexus with a diversified variety of methods, providing sensitivity and robustness and dealing notably with model uncertainty; ii) the study of the relevance of economic and functional government expenditure categories and of revenue sub-components; iii) panel Granger causality tests, and the assessment of the existence of cross-sectional dependence within homogeneous groups of countries.

In a nutshell, our results comprise notably:

i) for the full sample revenues have no significant impact on growth whereas government expenditures have significant negative effects; ii) the same is true for the OECD sub-sample with the addition that total government revenues have a negative impact on growth; iii) taxes on income are usually detrimental to growth; iv) public wages, interest payments, subsidies and government consumption have a negative effect on output growth; v) expenditures on social security and welfare are detrimental to growth; vi) both government spending on education and health boosts growth; vii) there is weak evidence supporting causality running for expenditures or revenues to GDP per capita (and TFP); viii) there is evidence supporting Wagner's Law.

The paper is organised as follows. Section two surveys the literature. Section three describes the analytical and econometric methodology. Section four presents the data and discusses our main results. Section five summarises the paper's main findings.

2. Literature

The nexus between fiscal policy and growth has been a subject of several previous studies (see Zagler and Durnecker, 2003, for a survey). Likewise, Gemmell (2004) has summarised several empirical work and explains that it is important to distinguish between productive and non-productive expenditure, and that results depend on whether the simultaneous effects of different revenue and expenditure categories as well as deficit decisions have been taken into account.

Some pioneer theoretical contributions, underlying our empirical analysis, are notably Modigliani (1961) and Diamond (1965). For instance, with an endogenous growth model, Cashin (1994) reports that increased government spending on productive items generate positive externalities, raising private investment and economic growth. Nevertheless, Slemrod et al. (1995) did not find conclusive correlations between taxes and the level of per capita income in their theoretical model. This supports the inconclusive results found across the literature and the debatable nature of the objective impact of fiscal policy on economic growth.

Empirical studies using the economic decomposition of budgetary items usually find evidence of a negative relationship between government expenditures and growth, such as Barro's (1997) seminal contribution in which he found a significantly negative effect on growth from the ratio of government consumption to GDP. Easterly and Rebelo (1993) take 100 countries from 1970 to 1988 and find that i) there is a strong association between the development level and the fiscal structure in poor countries relying heavily on international trade taxes, while income taxes are only important in advanced countries; ii) while the effects of taxation are difficult to isolate empirically.

Lee (1995) found that government consumption was associated with slower growth for a sample of 89 developed and developing countries for the period 1960-1985. With opposing results, Slemrod et al. (1995) report a positive correlation between government expenditure to GDP ratio and the level of real GDP per capita across countries and no relationship for OECD countries alone. Engen and Skinner (1992) mention that a balanced-budget increase in government spending reduces output growth in a sample of 107 countries from 1970 to 1985. Landau (1983) and Grier and Tullock (1989) analyse a sample of 104 and 115 countries, respectively, and find that the growth of government consumption is negatively correlated with growth, including the OECD.

For 28 OECD countries Afonso and Furceri (2010) report that social contributions, government consumption and subsidies have a sizeable negative and statistically significant effect on growth. Romero-Avila and Strauch (2008) conclude for the EU15 countries that the expenditure side of the budget appears to affect long-run growth over the business cycle. Fölster and Henrekson (1999) report a tendency towards a negative growth effect of large public expenditures, which is robust across different econometric specifications. Conte and Darrat (1988) study OECD countries between 1960 and 1984 and argue that government growth has had mixed effects on growth.

Hakro (2009) finds a positive relationship between government expenditure and GDP per capita growth for 21 Asian countries, while Bairam (1990) using a sample of 20 African countries from 1960 to 1985, finds that the effects of government expenditure cannot be generalized.

It is interesting to notice that when it comes to public investment one would expect it to boost growth. However, in Afonso and Furceri (2010) government investment has a sizeable negative and statistically significant effect on growth. Devarajan et al. (1996) found that for a sample of 43 developing countries increases in the share of public investment expenditure (including transportation and communication) have significant negative effects on growth. Prichett (1996) suggests the so-called "white-elephant" hypothesis in which public investment in developing countries is often used for unproductive projects. Nelson and Singh (1994) looking at 70 developing countries for two distinct time periods (1970-79; 1980-89) and uncover mixed effects of public investment on growth.

One the one hand, higher public investment raises the national rate of capital accumulation above the level chosen (in a presumed rational fashion) by private sector agents. Therefore, public capital spending may crowd out private expenditures on capital goods on an ex-ante basis as individuals seek to re-establish an optimal inter-temporal allocation of resources. On the other hand, public capital – particularly infrastructure capital as highways, water systems, sewers and airports – is likely to bear a complementary relationship with private capital in the private production technology. Thus, higher public investment may raise the marginal productivity of private capital and thereby crowd-in private investment (see Afonso and St. Aubyn, 2009).

Slemrod et al. (1995) found a positive correlation between the tax revenue-to-GDP ratio and the level of real GDP per capita across countries, particularly when developing countries were included in the sample. Plosser (1992) found a significant negative correlation between the level of taxes on income and profits (as a share of GDP) and growth of real per capita GDP. Koester and Kormendi (1989) in a cross-country analysis of 63 countries in the 1970s suggest that apparent negative effects of taxes on growth disappear upon controlling for potential endogeneity and the relation between growth and income per capita.

Regarding the functional decomposition of spending, Afonso and Alegre (2011), for a Euro-area panel between 1970 and 2006, find a significant dependence of productivity on public expenditure on education, as well as a relevant role of social security and health for economic growth and the labour market. Folster and Henrekson (2001) report a robust negative relationship between social expenditures and economic growth. Baum and Lin (1993) taking a heterogeneous sample of 47 countries find that the growth rate of educational expenditures has a significant positive impact on growth. The growth rate of welfare expenditures has a negative and insignificant impact on growth. Differently, Landau (1986) reports that government educational expenditure has noticeably reduced economic growth.

3. Methodology

3.1. Analytical framework

In the context of a neoclassical growth model the underlying basic aggregate production function can be written as $Y=F(L,K)$, with Y being the real aggregated output; L the labour force or population; and K capital (physical and human).

Nevertheless, the standard growth model is based on a conditional convergence equation that relates real growth of per capita GDP to the initial level of income per capita,[1] investment-to-GDP ratio (a proxy for physical capital), a measure of human capital or educational attainment and the population growth rate, augmented with government expenditures and revenues components.[2] As a result, the aggregate production function is *Y=F(L,K,G)* being *G* the relevant fiscal variable. Therefore the empirical specification to assess the linkages between fiscal policy and growth can be written as follows:

$$y_{it} - y_{it-1} = \alpha_{it} + \beta_0 y_{io} + \beta_1 x^j{}_{it} + \gamma G_{it} + \eta_t + \nu_i + \varepsilon_{it} \tag{1}$$

where *i* (*i*=1,…,*N*) denotes the country, *t* (*t*=1,…,*T*) indicates the period, $y_{it} - y_{it-1}$ represents the growth rate of real GDP per capita; y_{i0} is the initial value of real GDP per capita;[3] $x^j{}_{it}$ *j=1,2* is a vector of control variables ($x^1{}_{it}$ comprises of population growth, investment, education and trade openness; $x^2{}_{it}$ includes $x^1{}_{it}$ – apart from trade openness – and adds labour force participation and the unemployment rate);[4] G_{it} is a fiscal policy-related variable, either total government revenues or expenditures (or their respective sub-components[5]); ν_i, η_t correspond to the country-specific fixed effect and time-fixed effect, respectively. Finally, ε_{it} is a column vector of some unobserved zero mean white noise-type satisfying the standard assumptions. α, β_0, β_1 and γ are unknown parameters to be estimated. In addition, and in order to assess an eventual non-linear relationship, a squared term can also be included for the relevant fiscal variable

3.2. Econometric approaches

Model Selection

Several studies in the growth literature have found a negative bivariate relationship between growth and a measure of government size (e.g., Plosser, 1993). In addition, it is well known that the inclusion of particular control variables in a growth regression can wipe out (or change the signs of) this relationship (Easterly and Rebelo, 1993). Therefore, the motivation for the use of techniques dealing with uncertainty rests on the concern over the robustness of the candidate

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[1] The initial level of income per capita is a robust and significant variable for growth (in terms of conditional or beta convergence).

[2] Based on the theoretical underpinnings from, e.g., Landau (1983) or Ram (1986).

[3] For regressions using annual data, the lagged value of GDP(y_{it-1}) is used instead.

[4] For more details refer to Section 4.1 ("Data and Descriptive Statistics").

[5] On the revenue side we have (all in % GDP): tax revenues, domestic taxes on goods and services, taxes on income, profits and capital gains, taxes on property, taxes on payroll or work force, and social security contributions. On the expenditure side we have (all in % GDP): compensation of employees, interest payments, subsidies, public final consumption expenditure as well as a functional decomposition comprising of public spending on education, health, and social security and welfare.

variables in any cross-section regression used to explain different success patterns in real income growth.

With these constraints in mind, we follow Leamer's (1983) extreme bounds analysis (EBA). Adapted to our context, this implies the estimation of regressions of the form

$$Y = a_j + b_{yj} y + b_{zj} z + b_{xj} x_j + \varepsilon \,, \qquad (2)$$

where y is a vector of fixed variables that always appear in the regressions (initial level of income per capita, investment-to-GDP ratio, population growth and a measure of educational attainment), z denotes the variable of interest (different components of government expenditure and revenue) and x_j is a vector of three variables taken from the pool of X additional plausible control variables. The regression model has to be estimated for the M possible combinations of $x_j \in X$.[6] As many controls are captured by the country dummies we restrict the following ten variables in vector X (see the Appendix): dependency ratio, fertility, trade openness, labour force, urban population, unemployment, democracy index, Freedom House composite index, population density and a measure of financial depth (liquid liabilities over GDP). Therefore, ten conditioning variables imply ${}^{10}C_3 = 120$ possible combinations of $x_j \in X$.

We also employ the Bayesian Model Averaging (BMA) approach. Essentially BMA treats parameters and models as random variables and attempts to summarise the uncertainty about the model in terms of a probability distribution over the space of possible models. The method is used to average the posterior distribution for the parameters under all possible models, where the weights are the posterior model probabilities[7] (as discussed in more detail in Raftery (1995) and more recently applied by Malik and Temple (2009)). In the empirical section, the output of the BMA analysis includes the posterior inclusion probabilities for variables and a sign certainty index.[8] The higher the posterior probability for a particular variable the more robust that determinant for real GDP growth appears to be.

Panel Techniques

Cross-country regressions are usually based, in this context, on average values of fiscal variables and growth over long time periods. For instance, for long time spans, the level of government spending is likely to be influenced by demographics, particularly by an increasing

[6] For each model j one estimates b_{zj} and the corresponding standard deviation σ_{zj}. The lower extreme bound is defined as the lowest value of $b_{zj} - 2\sigma_{zj}$ and the upper extreme bound is defined to be the largest value of $b_{zj} + 2\sigma_{zj}$. If the lower extreme bound is negative and the upper extreme bound is positive, the variable is considered not to be robust.
[7] To evaluate the posterior model probability the BMA uses the Bayesian Information Criteria (BIC).
[8] For posterior inclusion, probabilities greater than 0.50, a sign certainty index is presented, clearly suggesting the relationship being either positive or negative.

share of elderly people. Therefore, a simultaneity issue arises. Moreover, problems such as endogeneity, both in terms of government spending and tax policies, and inefficiency, due to the discarding of information on within-country variation, can come up.

