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A PANEL ASSESSMENT FOR THE EU

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CONTENTS

Abstract

In this paper we test whether a reallocation of government budget items can enhance long-term GDP growth in a set of European countries. We apply modern panel data techniques to the period 1970-2006, and we use three alternative dependent variables in a growth regression: economic growth, total factor productivity and labour productivity. Our results are able to identify also the distortions induced by public expenditure in the private factors allocation. In particular, we detect a strong crowding-in effect associated to public investment, which have enhanced economic growth by boosting private investment. We also associate a significant dependence of productivity on public expenditure on education as well as the role of social security and health issues in growth and the labour market.

Keywords: economic growth, panel models, fiscal policy.

JEL Classification Numbers: C23, E62, H50, O40.

Non-technical summary

The role of fiscal policies on economic growth has driven several studies both on the theoretical and empirical on the empirical fronts. The subject is quite relevant, since the development of appropriate fiscal policies could lead to a persistent increase on economic growth. Therefore, governments need to know whether their public activities serve as an incentive to growth or if they represent an obstacle.

The link between the composition of government expenditure and revenue and economic growth has been the focus of recent developments in the endogenous growth theory. Some authors have proposed different channels through which public expenditure and taxation could affect economic growth and productivity. In particular, fiscal policy has been assumed to be able to affect production by altering the pattern of consumption and investment of the economy. This can occur via the introduction of incentives and disincentives in the utility and productivity of the individuals that affect the equilibrium in the labour market, and, in the case of government expenditure, also as a separate input that comes in the production function. We also want to consider this debate in the empirical analysis by comparing the results of using three alternative dependent variables in the estimation of a growth regression: economic growth, total factor productivity (TFP) and labour productivity.

Under the denomination of endogenous growth models, in the last decade a large strand of literature includes a variety of fiscal variables under diverse forms and with heterogeneous consequences. Nevertheless, there are some issues in which economic theory seems to have reached a certain level of agreement, for example the role of public capital on growth or the perverse effect of capital taxation relative to other types of taxation. We use in this paper a simple theoretical model, in order to summarise the key findings of the relationship of public expenditure with economic growth. The model will also be