Resorting to panel data can overcome (some of) these problems, and has other advantages. Specifically, we focus mainly on combined cross-section time-series regressions using cumulative 5-year non-overlapping averages to smooth the effects of short-run fluctuations, even though initial growth regressions will be first estimated with annual data. We run within fixed-effects as a benchmark model despite being aware of the econometric IV-related problems associated with this method in the context of fiscal policy and growth. Given that technological change occurs over time, a time index is a logical way to control for the effect of technological progress on the evolution of per capita GDP growth. However, the effect of technological change on output growth would likely not be well captured by a simple time trend that assumes a constant effect over time. Indeed, a Lowess smoothing of per capita GDP against government expenditure and revenue suggests that there are some non-linear relationships (not shown). Therefore, non-linear effects of technological change on output growth are allowed for by using individual year indicator dummies in most estimated panel models.[9]

Finally, another contribution in our study is the use of two robust estimators, the Method of Moments (MM)[10] and the Least Absolute Deviation (LAD)[11] to deal with outliers.

Bias and endogeneity

One needs to address the potential endogeneity problem of right-hand side regressors and while country-specific fixed effects might capture some of the omitted variables (if we miss out an important variable it not only means our model is poorly specified it also means that any estimated parameters are likely to be biased),[12] it does not solve the problem and we may get may get biased

[9] Since the empirical model assumes that production technology is homogeneous across countries there is nothing inherently inconsistent with the assumption that TFP growth is the same across countries. The period covered by the data includes a number of characteristic slumps (e.g. the two oil crises in the 1970s), but nevertheless one is able to identify a generally upward movement of TFP, particularly in the 1990s.

[10] This estimator fits the efficient high breakdown estimator proposed by Yokai (1987), which on the first stage takes the S estimator applied to the residual scale and derives starting values for the coefficient vectors, and on the second stage applies the Huber-type bisquare M-estimator using iteratively re-weighted least squares (IRWLS) to obtain the final coefficient estimates.

[11] It minimises the sum of squares over half the observations. The estimator seeks out part of the data for which the model has greatest explanatory power and then bases the parameter estimates on just that portion of the data. We then exclude any observations for which the LAD residual is more than two standard deviations from the mean residual, before re-estimating the model by OLS or FE.

[12] If the variables are uncorrelated with the omitted variables, then our results may be unbiased. Thus, by not using predictors that might be correlated with a possible important omitted variable, we may reduce the bias. Therefore, if we put a predictor that is correlated with an omitted variable into our model, we generate endogeneity bias. On the other hand, the more variables that we have in our model, the less likely it is that we are omitting something.

coefficient estimates. Therefore, we also use the bias-corrected least-squares dummy variable (LSDV-C) estimator by Bruno (2005).

Moreover, we use a panel Instrumental Variable-Generalised Least Squares (IV-GLS) approach, which is then complemented by estimating the main equations using Generalised Methods of Moments (GMM). The first-differenced GMM estimate can be poorly behaved if the time series are persistent. This problem can get very serious in practice and authors like Bond, Hoeffler and Temple (2001) suggest the use of a more efficient GMM estimator, the system estimator, to exploit stationarity restrictions.[13]

Hence, we estimate the growth specifications by system-GMM (SYS-GMM) which jointly estimates the equations in first differences, using as instruments lagged levels of the dependent and independent variables, and in levels, using as instruments the first differences of the regressors. Regarding the information on the choice of lagged levels (differences) used as instruments in the difference (level) equation, as work by Roodman (2009) has indicated, when it comes to moment conditions more is not always better.[14]

Panel Granger causality

We also perform a panel version of a Granger-causality test between per capita GDP (and TFP) and fiscal variables, similarly to Huang and Temple (2005).[15] Our TFP variable is a newly computed measure based on growth accounting techniques according to the methodology described in Afonso and Jalles (2011).

Since causality can run in either direction, one cannot take government expenditures and government revenues as strictly exogenous. Alternatively, we run partial adjustment specifications which allow feedback by means of sequential moment conditions to identify the model (see Arellano, 2003). The standard approach in the literature would be to specify an AR(1) model as follows:

$$y_{it} = \alpha_1 y_{it-1} + \beta_1 x_{it-1} + \eta_i + \phi_t + v_{it} \ , \qquad (3)$$

with $i=1,2,...N; t=1,2,...,T$, and where in our case y_{it} is real per capita GDP (or TFP) and x_{it} will be independent government expenditures and revenues (deflated and in per capita terms). The

[13] Although stationarity of averages of investment and population growth rates are quite consistent with the Solow growth model, constant means of the per capita GDP series are clearly not. Fortunately, also here, the inclusion of the time dummies solves the problem without violating the validity of the additional moment restrictions used by the system GMM estimator. In the type of convergence regressions to be analysed, the succession of time dummies can be interpreted as the evolution of common TFP over time.

[14] The GMM estimators are likely to suffer from "overfitting bias" once the number of instruments approaches (or exceeds) the number of groups/countries. In the present case, the choice of lags was directed by checking the validity of different sets of instruments and we rely on comparisons of first stage R-squares.

[15] They applied the same technique to study the trade-finance relationship in a panel of heterogeneous countries.

reverse relationship is also explored to test notably the hypothesis of the Wagner's Law holding for the full sample and OECD sub-sample.

The model in (3) allows for unobserved heterogeneity through the individual effect η_i that captures the joint effect of time-invariant omitted variables. ϕ_t is a common time effect, while v_{it} is the disturbance term. We also assume that x_{it} is potentially correlated with η_i and may be correlated with v_{it}, but is uncorrelated with future shocks $v_{it+1}, v_{it+2},...$ The model can be estimated by difference-GMM (DIF-GMM), which makes use of all available lagged levels of y_{it} and x_{it} dated *t-2* (and earlier) as instruments. We use Hansen J's test to assess the model specification and overidentifying restrictions. As there are a number of limitations of DIF-GMM estimation[16], the system-GMM estimator can be used to alleviate the weak instruments problem. In our setting, the SYS-GMM uses the standard moment conditions, while SYS-GMM1 (modified 1) only uses the lagged first-differences of y_{it} dated *t-2* (and earlier) as instruments in levels and SYS-GMM2 (modified 2) only uses lagged first-differences of x_{it} dated t-2 (and earlier) as instruments in levels.

In the AR(1) model, one hypothesis of economic interest is the null $\beta_1 = 0$ – this can be interpreted as a panel data test for Granger causality. Instead of a Wald-type test, we use an alternative methodology: we estimate both the unrestricted and the restricted models using the same moment conditions, and then compare their (two-step) Hansen J statistics using an incremental Hansen test defined as:

$$D_{RU} = n(J(\tilde{\gamma}) - J(\hat{\gamma})) \qquad (4)$$

where $J(\tilde{\gamma})$ is the minimized GMM criterion for the restricted model, $J(\hat{\gamma})$ for the unrestricted model, and *n* is the number of observations.[17]

There are some additional issues of interpretation worth discussing in the context of the use of the above model. One may be interested in the stability of the estimated model. If our model is stable, we can compute a point estimate for the long-run effect[18] of x_{it} on y_{it}:

$$\beta_{LR} = \beta_1 / (1 - \alpha_1), \qquad (5)$$

[16] For instance, the lagged levels of the series may be weak instruments for first differences, especially when they are highly persistent, or the variance of the individual effects is high relative to the variance of the transient shocks.

[17] Under the null, D_{RU} is asymptotically distributed as χ_r^2 where *r* is the number of restrictions. The intuition is that, if the parameter restriction ($\beta_1 = 0$) is valid, the moment conditions should keep their validity even in the restricted model. For more details see Bond and Windmeijer (2005).

[18] An approximate standard error for this long-run effect is estimated using the Delta Method.

Lastly, we can test for unobserved heterogeneity. In the absence of individual effects, the following additional moment conditions become valid, corresponding to the use of lagged-levels as instruments in the levels equation:

$$E[y_{it-1}(y_{it} - \alpha_1 y_{it-1} - \beta_1 x_{it-1} - \phi_t)] = 0$$
$$E[x_{it-1}(y_{it} - \alpha_1 y_{it-1} - \beta_1 x_{it-1} - \phi_t)] = 0 \,. \qquad (6)$$
$$t = 2,...,8$$

The validity of these additional set of moment conditions (that can be tested using an incremental Hansen test relative to difference or system GMM), can be evaluated with a test for the presence of unobserved heterogeneity (where the null is no heterogeneity).[19]

Cross-sectional dependence

We are aware of the potential issue (in particular, bias in coefficient estimates) induced by a significant cross-sectional dependence (within similar groups of countries in our sample) in the error term of the model. As put forward by Eberhardt et al. (2010), the so-called unobserved common factor technique relies on both latent factors in the error term and regressors to take into account the existence of cross-sectional dependence. Developed with the panel-data/time-series econometric literature over the course of the past few years, this method has been largely employed in macroeconomic panel data exercises (see, e.g., Coakley et al. (2006), Pesaran and Tosetti (2007), Bai (2009), Kapetanios et al. (2009), Afonso and Rault (2010) and Eberhardt and Teal (2011 and references therein)). This common factor methodology takes cross-sectional dependence as the outcome of unobserved time-varying omitted common variables or shocks which influence each cross-sectional element in a different way. Cross-sectional dependence in the error term of the estimated model results then in inconsistent coefficient estimates if independent variables are correlated with the unspecified common variables or shocks.

With this in mind, we test for the presence of cross-sectional dependence Pesaran's (2004) CD test statistic based on a standard normal distribution. We then run some of the most important regression equations with Driscoll-Kraay (1998) robust standard errors. This non-parametric technique assumes the error structure to be heteroskedastic, autocorrelated up to some lag and possibly correlated between the groups. Given the particular nature of the dependent variable and the possibility of error dependence another estimation approach would be worthwhile. We rely on the Pesaran (2006) common correlated effects pooled (CCEP) estimator, a generalization of the fixed effects estimator that allows for the possibility of cross section correlation. Including the (weighted) cross sectional averages of the dependent variable and individual specific regressors is

[19] The motivation for using this test is that, if individual effects are absent, the pooled OLS will be a consistent estimator, despite not fully efficient given the presence of heteroskedasticity.

suggested by Pesaran (2009) as an effective way to filter out the impacts of common factors, which could be common technological shocks or macroeconomic shocks, causing between group error dependence.

4. Empirical analysis

4.1. Data and descriptive analysis

The dataset was collected from several sources (see Appendix for definitions, acronyms and sources). Our main dependent variables are: real GDP per capita retrieved from the World Bank's Word Development Indicators (WDI); and TFP whose construction is described in Afonso and Jalles (2011).

Fiscal variables come from the WDI, the IMF's International Financial Statistics (IFS) and Easterly's (2001) data. They comprise the Budget Balance (% GDP) and the Central Government Debt (% GDP) – the latter retrieved from the IMF's historical debt database due to Abas et al. (2010). On the government revenue side we have, as % of GDP: Total Government Revenue, Tax Revenue, Taxes on Goods and Services, Taxes on Payroll or work force, Taxes on Income, Profits and Capital Gains, Taxes on Property, and Social Contributions. On the government expenditure side we consider, as a % of GDP: Total Government Expenditure, Compensation of Employees, Interest Payments, Subsidies, Public Final Consumption Expenditure, and a functional decomposition comprising of Spending on Education, Spending on Health, and Spending on Social Security and Welfare.

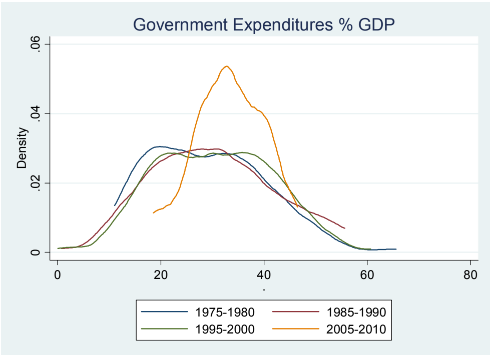
With respect to human capital proxies we mainly rely on the average years of schooling for the population over 25 years old from the international data on educational attainment by Barro and Lee (2010), but we also take the literacy rate (% of people ages 15 to 24), primary school enrolment (% gross), primary school duration (years), secondary school enrolment (% gross), secondary school duration (years), tertiary school enrolment (% gross) and tertiary school duration (years) from the WDI, for robustness purposes.

As for other controls and regressors, most come from either the WDI or from the IMF's IFS, as follows: land area (in square kilometres), population, real interest rate (%), interest rate spread (lending rate minus deposit rate), imports and exports of goods and services (BoP, current USD), labour participation rate (% of total labour force), labour force, unemployment, (% of total labour force), fertility rate (births per woman), urban population (% of total), short-term debt (% of exports of goods and services), terms of trade adjustment (constant LCU), real effective exchange rate index (2000=100).

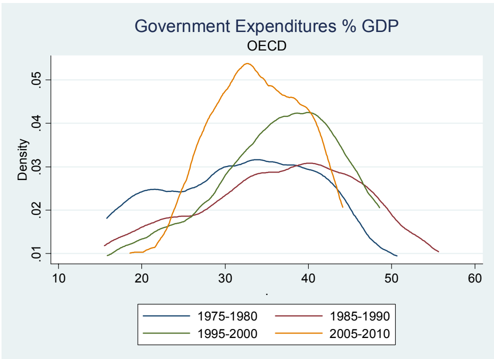
It is also interesting to see how government expenditure and revenue ratios evolved over time. For this purpose we plot the Kernel density estimates (Figure 1). We see that government spending and revenue have increased throughout time, which implies an increase of the size of the government notably when trying to provide the additional services related to the welfare state. This result is particularly clear for the case of government spending, in all country sub-groups.

Figure 1: Kernel Density estimates Expenditures and Revenues (% GDP)

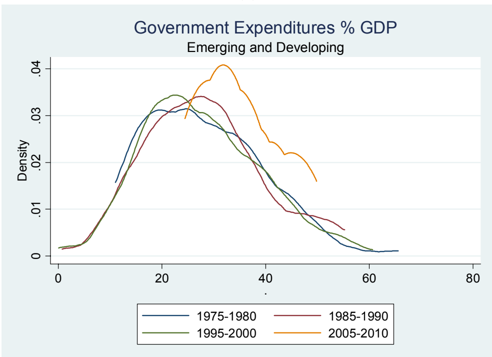
(a)



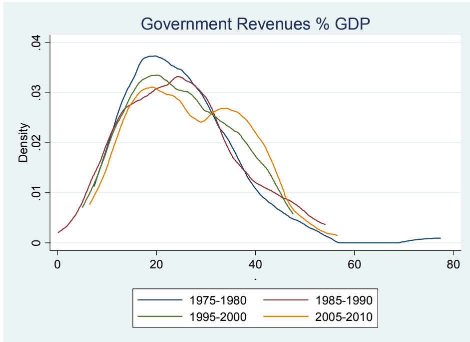
(b)



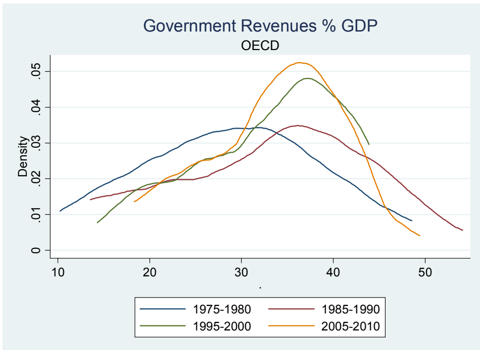
(c)



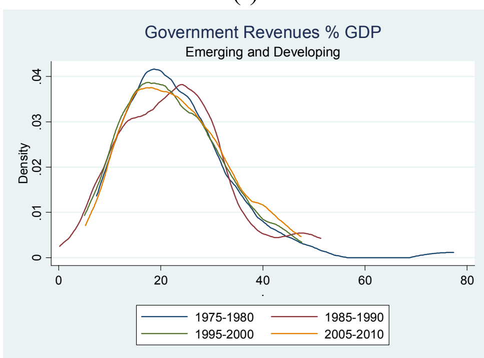
(d)



(e)



(f)



Source: Authors' estimates.

4.2. Model selection

In Table 1 we report our results from the EBA analysis (which controls for collinearity) for the full sample. The evidence suggests that both total government revenues and expenditures have a significantly negative impact on output growth (both the upper and lower bounds report the same sign) and this is in line with Folster and Henrekson (2001) and Afonso and Furceri (2010). Moreover, the most negative effect (in terms of coefficient magnitude) comes from taxes on payroll or workforce. Taxes on property, however, seem to boost growth. Turning to expenditures, public investment has a significantly negative effect on output growth, whereas government spending on wages of the public sector's employees and consumption appear to be detrimental to per capita GDP. We are aware that one of the strongest objections to EBA is that the models generating the bounds might be flawed (e.g., an important variable may be omitted). Hence, the results of an EBA should be carefully analysed.

[Table 1]

One reason for the strong appeal of the BMA is that the weights in the final averaging procedure are tied quite closely to the predictive ability of the different models. Vis-à-vis the EBA, in the BMA there is no set of fixed variables included and the number of explanatory variables in the specifications is flexible. In Table 2 we have the results from our BMA application where the dependent variable is the growth rate of per capita GDP. We present 10 different possible models containing different sets of regressors grouped by type: scale/size, living conditions, policy/institutional, education and, finally, government.

A robust result is that the initial level of per capita GDP should be included and it has the expected negative (and significant) sign, translating the conditional beta-type convergence hypothesis. Moreover, size, proxied either by population, land area or labour force, is detrimental to growth. Other interesting results are the fact that both mortality and fertility rates (proxying living conditions and state of development) have a negative effect on growth. Policy variables such as openness to international trade have a positive impact on growth, and the same is true with institutional measures such as the Freedom House index and the Polity democracy index. Furthermore, we confirm the (positive) impact of human capital, traditionally included in both theoretical neoclassical and endogenous growth models and seminal empirical studies. With respect to government-related variables the main findings are: i) inconclusive results for the effects of government revenues attested by mixed evidence from models 5 and 10, and a negative impact of government outlays. Evidence seems to suggest that both the debt-to-GDP ratio and debt average term to maturity negatively affect growth.

[Table 2]

We then take a similar approach and set of regressors to study their impact on TFP growth and on the stock of capital per worker growth (see Afonso and Jalles, 2011). Some results worth highlighting are the following. We observe that education matters positively to TFP growth as well as government revenues and expenditures, while debt has a detrimental effect. The same applies to the growth rate of the capital stock per worker.

Finally, in Table 3 for each dependent variable previously discussed we report the top models based on their R-squares. All in all, the best models include expenditure components and signal the relatively less important impact/effect attributed to government revenues' categories.

[Table 3]

4.3. Fiscal-growth relationship

According notably to Gupta et al. (2005) the composition of public outlays has a bearing on the nexus between budget deficits and growth. Table 4 summarizes the results of a series of panel regressions of per capita GDP growth on four variables: total government expenditures (% GDP), total government revenues (% GDP) and their growth rates, using 5-year averages. When expenditure is included alone in the equation, the correlation between government size and growth is negative and significant at the 1 percent level. Government revenue appears with a negative, though insignificant, coefficient when included alone (specification 3). However, initial government revenues are strongly correlated with initial income per capita (specification 11), a variable which is itself negatively correlated with growth (specification 1). Hence, total government revenue could be capturing part of the effect of initial income when we omit this variable from the equation. Even after controlling for initial income, the coefficient of total government revenue remains negative and insignificant. The expansion of government revenues, rather than its absolute size, seems to boost growth (specifications 5 and 9). If instead of fixed-effects we accounted for endogeneity problems and ran an IV-GLS regression results don't change.

[Table 4]

Results for the OECD sub-sample (available from the authors) show that both expenditures and revenues appear with statistically significant negative coefficients in almost all regressions. Moreover, and even if both variables are strongly correlated with initial income per capita, after controlling for initial income, we still get the same result. The coefficients of total government revenue and expenditure are negative and significant. Contrary to the full sample case, government revenue growth is detrimental to economic growth. The same is true for spending growth (previously insignificant for the full sample).[20]

Taking the "standard" regressors usually present in growth regressions – initial per capita GDP, population growth, trade openness, education and private investment – we explore how sensitive are total government expenditures and revenues when included together with this variable set. Table 5 shows that total government expenditures have a negative and statistically significant effect on output growth for the entire sample as well as for the OECD and emerging

[20] An IV-GLS estimation does not alter the main findings.

economies sub-groups when fixed-effects estimation is carried out. For emerging countries, government revenues have a detrimental effect to growth.[21] Making use of outlier-robust LAD and MM techniques does not alter our results[22], nor if one controls for endogeneity issues with panel IV-GLS, DIFF-GMM and SYS-GMM. Therefore, the statistically significant negative coefficient of total government expenditures is robust across econometric specifications, whereas less clear results (insignificance) are attributed to the effects of government revenues on output growth. As an additional robustness exercise, conducting the same analysis with annual data instead doesn't alter qualitatively our previous findings.

[Table 5]

4.3.1. Budgetary Economic Decomposition

In order to assess the impact of different budgetary sub-components on output growth, we estimate the following baseline specification:

$$y_{it} - y_{it-1} = \alpha_{it} + \beta_0 y_{i0} + \beta_1 Z^1{}_{it} + \gamma F_{it} + \eta_t + \nu_i + \varepsilon_{it} \qquad (8)$$

where $y_{it} - y_{it-1}$ represents again the growth rate of real GDP per capita, and y_{i0} is the initial value of the real GDP per capita. $Z^1{}_{it}$ is a vector of control variables; F_{it} is a vector of budgetary component(s) of interest, either from the expenditure or revenue side); ν_i, η_t correspond to the country-specific fixed effect and time-fixed effect, respectively. Finally, ε_{it} is some unobserved zero mean white noise-type column vector satisfying the standard assumptions. $\alpha, \beta_0, \beta_1, \gamma$ are unknown parameter vectors to be estimated. $Z^1{}_{it}$ includes labour force participation rate, population growth, education, private investment.

We know that a typical business cycle correlation might imply that when growth falls, government expenditure increases and tax revenues would typically decrease. Furthermore, an expansionary fiscal policy can stimulate aggregate demand and thus growth. To check the importance of these correlations a control variable unemployment has been included in the model, because it is the variable that mostly varies with the business cycle.

Given our benchmark equation (8) together with its respective set of controls, we now move to the inclusion of different sub-components of government revenues and expenditures. In Table 6 (panel A) we include each item, one at a time.

[Table 6]

[21] Running an IV-GLS estimator enforces our results and increases the magnitude of the coefficient estimates.
[22] Given that outliers do not seem to strongly affect the total number of observations nor the coefficient estimates, for the remainder of the paper we shall focus solely on fixed-effects and on endogeneity-related econometric techniques (mostly panel IV-GLS and GMM).

Inspecting first the revenues' (panel A1) we observe that each component does not significantly affect growth in OECD countries. However, domestic taxes on goods and services have a positive effect on output growth for the full sample and emerging economies sub-group, but not for the OECD. This may seem counterintuitive, but Helms (1985) and Mofidi and Stone (1990) found that taxes spent on publicly provided productive inputs tend to enhance growth.[23] For the emerging economies group, taxes on income, profits and capital gains have a statistically significant negative impact on growth, whereas taxes on payroll or workforce has a reverse effect. [24]

Turning to the expenditure side (panel A2), final government consumption has a significantly negative effect on output growth for the full and OECD samples. Indeed, economic theory suggests a variety of explanations for the negative relationship between government spending and growth. First, government spending can crowd out private spending.[25] Second, the level of government spending may proxy other government intrusions into the workings of the private sector, especially regulations which restrain economic growth and efficiency. Empirically, our results are in line with the works by Landau (1983, 1986), Grier and Tullock (1989), Barro (1991), Barro and Sala-i-Martin (1995), who have found a negative effect of government consumption on growth.

Still in Table 6 (panel A), for the OECD sub-group, apart from public investment, which appears with a positive but insignificant coefficient, all remaining spending components adversely affect growth, in particular expenditures with wages and consumption spending. For the full sample and emerging economies sub-group, public investment appears with a significantly negative coefficient. Possibly inefficient and bureaucratic public sectors may generate lobbying, rent-seeking and other non-productive outcomes and activities that erode potentially the positive contribution coming from such investment. This is also in line with the literature reviewed before (notably Devarajan et al., 1996, and Prichett, 1996).

In addition, we observe that interest payments and subsidies have a negative effect on GDP per capita growth, the latter eventually due to the fact that it creates deadweight loss inefficiencies when distorting the market from its own natural equilibrium.[26]

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[23] Theoretically, in Barro-style models, increases in taxes can enhance, have no effect or impede growth depending, in particular, on the initial level of taxes as well as how revenues are spent.

[24] Most growth models predict that taxes on investment and income have a detrimental effect on growth. These taxes affect the growth rate through a direct channel, reducing the private returns to accumulation. On empirical grounds, the effects of taxes on growth are not so clear and most research has focused on OECD countries.

[25] In theory, government expenditure can be allocated to growth enhancing infrastructure and education but outlays also go for redistribution or government-mandated consumption, which does not improve productivity.

[26] As a sensitivity exercise (not shown) we have repeated the analysis without labour force participation and unemployment. A few differences are worth mentioning. On the revenue side the statistical significance is lower, particularly with respect to domestic taxes on goods and services, which are no longer significant in any regression.

As a next step we include all components of each budgetary block simultaneously in regression (8). Table 6, Panel B, reports the results for both the revenue and expenditure blocks. As when included individually, domestic taxes on goods and services appear with a statistically significant positive coefficient in the growth regression. Regarding taxes on income, profits and capital gains, the negative significance is absent in the emerging economies sub-group, but it is present for the full sample. As regards the OECD sub-group, revenue variables are never significant in per capita GDP growth equations.

Taking account of endogeneity problems (with a corresponding panel IV-GLS approach – not shown) increases the significance level in most coefficients, in particular the basic set of controls (negative effect of unemployment for both the full and OECD samples; negative effect of population growth. Most revenues' coefficients for the OECD sub-group remain insignificant.[27]

Regarding the expenditure items in Panel B2, on average, the R-squares are somewhat higher than when disaggregated revenues are included in the regressions. Overall, evidence suggests a higher importance attributed to government expenditures than to revenues. Apart from expected signs on the basic set of controls as already discussed, a closer inspection indicates that wage spending keeps its negative impact on growth equations, similarly as to when it is included individually in the regression, although not statistically significant. Government final consumption expenditure is detrimental to growth. As with the case of government revenues, when endogeneity is taken into account, most coefficients increase their significance levels with "right" sign estimates. Moreover, R-squares increase from FE to IV-GLS estimation in every specification.

4.4. Functional spending

Government spending can play an essential role in economic development by maintaining law and order, providing economic infrastructure, harmonizing conflicts between private and social interests, increasing labour productivity through education and health and enhancing export industries. Hence, in terms of the functional decomposition of government expenditures, we differentiate the effects from spending on education, health, and social security (and welfare), which constitute the main items of government spending.

In Table 7, Panel A, each of the above spending categories is included in the regression one at a time. For reasons of parsimony we do not report the full set of coefficient estimates. Regarding social security spending, it has a statistically negative effect on growth in the OECD sub-group.

Taxes on income become statistically significant and negative in specification 1, thereby adversely affecting output growth. On the expenditure side results are kept qualitatively unchanged.

[27] Alternatively, running system-GMM for the full sample (not shown) removes any statistically significance out of the revenue's categories, confirming Easterly and Rebelo's (1993) claim that taxes are difficulty to isolate empirically.

This is in accordance with e.g. Landau (1983, 1986), Barro (1991) and Grier and Tullock (1989) who found a negative relationship between social expenditures and growth.

In Panel B, the three variables of interest are included simultaneously in each regression. In Panel B, the same conclusions apply with the addition that government expenditure on education now affects positively growth in the emerging economies sub-group. It has been argued that investment in human capital like education (Barro and Sala-i-Martin, 1995) and health (Devarajan et al., 1996) has positive effects on growth.

[Table 7]

4.5. The cyclicality of functional spending

The cyclicality of government expenditure is also an important issue, notably from a policy making perspective. Therefore, we assess the cyclicality of the three sub-categories previously discussed: education, health, and social security and welfare spending. Changes in expenditure patterns may arise from discretionary actions by policy makers or from the operation of automatic stabilizers (see notably Granado et al., 2010). Our analysis is an encompassing one since we i) consider, besides education and health, also government expenditure on social security and welfare,[28] ii) and use a substantially large time span (1970-2008).

Most studies find that fiscal policy is procyclical in developing countries and countercyclical or acyclical in advanced ones.[29] A number of explanations have been put forward to justify the different cyclical pattern in different groups of countries (see, Tornell and Lane (1999) or Gavin and Perotti (2007) for review). With this in mind, we transform our spending variables into log levels, deflated with the CPI at 2000 prices (which matches the same reference year for real GDP). Following the literature we estimate:

$$EXP_{it} = \alpha_{it} + \beta_0 Y_{it} + \beta_1 BB_{it-1} + \beta_2 TOT_{it} + \eta_t + \nu_i + \varepsilon_{it} \qquad (9)$$

where EXP_{it} is the change in the real value of the log of the expenditure item of interest and Y_{it} is the real GDP growth rate. BB_{it-1} is the government's budget balance (% GDP), which captures the potential effect of borrowing constraints on public spending. Countries with high initial budget deficits are perceived to be at a greater risk of debt default and as a result have a lower access to capital markets during recessions. They would be expected to exhibit a higher degree of pro-cyclicality. TOT_{it} is an index (its change) of the country's terms of trade.[30] The remaining usual

[28] These three functional spending categories accounted for 41.6%, 54.7%, and 34.5% of government spending, respectively in the full, OECD and developing country-group over the full time span considered in our sample.
[29] See, inter alia, Tornell and Lane (1999), Alesina and Tabellini (2005) and Ilzetzki and Vegh (2008).
[30] The rate of change in the terms of trade is meant to capture the effects of external shocks on fiscal cyclicality. The impact of external shocks is often more pronounced in developing countries due to the close connection between the budget balance and the foreign sector.

assumptions apply, in particular v_i and η_t are country specific and time effects – the latter to control for global shocks. β_0 is the parameter of interest, measuring the degree of cyclicality: a positive estimate implies a pro-cyclical behaviour; a negative one indicates a countercyclical behaviour of the respective spending items.

The potential endogeneity is taken care by running SYS-GMM with appropriate lags of the regressors used as instruments.[31] We first estimate (9) without control variables using annual data for the full, OECD and Emerging and Developing (E+D) samples (not shown). Most GDP growth coefficients are statistically insignificant for all four spending categories, apart from evidence of countercyclical total government expenditures attributed to the OECD sub-group (which is in line with the literature) and a countercyclical pattern for expenditures in social security and welfare in the different samples, in line with Hallerberg and Strauch (2002) and Darby and Melitz (2008). In Table 8 we report estimated coefficients now with the full control set included. For the OECD the government expenditure coefficient remains significant. Moreover, we keep the countercyclical result for spending on social security and welfare (for both the full and OECD samples).

[Table 8]

Given that public expenditures may respond asymmetrically during good and bad times, we test this hypothesis by accounting for so-called good and bad times. Therefore, we define g*ood times* as those in which the output gap is positive and *bad times* when the output gap is negative.[32] Our results suggest that for the OECD group total government expenditure is countercyclical in both good and bad times, with the coefficient in bad times being 50% larger in absolute value (more negative). We keep the acyclicality result for education and health expenditures, and the countercyclical result for spending in social security and welfare is also maintained. In fact, in good times the estimated coefficient for social security spending is larger in magnitude (more negative). For emerging and developing countries our results are in line with Jaimovich and Panizza (2007) who report that after controlling for endogeneity, total government spending is acyclical in both good and bad times.

All in all, most spending items are acyclical, with the exception of total expenditures and spending on social security and welfare where evidence points to counter-cyclicality, particularly in OECD countries.

[31] Fixed effects estimation results are available from the authors upon request.

[32] The output gap is computed as the difference between actual and potential, and potential GDP is obtainded by means of HP filter extraction. As a robustness check, filtering instead with either the Baxter-King or Christiano-Fitzgerald alternatives didn't qualitatively alter our main results.

4.6. Non-linearities in budgetary decomposition

An additional exercise is to further explore possible effects coming from non-linearities in the context of the budgetary decomposition. The results in the previous sections suggest that the reduction of budget deficits can be conducive to higher growth. Of interest is whether these results hold for all countries (and sub-groups) in the sample(s), in particular, for countries that have already achieved a modicum of macroeconomic (fiscal) stability.[33] Therefore, we spit the sample(s) into countries labelled "above" or "below", based on a given fiscal threshold. Specifically, an "above" type country is defined as a country that maintained on average (over time) a budget deficit below 3% of GDP. Conversely, a "below" type country is such that it maintained an average budget deficit above 3% of GDP.[34] We also repeat the procedure with a 60% of GDP government debt threshold (that is, the "above" type country is one that maintained an average debt ratio below 60% of GDP over the period; mutatis mutandis for the "below" case).[35]

In Table 9 we report the results with the 3% deficit threshold. Needless to say that some of these results require care in interpretation given the truncated nature of the resulting sample and reduced number of available observations. First, both the unemployment rate and the dependency ratio appear with a negative and statistically high coefficient in several regressions.

In the fixed-effects specifications 7-12 for the revenue panel both in the full sample and in the emerging economies sub-group, some points are worthwhile emphasizing. Apart from retaining the positive coefficient on domestic taxes on goods and services that we have commented on before, the case of the below 3% threshold, for the full sample, now registers a statistically positive coefficient on the contributions to social security, which previously where insignificant (but positive still) in Table 6. For the case above 3%, the emerging economies sub-group retain the statistically negative impact of social security contributions allocated in Table 6 for the entire emerging group (though now with an increased magnitude of the estimate). For this group of countries, taxes on income, profits and capital gains is detrimental to growth in the below 3% deficit set of economies.

[33] On the same line see, e.g., Gupta et al. (2005).

[34] The 3% value is an ad-hoc number stemming from the European Union Stability and Growth Pact (SGP) rationale. For the OECD sub-group, countries classified as being "above" average, lower deficits, are: Australia, Canada, Czech Republic, Denmark, Finland, France, Germany, Iceland, Korea, Luxembourg, Netherlands, New Zealand, Norway, Poland, Slovakiam Spain, Switzerland, UK and US. The "below" average ones, higher deficits, are: Austria, Greece, Hungary, Ireland, Italy, Japan, Mexico, Portugal, Sweden and Turkey.

[35] The 60% limit for the debt ratio is related to the SGP framework, although also endogenously computed in Afonso and Jalles (2011), above which government debt is detrimental to growth – see further details therein. According to this threshold for the OECD sub-group, countries "above" average, lower debt ratio, are: Australia, Czech Republic, Denmark, Finland, Germany, Iceland, Ireland, Japan, Korea, Luxembourg, Mexico, Netherlands, New Zealand, Norway, Slovakia, Spain, Sweden, Switzerland, Turkey, UK and US. The "below" average ones, higher debt ratio, are: Austria, Belgium, Canada, France, Greece, Hungary, Italy and Portugal.

Furthermore, for the OECD sub-sample, coefficient estimates which were entirely insignificant in Table 6 now appear with statistically meaningful coefficients. Moreover, it is interesting to observe that depending whether we take the below or above 3% threshold set of economies, coefficient signs may be reversed (e.g., negative impact of taxes on income, profits and capital gains as well as taxes on payroll or workforce for the above 3% group, but positive ones for the below 3% group). For instance, this can imply that with higher fiscal imbalances, additional taxes on income depress growth.

Third, for the expenditure set of regressions, results are less controversial or dubious in their "expected" or "right" coefficient signs. As before, we have negative effects of government spending on wages, final consumption and public investment (the latter notably for the emerging economies sample, regardless of the deficit threshold).

As a robustness exercise we have conducted a sensitivity analysis based on the exclusion of labour force participation, unemployment and dependency ratio (not shown). Whereas coefficients, magnitudes and statistical significance levels in the expenditure-based regressions are kept unchanged, the same does not apply to specifications 7-12, concerning revenues. In particular, we lose significance in all revenue components for the OECD below 3% sub-group (the results of Table 6). For the OECD above 3% case, domestic taxes on goods and services have a statistically negative coefficient and taxes on property a statistically positive coefficient, both of which were absent before (we loose significance on the remaining variables) though. All in all, results with revenue components are sensitive to the inclusion/exclusion of particular controls, and hence should be interpreted with care.

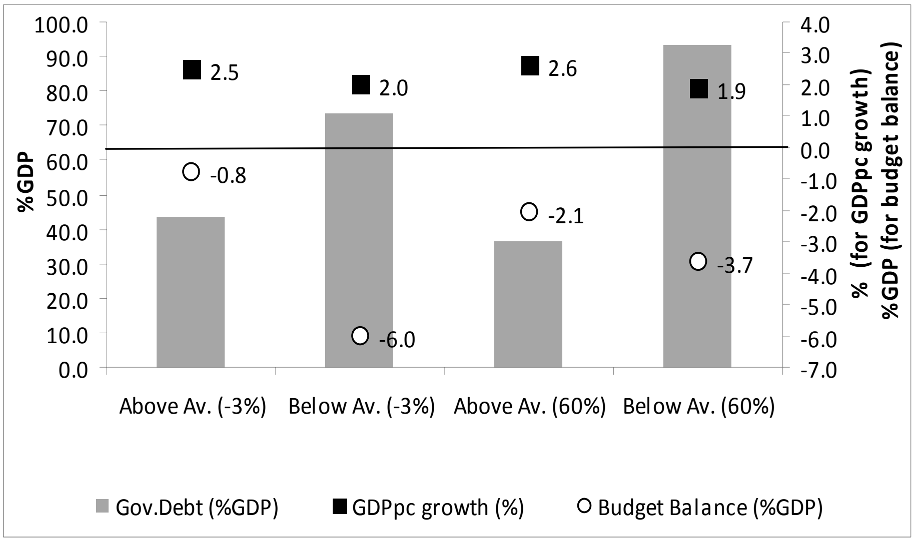
Finally, we have redefined our deficit threshold such that now instead of averaging over the countries time span, we take each 5-year average period to assess/determine the above and below 3% classification. Moreover, as before but now based on the new criterion, we did the analysis with the labour force participation, unemployment and dependency ratio excluded from the set of regressors. Reporting all these would lead us far off-track. A typical result is the confirmation that government expenditures' components are generally detrimental to growth irrespectively of the country group and deficit threshold classification. As for revenues' components, results are mixed, unclear or contradictory depending on the set of regressors included, geographical sample and deficit rule used.

[Table 9]

As described above we also used a 60% threshold for the average public debt-to-GDP ratio over a country's time series span. For reasons of parsimony results are available upon request. Overall, we get mixed evidence from revenues' components coefficient estimates. As for the expenditures' components, government spending on wages and government final consumption appear with statistically significant negative signs. Redoing these estimations with the truncated set of basic regressors or using the 5-year average period debt-rule instead of the country average, doesn't alter the main results (not shown).

Figure 2 summarizes the relationship between output growth, government debt-to-GDP ratio and the budget balance ratio according to the 3% (60%) fiscal thresholds classification. The pattern arising is that countries with average lower debt ratios and with lower budget deficits are associated with higher GDP real growth rates.

Figure 2: "Above" and "Below" Average Performers, pc GDP growth, budget and debt ratios



Source: Authors' estimates.

4.7. Panel Granger-causality tests

It is also important to understand whether expenditures (revenues) Granger cause per capita GDP (and TFP), or the reverse applies or even if one finds two-way bidirectional causality. In previous studies, Hakro (2009) finds evidence suggesting that government expenditures are growth inducing, and a larger size of the government will certainly create opportunities of employment and hence growth, and subsequently higher income per capita. In a related sample Kumar (2009) infers instead that Wagner's Law does hold.[36] Yuk (2005) takes a long term perspective on UK time series and, although support for Wagner's Law is sensitive to the choice of the sample period, there is evidence that GDP growth Granger-causes the share of government spending in GDP. Loizides and Vamvoukas (2004) using a bivariate ECM conclude that government size Granger causes economic growth in all countries in the short and long run; economic growth Granger causes increases in the relative size of government in Greece, and when inflation is included, in the UK.

[36] A stylised fact of public economics about the long-run tendency for public expenditure to grow relative to some national income aggregate such as GDP.

We find little evidence of robust Granger causality from per capita GDP to government expenditure[37] across econometric specifications, with only one model indicating a negative short and long-run effect of total government expenditure on output growth.

However, there is stronger evidence supporting the reverse relationship, that is, from GDP to expenditures, therefore favouring the idea of Wagner's Law. In particular, there are significant short and long-run effects, we reject the null of no Granger-causality using our two-step Hansen incremental test, and diagnostics are well behaved (Table 10).[38]

[Table 10]

With respect to causality running from government expenditures to TFP we find evidence supporting it, together with positive and significant short and long-run coefficients. For the OECD sub-group results are similar (not shown).

4.8. Cross-sectional dependence

As discussed in Section 3 it is natural to suspect about the existence of cross-sectional dependence across homogeneous groups of economies. Therefore, we use Pesaran's CD test[39] for the OECD sub-samples and we find a statistic of 15.26, corresponding to a p-value of zero (the null hypothesis is cross-sectional independence).

In Table 11 we run benchmark type growth regressions for this OECD sample using both a Driscoll-Kraay robust estimation approach and the Pesaran's Common Correlated Effects Pooled Estimator (CCEP). We restrict ourselves to the examination of seven main variables of interest: total government expenditures and revenues (% GDP), their respective growth rates, and the functional decomposition of government expenditures (education, health, and social security and welfare). Similarly to our earlier results we find negative and statistically significant coefficients for the effect of total government expenditures and revenues on output growth (the latter only true when running the Driscoll-Kraay regression). We find a negative effect of revenues' growth rate, confirming previous results. As for specifications 5 and 10 both government spending on education and health yield insignificant coefficients, though social security spending yields a statistically negative coefficient – reinforcing our previous results.

[Table 11]

[37] Both total government expenditures and revenues (% GDP) were converted to nominal levels, deflated using the CPI and scaled by population. Hence, we have real GDP per capita and either real total government expenditures or revenues in per capita terms as well (so that both variables of interest are comparable).

[38] Redoing the analysis for the OECD sub-sample (not shown), we get slightly stronger results favouring Granger causality from government spending to GDP for a positive short-run effect in 3 out of 6 models. Nevertheless, there does not seem to be a significant long-run effect. For the OECD the reverse relationship still holds with evidence of Granger-causality from GDP to government spending, as well as positive and significant short and long-run effects in both the pooled OLS and FE models.

[39] A standard growth equation including a basic set of controls and the debt ratio is estimated with within fixed effects.

5. Conclusion

We have used cross-sectional/time series data for a panel of 155 developed and developing countries for the period 1970-2008, in order to assess the potential linkage between fiscal policy developments and economic growth. More specifically, we focused on a number of econometric issues that can have an important bearing on the results, notably simultaneity, endogeneity, (two-way) causality, the relevance of nonlinearities, cross-section dependence, and threshold effects.

Our results from the model selection-based techniques suggest a negative impact of government spending and its components, whereas as for government revenues (and components) these techniques seem to indicate they may have a positive impact on output growth. Graphically, a two-way scatter plot of government expenditures and revenues against the GDP per capita growth indicate a positive relationship in both cases for the emerging economies group, and the existence of a negative relationship for the OECD. Though informative these simple descriptive statistics should be taken with care. What one can undoubtedly conclude, as confirmed by the Kernel density estimates, is that government expenditures and revenues ratios have increased over time with a movement of the distribution towards the right-hand-side.

Our evidence also suggests that for the full sample revenues have no significant impact on growth (though their growth rate has a positive impact) whereas government expenditures appear with highly significant negative signs. The same is true for the OECD group with the addition that now total government revenues have a negative impact on growth (however, when included together with other regressors it looses significance). If we decompose revenues, our empirical evidence is weak and unclear as to concrete effects, with the more general conclusion that taxes on income are usually detrimental to growth. Regarding expenditures, results are more robust and consistent across samples and econometric specifications; in particular public wages, interest payments, subsidies and government consumption are found to negatively affect output growth. Concerning the functional classification of government spending, expenditures on social security and welfare are detrimental to growth, whereas both government spending on education and health boosts growth. Most results are confirmed even after we address cross-sectional dependence.

Granger causality tests find relatively weak evidence supporting causality running for expenditures or revenues to GDP per capita (and TFP), but the reverse appears to be consistently stronger notably for spending, that is, evidence of the Wagner Law. For the OECD these effects are usually more pronounced. Interestingly, and depending whether we take the below or above 3% threshold budget deficit set of economies, we observe a negative impact, on growth, of taxes on income, profits and capital gains as well as taxes on payroll or workforce for the above 3% group, but a positive one for the below 3% group of countries.

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Table 1: Extreme Bounds Analysis (full sample)

Variables	taxproperty_gdp	taxpayroll_gdp	taxsscgovrev_gdp	govexpwages_gdp	govcons_gdp	pubinv_gdp
EBA lower bound	0.5886**	-0.7356**	0.0344**	-0.1195***	-0.1047***	-0.071**
	(2.0070)	(-2.2678)	(2.0750)	(-3.2197)	(-5.2472)	(-2.324)
EBA upper bound	0.9026***	-0.6513**	0.0464***	-0.0736**	-0.0489**	-0.062**
	(2.8357)	(-1.9777)	(2.8086)	(-1.9908)	(-2.4324)	(-2.010)
Variables	totgovrev_gdp	totgovexp_gdp	taxrev_gdp	domtaxesgs_gdp	taxesincome_gdp	
EBA lower bound	-0.0433***	-0.0609***	-0.0945***	0.0771**	-0.0735**	
	(-3.0642)	(-4.2444)	(-4.0166)	(2.0633)	(-2.3915)	
EBA upper bound	-0.0265**	-0.0253**	-0.0420**	0.1431***	-0.0598*	
	(-1.9788)	(-1.9844)	(-2.1873)	(3.5576)	(-1.9658)	

Note: *,**,*** denote significance levels at 10, 5 and 1%, respectively.

Table 2: BMA-Determinants of GDP per capita growth

Model	gdppcgr																			
Variable	PIPs	Sign	PIPs	Sign	PIPs	Sign	PIPs	Sign	PIPs	Sign	PIPs	Sign	PIPs	Sign	PIPs	Sign	PIPs	Sign	PIPs	Sign
Spec.	1		2		3		4		5		6		7		8		9		10	
inigdp	1.00	-	0.68	-	0.88	-	0.92	-	0.98	-	0.84	-	0.56	-	0.65	-	0.70	-	0.81	-
Scale/size																				
laborf	1.00	+	0.97	+	0.91	-														
popgr							0.95	-	0.2		0.99	-	0.88	-	0.99	-	0.53	-	0.69	-
land_area	1.00	-	0.96	-	0.88	-	0.85	-	1.00	-	0.99	-	0.21		0.99	-	0.51	-	1.00	-
Living conditions																				
mortality	1.00	-																		
fertility	1.00	-																		
depratio_wa	0.00																		0.00	
urban_pop	1.00	-																		
unemp	0.48																			
Policy/institutional																				
openness			0.98	+															0.53	+
termstrade			0.98	+																
reer			0.99	+																
fhindex			0.61	+															0.77	+
corrind			0.73	-															1.00	-
Education																				
primary_enrol					0.88	+														
secondary_enrol					0.81	+													1.00	+
tertiary_enrol					0.67	+														
literates					0.91	+														
Government																				
totgovrev_gdp									1.00	+									0.81	-
domtaxesgs_gdp													0.97	-						
taxesincome_gdp													0.99	+						
taxproperty_gdp													0.90	+						
taxpayroll_gdp													0.99	+						
taxsscgovrev_gdp													0.99	+						
totgovexp_gdp											0.99	-								
govexpwages_gdp															0.99	+				
intpay_gdp															0.99	-				
subs_gdp															0.99	-				
govcons_gdp															0.01					
pubinv_gdp															0.03					
govexpedu_gdp																	0.99	-		
govexphea_gdp																	0.99	+		
govexpss_gdp																	0.98	+		
debtavtermmat							0.94	-												
debt_gdp							0.73	-	0.30		0.23									
R-squared	0.22		0.10		0.14		0.22		0.16		0.10		0.19		0.36		0.06		0.37	

Note: The dependent variable is real GDP per capita growth over the sample full period, 1970-2010. The variable description is in the main text. The BMA analysis yields the posterior probabilities of inclusion (PIPs) and the sign certainty index of a relationship. A sign is given to the PIPs greater than 0.5. No sign means the sign of estimated relationship being uncertain.

Table 3: Top 3 BMA-type Models and their posterior probabilities

	1	2	3
Dependent	gdppcgr	tfpnew_60gr	kgr
Regressors			
inigdppc	*, s	*, s	*
gdp2000		*, s	
pop		*, s	
laborf	*, s		*
landarea	*, s		*
depratio_wa	*		
openness	*, s		
fhindex	*, s		
demo	*, s		
secondary_enrol	*, s		
totgovrev_gdp	*, s		
govexpwages_gdp		*, s	*, s
intpay_gdp		*, s	*, s
subs_gdp		*, s	*, s
govcons_gdp		*, s	*, s
pubinv_gdp		*, s	*, s
R-squared	0.37	0.26	0.74

Note: This table presents the top models for per capita GDP, TFP, and per worker capital stock, ranked by their R-squares in the whole sample. The variable description is in the main text. * and s, denote inclusion of the variable in the BMA regression and whether it reported a statistically significant coefficient, respectively.

Table 4: Baseline cross-country growth equations, 5-year averages

Dependent Variable	gdppcgr									initot govexp	initot govrev
Estimation	FE (within)										
Sample	ALL										
Spec.	1	2	3	4	5	6	7	8	9	10	11
inigdppc	-2.78***					-3.69***	-2.65***	-3.29***	-1.98***	-1.09	3.39**
	(0.459)					(0.603)	(0.502)	(0.650)	(0.443)	(1.847)	(1.309)
totgovexp_gdp		-0.06**				-0.07***		-0.07**			
		(0.023)				(0.022)		(0.027)			
totgovrev_gdp			-0.04				-0.02		-0.01		
			(0.038)				(0.043)		(0.040)		
totgovexpgr				1.39				-4.75			
				(7.249)				(7.903)			
totgovrevgr					27.01***				28.47***		
					(7.427)				(6.610)		
gfcf_gdp						0.14***	0.18***	0.14***	0.16***		
						(0.040)	(0.045)	(0.051)	(0.047)		
Obs.	1,395	561	812	446	664	539	783	435	649	392	607
R-squared	0.08	0.01	0.00	0.00	0.06	0.19	0.13	0.16	0.17	0.00	0.03

Note: The models are estimated by Within Fixed Effects (FE-within). The dependent variable is either real GDPpc growth (gdppcgr), the initial level of government expenditure (%GDP) or the initial level of government revenues (%GDP), as identified in the first row. Robust heteroskedastic-consistent standard errors are reported in parenthesis below each coefficient estimate. Time fixed effects were included, but are not reported. Also a constant term has been estimated but it is not reported for reasons of parsimony. *, **, *** denote significance at 10, 5 and 1% levels

Table 5: Total General Government Revenue and Expenditure and Growth, 5-year averages

Dependent Variable: Real GDPpc growth	Fixed-Effects (within)						FE-LAD		MM		LSDV-C		DIFF-GMM		SYS-GMM	
Sample	All		OECD		Emerging		All									
Spec.	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*	*12*	*13*	*14*	*15*	*16*
inigdppc	-4.96***	-6.00***	-2.53***	-2.45***	-3.87***	-7.15***	-4.22***	-4.94***	-0.68***	-0.35*	-5.17***	-5.40***	-4.61***	-8.66***	-0.71***	-0.07
	(0.768)	(0.820)	(0.439)	(0.343)	(1.308)	(1.535)	(0.733)	(0.805)	(0.097)	(0.180)	(0.577)	(0.611)	(1.373)	(1.446)	(0.222)	(0.289)
popgr	-0.48*	-0.31	-0.91**	-1.27***	-1.00**	-1.68**	-0.56***	-0.45***	-0.87***	-0.55**	-0.46*	-0.23	-0.30	0.01	-0.36**	-0.33
	(0.267)	(0.192)	(0.339)	(0.359)	(0.463)	(0.716)	(0.208)	(0.164)	(0.155)	(0.227)	(0.274)	(0.300)	(0.429)	(0.206)	(0.153)	(0.231)
trade_gdp	0.04***	0.05***	0.04**	0.02***	0.02	-0.00	0.04***	0.04***	0.01***	0.01***	0.04***	0.05***	0.12***	0.09***	0.01*	0.01
	(0.012)	(0.013)	(0.014)	(0.009)	(0.022)	(0.038)	(0.012)	(0.011)	(0.002)	(0.002)	(0.010)	(0.009)	(0.025)	(0.022)	(0.006)	(0.005)
gfcf_gdp	0.16***	0.11***	0.13**	0.11**	0.30***	0.32**	0.15***	0.10***	0.15***	0.15***	0.14***	0.13***	0.10	0.01	0.30***	0.25***
	(0.045)	(0.039)	(0.052)	(0.046)	(0.108)	(0.120)	(0.044)	(0.037)	(0.028)	(0.044)	(0.029)	(0.032)	(0.071)	(0.076)	(0.043)	(0.039)
education	0.04***	0.04***	0.02**	0.02***	0.05**	0.04	0.04***	0.03***	0.03***	0.02***	0.05***	0.03**	0.01	0.06***	0.04***	0.02
	(0.010)	(0.010)	(0.006)	(0.006)	(0.020)	(0.030)	(0.009)	(0.010)	(0.006)	(0.007)	(0.014)	(0.014)	(0.027)	(0.021)	(0.010)	(0.011)
totgovrev_gdp	-0.03		-0.03		-0.18***		-0.02		-0.05***		-0.02		-0.06		-0.03	
	(0.040)		(0.035)		(0.041)		(0.033)		(0.015)		(0.027)		(0.067)		(0.032)	
totgovexp_gdp		-0.08***		-0.12***		-0.26***		-0.08***		-0.05***		-0.07**		-0.10***		-0.07***
		(0.024)		(0.022)		(0.086)		(0.023)		(0.014)		(0.029)		(0.036)		(0.023)
Obs.	746	515	202	191	173	113	732	504	746	515	733	503	564	389	746	515
R-squared	0.23	0.30	0.27	0.38	0.32	0.35	0.20	0.24								
Hansen (p-value)													0.09	0.50	0.37	0.95
AB AR(1) (p-value)													0.01	0.00	0.00	0.00
AB AR(2) (p-value)													0.46	0.15	0.54	0.07

Note: The models are estimated by OLS (OLS-pooled), OLS with Least Absolute Deviation robust version (OLS-LAD), MM estimator a la Yohai (1987) which efficiently makes uses of both the S and Huber-type M estimators using iteratively reweighted least squares (IRWLS), Bias-Corrected Least Squares Dummy Variable (LSDV-C), Within Fixed Effects (FE-within), Two-Step robust Difference GMM (DIFF-GMM) and Two-Step robust System GMM (SYS-GMM). For the latter two methods lagged regressors are used as suitable instruments. The dependent variable is real GDPpc growth. Robust heteroskedastic-consistent standard errors are reported in parenthesis below each coefficient estimate. The Hansen test evaluates the validity of the instrument set, i.e., tests for over-identifying restrictions. AR(1) and AR(2) are the Arellano-Bond autocorrelation tests of first and second order (the null is no autocorrelation), respectively. A constant term has been estimated but it is not reported for reasons of parsimony. *, **, *** denote significance at 10, 5 and 1% levels.

Table 6: Growth equations with Budgetary Economic Decomposition when fiscal variables are introduced one at a time in the benchmark equations, 5-year averages

Dependent Variable: Real GDPpc growth	Fixed Effects (within)					
Sample	All	OECD	Emerg	All	OECD	Emerg
	Panel A1			Panel B1		
Spec.	1	2	3	4	5	6
Revenue Variables						
taxrev_gdp	0.06	0.01	0.03			
	(0.127)	(0.192)	(0.211)			
domtaxesgs_gdp	0.39***	0.01	0.39*	0.50***	-0.28	
	(0.117)	(0.242)	(0.210)	(0.163)	(0.489)	
taxesincome_gdp	-0.07	-0.06	-0.81**	-0.40*	-0.22	-2.24
	(0.060)	(0.091)	(0.378)	(0.205)	(0.355)	(1.425)
taxproperty_gdp	-0.52	-0.31	0.08	-0.85	0.67	
	(0.693)	(0.505)	(1.972)	(0.760)	(0.541)	
taxpayroll_gdp	0.65	0.88	10.30***	-0.05	0.50	-12.96
	(1.089)	(0.538)	(1.841)	(0.763)	(0.766)	(8.861)
taxsscgovrev_gdp	0.03	-0.01	0.20	0.11	-0.02	2.57**
	(0.044)	(0.069)	(0.182)	(0.173)	(0.218)	(1.050)
	Panel A2			Panel B2		
Expenditure Variables						
govexpwages_gdp	-0.03	-0.57***	0.15	-0.23	-0.18	-0.20
	(0.159)	(0.153)	(0.225)	(0.177)	(0.197)	(0.218)
intpay_gdp	-0.00	-0.26**	-0.01	0.08	0.55	-0.12
	(0.003)	(0.127)	(0.010)	(0.051)	(0.390)	(0.422)
subs_gdp	0.00	-0.08***	-0.00	-0.04**	-0.11**	0.17**
	(0.001)	(0.019)	(0.003)	(0.019)	(0.042)	(0.064)
govcons_gdp	-0.19***	-0.45***	0.02	-0.28***	-0.34	-0.22
	(0.051)	(0.147)	(0.142)	(0.084)	(0.220)	(0.134)
pubinv_gdp	-0.25***	0.69	-0.38**	-0.28*	-0.46**	-0.68***
	(0.080)	(0.748)	(0.169)	(0.139)	(0.199)	(0.176)

Note: The models are estimated by Within Fixed Effects (FE-within). The dependent variable is real GDPpc growth. Different individual regressions using the set of regressors and controls present in table 6 were performed and only coefficients of interest are reported for economy of space. Revenue and expenditure variables were included individually in each regression in Panel A. Simultaneously inclusion of different budgetary components was performed in Panel B. Full results are available from the authors upon request. Robust heteroskedastic-consistent standard errors are reported in parenthesis below each coefficient estimate. Time fixed effects were included, but are not reported. A constant term has been estimated but it is not reported for reasons of parsimony. *, **, *** denote significance at 10, 5 and 1% levels.

Table 7: Growth equations with functional spending: fiscal variables are introduced simultaneously (Panel A) and one at a time (Panel B), benchmark equations, 5-year averages

Dependent Variable: Real GDPpc growth	Fixed Effects (within)		
Sample	All	OECD	Emerg
Spec.	1	2	3
Panel A			
govexpedu_gdp	0.29	0.11	-0.44
	(0.358)	(0.306)	(0.724)
govexphea_gdp	-0.30	-0.26	2.55
	(0.302)	(0.286)	(2.117)
govexpss_gdp	-0.10	-0.42***	0.49
	(0.115)	(0.093)	(0.283)
Obs.	223	96	56
R-squared	0.24	0.32	0.67
Panel B			
govexpedu_gdp	0.04	-0.00	0.62*
	(0.169)	(0.128)	(0.332)
govexphea_gdp	-0.24	-0.30	1.18
	(0.334)	(0.387)	(1.812)
govexpss_gdp	-0.09	-0.42***	0.06
	(0.119)	(0.087)	(0.200)

Note: The models are estimated by Within Fixed Effects (FE-within). The dependent variable is real GDPpc growth. Different individual regressions using the set of regressors and controls present in table 14b. (in bold) were performed and only coefficients of interested are reported for economy of space. Expenditure components (education, health and social security) were included individually in each regression. Full results are available upon request. Robust heteroskedastic-consistent standard errors are reported in parenthesis Time fixed effects and a constant were included, but are not reported*, **, *** denote significance at 10, 5 and 1% levels.

Table 8: Cyclicality of public expenditures (functional approach), annual data (with control variables)

Dependent Variable	Total Gov. Exp.			Gov. Exp. Education			Gov. Exp. Health			Gov. Exp. Social Security and Welfare		
Sample	All	OECD	E+D	All	OECD	E+D	All	OECD	E+D	All	OECD	E+D
Spec.	1	2	3	4	5	6	7	8	9	10	11	12
gdppcgr	-0.49	-4.56**	0.45	-0.29	-0.51*	-0.08	-0.05	-0.24	-0.08	-0.83**	-3.63***	-0.34
	(0.841)	(2.027)	(0.984)	(0.269)	(0.304)	(0.264)	(0.123)	(0.349)	(0.087)	(0.355)	(1.281)	(0.258)
ToT gr	-0.03	-0.12***	-0.02	-0.00	0.00	-0.00	0.00	0.00	0.00	-0.02**	-0.03	-0.00
	(0.025)	(0.027)	(0.035)	(0.006)	(0.007)	(0.005)	(0.005)	(0.006)	(0.005)	(0.011)	(0.024)	(0.007)
govbal_gdp(-1)	0.04***	0.01	0.06***	0.01**	0.00	0.01**	0.00	0.00	0.00	0.01**	0.01*	0.00
	(0.009)	(0.009)	(0.010)	(0.002)	(0.003)	(0.002)	(0.001)	(0.002)	(0.001)	(0.003)	(0.007)	(0.002)
Observations	772	366	406	673	253	420	521	219	302	492	219	273
Hansen (p-value)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
AB AR(1) (p-value)	0.00	0.00	0.00	0.02	0.11	0.03	0.09	0.17	0.17	0.01	0.09	0.05
AB AR(2) (p-value)	0.06	0.50	0.08	0.31	0.67	0.25	0.27	0.53	0.26	1.00	0.39	0.07

Note: The models are estimated by Two-Step robust System GMM (SYS-GMM). Lagged regressors are used as suitable instruments. The dependent variable is either total government expenditures, government expenditures on education, health or social security and welfare (all in % GDP), as identified in the first row. "E+M" denote the emerging and developing countries sub-group. Robust heteroskedastic-consistent standard errors are reported in parenthesis. The Hansen test evaluates the validity of the instrument set. AR(1) and AR(2) are the Arellano-Bond autocorrelation tests of first and second order (the null is no autocorrelation), respectively. A constant term has been estimated but it is not reported for reasons of parsimony. *, **, *** denote significance at 10, 5 and 1% levels.

Table 9: Growth equations with Budgetary Decomposition of Public Budget Balance (Revenue and Expenditure), 5-year averages – different samples with non-linear effects of fiscal policy, according to the 3% Budget Deficit threshold

Dependent Variable: Real GDPpc growth	Fixed Effects (within)																	
Sample	All		OECD		Emerg		All		OECD		Emerg		All		OECD		Emerg	
	>3%	<3%	>3%	<3%	>3%	<3%	>3%	<3%	>3%	<3%	>3%	<3%	>3%	<3%	>3%	<3%	>3%	<3%
Spec.	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*	*12*	*13*	*14*	*15*	*16*	*17*	*18*
inigdppc	-3.83***	-5.31***	-2.66	-3.40**	-2.02	-8.27***	-5.95*	-16.35***	-21.15***	-5.14	-3.82**	-20.83***	-4.15	-6.25***	-4.43	-3.05**	-7.47***	-13.06***
	(1.042)	(1.210)	(1.640)	(1.322)	(1.526)	(2.813)	(3.181)	(2.565)	(3.905)	(2.962)	(1.417)	(2.893)	(4.787)	(1.697)	(2.763)	(1.037)	(1.341)	(1.651)
lfp	0.06	-0.12	-0.02	-0.23	0.02	-0.24	0.08	-0.32**	0.79**	-1.57***	0.20	-0.04	-0.19	0.26	0.19	-0.23	0.06	0.37***
	(0.100)	(0.112)	(0.166)	(0.158)	(0.041)	(0.215)	(0.214)	(0.117)	(0.226)	(0.277)	(0.236)	(0.140)	(0.533)	(0.162)	(0.132)	(0.141)	(0.109)	(0.058)
unemp	-0.06	-0.14	-0.07	-0.18	-0.01	-0.15	-0.58***	0.01	-1.74***	-0.80***	0.28	0.11	0.32	-0.12	0.05	-0.24**	0.37	-0.20
	(0.065)	(0.085)	(0.265)	(0.105)	(0.097)	(0.194)	(0.123)	(0.155)	(0.101)	(0.194)	(0.259)	(0.182)	(0.427)	(0.115)	(0.171)	(0.105)	(0.291)	(0.112)
popgr	0.23	-0.14	-1.20*	0.14	-1.62**	-1.34	0.12	1.64	-1.19	5.90***	-2.92**	-7.12**	-0.14	-0.31**	-2.23**	-2.08***	-9.36***	-6.45**
	(0.900)	(0.183)	(0.554)	(0.812)	(0.666)	(0.853)	(0.685)	(0.997)	(1.178)	(1.187)	(1.090)	(2.334)	(2.054)	(0.108)	(0.795)	(0.496)	(1.990)	(2.262)
gfcf_gdp	0.17***	0.18***	0.16	-0.03	0.18***	0.37***	0.06	0.36**	-1.44***	-0.82***	0.38*	0.59***	0.38**	-0.23	0.21	-0.02	0.38**	0.66***
	(0.053)	(0.063)	(0.203)	(0.099)	(0.053)	(0.103)	(0.229)	(0.139)	(0.101)	(0.219)	(0.183)	(0.095)	(0.179)	(0.139)	(0.176)	(0.095)	(0.158)	(0.108)
education	0.04***	0.02	0.01	0.03**	0.02	0.09	0.07**	0.10***	0.12***	0.00	0.04	-0.05	0.02	-0.04	0.04	0.02*	0.01	-0.18*
	(0.013)	(0.019)	(0.011)	(0.010)	(0.015)	(0.085)	(0.031)	(0.026)	(0.021)	(0.019)	(0.052)	(0.094)	(0.017)	(0.052)	(0.022)	(0.010)	(0.017)	(0.085)
depratio_wa	-0.09***	-0.24***	-0.09	-0.22*	-0.05	-0.23***	-0.16***	-0.13**	-0.21	-0.32**	0.03	-0.19*	-0.18	-0.30**	-0.18**	-0.09**	0.25**	-0.06
	(0.031)	(0.043)	(0.055)	(0.110)	(0.047)	(0.066)	(0.049)	(0.051)	(0.153)	(0.099)	(0.103)	(0.088)	(0.127)	(0.128)	(0.061)	(0.035)	(0.108)	(0.064)
<u>Revenue Variables</u>																		
domtaxesgs_gdp							0.52*	0.30	-0.44	2.70***	1.17	0.00						
							(0.269)	(0.257)	(0.455)	(0.474)	(0.638)	(0.374)						
taxesincome_gdp							-0.40	-0.25	-0.92**	4.14***	-0.44	-0.60*						
							(0.265)	(0.348)	(0.331)	(0.933)	(0.706)	(0.304)						
taxproperty_gdp							-0.35	0.72	1.91	12.72***	-2.81	-1.93						
							(0.768)	(2.020)	(1.143)	(2.770)	(2.385)	(1.113)						
taxpayroll_gdp							-0.96	0.35	-1.91*	5.74***								
							(1.602)	(1.578)	(0.933)	(1.543)								
taxsscgovrev_gdp							0.09	0.58***	0.68***	-3.52***	-1.19***	-0.09						
							(0.164)	(0.167)	(0.134)	(0.695)	(0.317)	(0.416)						
<u>Expenditure Variables</u>																		
govexpwages_gdp													-0.25	-0.19	-0.32***	-0.44**	-0.43	-0.66
													(0.285)	(0.233)	(0.073)	(0.198)	(0.251)	(0.620)
intpay_gdp													-4.09	0.18*				
													(5.100)	(0.095)				
subs_gdp														-0.08**				
														(0.034)				
govcons_gdp													-0.06	-0.58***	-0.39***	-0.15**	-0.53**	-0.01
													(0.157)	(0.198)	(0.100)	(0.060)	(0.159)	(0.150)
pubinv_gdp													-0.18	-0.05	-0.12	0.04	-1.16***	-0.53***
													(0.157)	(0.228)	(0.266)	(0.311)	(0.223)	(0.088)
Observations	202	346	66	109	50	98	48	48	20	23	26	34	47	58	47	68	21	30
R-squared	0.27	0.29	0.25	0.27	0.48	0.39	0.57	0.78	0.99	0.95	0.83	0.90	0.61	0.75	0.66	0.45	0.99	0.87

Note: The models are estimated by Within Fixed Effects (FE-within). The dependent variable is real GDPpc growth. "Above" and "below" performers are classified as those having maintained an average (over the country's time span) budget deficit below 3% or over 3%, respectively. Robust heteroskedastic-consistent standard errors are reported in parenthesis below each coefficient estimate. Time fixed effects were included, but are not reported. Also a constant term has been estimated but it is not reported for reasons of parsimony. *, **, *** denote significance at 10, 5 and 1% levels.

Table 10: Panel Granger-Causality - Total Government Expenditures and GDPpc (full sample)

Dep.Var. totgovexppc	OLS levels	Within Group (FE)	DIF-GMM	SYS-GMM	SYS-GMM-1	SYS-GMM-2
Model	(1)	(2)	(3)	(4)	(5)	(6)
Instrument set	none	none	Full	Full	Reduced	Reduced
Lag1 totgovexppc	0.04	-0.98**	-1.63***	-0.14	-0.12	-1.68***
	(0.201)	(0.395)	(0.476)	(0.127)	(0.073)	(0.166)
Lag1 GDPpc	2.43**	32.76***	25.28	6.45*	9.49***	12.29**
	(0.950)	(8.946)	(24.939)	(3.635)	(2.941)	(6.223)
Obs.	320	320	226	320	320	320
R-squared	0.01	0.19				
AB AR(1) (p-value)			0.26	0.29	0.29	0.25
AB AR(2) (p-value)			0.65	0.31	0.31	0.60
Hansen p-value			0.01	0.03	0.28	0.61
Granger causality p-value	0.01	0.00	1.00	0.13	0.00	0.00
Unobs. Heterogeneity				0.00	0.00	0.00
LR effect point estimate	2.51*	16.54***	9.62	5.67	8.47***	4.59**
(standard error)	(1.287)	(3.053)	(10.053)	(3.649)	(2.682)	(2.166)

Note: Our five-year averages dataset was used for the purpose of assessing Granger causality. Year dummies are included in all models (coefficients not reported). Figures in parenthesis below point estimates are standard-errors. The GMM results reported here are two-step estimates with heteroskedasticity-consistent standard errors. The Hansen test is used to assess the overidentifying restrictions; the test uses the minimized value of the corresponding two-step GMM estimator. The difference Hansen test is used to test the additional moment conditions used by the system GMM estimators in which SYS GMM uses the standard moment conditions, while SYS GMM-1 only uses the lagged first-differences of totgovexp_gdp dated t-2 (and earlier) as instruments in levels and SYS-2 only uses lagged first-differences of GDPpc dated t-2 (and earlier) as instruments in levels. The heterogeneity test is used to test the null that there are no individual effects (see text). The Granger causality test examines the null hypothesis that is totgovexp_gdp not Granger-caused by GDPpc; the test statistic is criterion based, using restricted and unrestricted models (see main text for details). The LR effect is the point estimate of the long-run effect of GDPpc on totgovexp_gdp. Its standard error is approximated using the delta method. *, **, *** denote significance at 10, 5 and 1% levels.

Table 11: Growth equations with Government Expenditures and Revenues – accounting for Cross-Sectional Dependence, 5 year averages data – OECD

Dependent Variable: Real GDPpc growth	Discroll Kraay Robust Estimation					CCEP				
Model	1	2	3	4	5	6	7	8	9	10
Sample	OECD									
inigdppc	-0.81***	-0.77***	-0.12	-0.65***	-0.54*	-2.45***	-2.53***	-2.12***	-2.83***	-2.47***
	(0.221)	(0.251)	(0.249)	(0.169)	(0.267)	(0.522)	(0.555)	(0.719)	(0.509)	(0.802)
popgr	-0.46*	-0.23	0.39**	0.02	-0.14	-1.27***	-0.91***	-0.05	-0.83***	-0.18
	(0.245)	(0.187)	(0.159)	(0.167)	(0.183)	(0.285)	(0.296)	(0.384)	(0.291)	(0.415)
gfcf_gdp	0.01**	0.01**	-0.00	0.01	0.02**	0.02**	0.02*	0.01	0.02*	0.03**
	(0.004)	(0.003)	(0.004)	(0.006)	(0.006)	(0.009)	(0.009)	(0.011)	(0.009)	(0.013)
openness	0.09***	0.11***	0.20***	0.13***	0.10***	0.11***	0.13***	0.26***	0.14***	0.16***
	(0.022)	(0.029)	(0.029)	(0.029)	(0.032)	(0.038)	(0.040)	(0.049)	(0.039)	(0.056)
education	0.01***	0.01***	0.01***	0.01***	0.02***	0.02***	0.04***	0.04***	0.04***	0.06***
	(0.003)	(0.003)	(0.002)	(0.003)	(0.004)	(0.008)	(0.009)	(0.013)	(0.008)	(0.015)
totgovexp_gdp	-0.06***					-0.12***				
	(0.012)					(0.024)				
totgovrev_gdp		-0.04***					-0.03			
		(0.010)					(0.033)			
totgovrevgr			-35.41***					-35.49***		
			(6.735)					(9.042)		
totgovexpgr				17.45*					15.19	
				(9.007)					(9.498)	
govexpedu_gdp					0.00					-0.31
					(0.035)					(0.193)
govexphea_gdp					-0.05					-0.19
					(0.036)					(0.155)
govexpss_gdp					-0.10***					-0.14*
					(0.018)					(0.078)
Obs.	191	202	142	195	133	191	202	142	195	133
R-squared	0.28	0.27	0.31	0.23	0.26	0.38	0.27	0.40	0.29	0.39

Note: The models are estimated with either Driscoll Kraay robust estimator or the Pesaran's Common Correlated Effects Pooled estimator (CCPE) to correct for the existence of cross-sectional dependence in the OECD. The dependent variable is real GDPpc growth. Standard errors are reported in parenthesis below each coefficient estimate. A constant term has been estimated but it is not reported for reasons of parsimony. *, **, *** denote significance at 10, 5 and 1% levels.

Appendix – Sample, variables and sources

Variable	Definition/Description	Acronym	Source
real GDP per capita		*Gdppc*	World Bank's Word Development Indicators (WDI)
gross fixed capital formation (% GDP)		*Gfcf_gdp*	WDI
public investment (% GDP)		*Pubinv_gdp*	WDI
Total Factor Productivity	Variable constructed using growth accounting techniques	*Tfp*	version 6.3 of the Penn World Table (PWT) of Heston et al. (2009) and Barro and Lee's (2010).
Government budget surplus or deficit (% of GDP)	The government budget surplus or deficit as a percentage of GDP.	*Govbal_gdp*	WDI, IMF IFS, Easterly (2001)
Central Government Debt (% GDP)		*Govdebt_gdp*	WDI, IMF IFS, Easterly (2001)
Total Government Revenue (% GDP)		*Totgovrev_gdp*	WDI, IMF IFS, Easterly (2001)
Tax revenue (% GDP)		*Taxrev_gdp*	WDI, IMF IFS, Easterly (2001)
Domestic taxes on goods and services (% GDP)	This includes VAT, excises, profits of fiscal monopoly etc.	*Domtaxesgs_gdp*	WDI, IMF IFS, Easterly (2001)
Taxes on payroll or work force (% of GDP)	This category consists of taxes that are collected from employers or the self-employed and that are not earmarked for social security schemes.	*Taxpayrool_gdp*	WDI, IMF IFS, Easterly (2001)
Taxes on income, profits and capital gains (% GDP)		*Taxincome_gdp*	WDI, IMF IFS, Easterly (2001)
Taxes on property (% of GDP)	Taxes on the use, ownership, or transfer of wealth	*Taxproperty_gdp*	WDI, IMF IFS, Easterly (2001)
Tax and social security contributions government revenue (% of GDP)	Total government revenue from taxes and social security contributions	*Taxssgovrev_gdp*	WDI, IMF IFS, Easterly (2001)
Total Government Expenditure (% GDP)		*Totgovexp_gdp*	WDI, IMF IFS, Easterly (2001)
Compensation of employees (% GDP)		*Govexpwages_gdp*	WDI, IMF IFS, Easterly (2001)
Interest Payments (% GDP)		*Inpay_gdp*	WDI, IMF IFS, Easterly (2001)
Subsidies (% GDP)		*Subs_gdp*	WDI, IMF IFS, Easterly (2001)
Public Final Consumption Expenditure (% GDP)		*Govcons_gdp*	WDI, IMF IFS, Easterly (2001)
Public spending on Education (% GDP)		*Govexpedu_gdp*	WDI, IMF IFS, Easterly (2001)
Public spending on Health (% GDP)		*Govexphea_gdp*	WDI, IMF IFS, Easterly (2001)
Public spending on Social Security and Welfare related (% GDP)		*Govexpss_gdp*	WDI, IMF IFS, Easterly (2001)
School attainment	average years of schooling in the population over 25 years old from the international data on educational attainment	*Edu*	Barro and Lee (2010)
literacy rate (% of people ages 15 to 24)		*Literates*	WDI
primary school enrolment (% gross)		*Primary_enrol*	WDI
primary school duration (years)		*Primary_dur*	WDI
secondary school enrolment (% gross)		*Secondaru_enrol*	WDI
secondary school duration (years)		*Secondary_dur*	WDI
tertiary school enrolment (% gross)		*Tertiary_enrol*	WDI
tertiary school duration (years)		*Tertiary_dur*	WDI
land area (in square kilometres)		*Land_area*	WDI
population		*Pop*	WDI
imports and exports of good and services (BoP, current USD)		*Imp, exp*	WDI
labour participation rate (% of total)		*Lfp*	WDI
labour force		*Laborf*	WDI
unemployment, total (% of total labour force)		*Unemp*	WDI
fertility rate (births per woman)		*Fertility*	WDI
age dependency ratio (% of working age population)		*Depratio_wa*	WDI
urban population (% of total)		*Urban_pop*	WDI
Short-term debt (% of exports of goods and services)		*Short_debt_gdp*	WDI
terms of trade adjustment (constant LCU)		*Terms_trade*	WDI
real effective exchange rate index (2000=100)		*Reer*	WDI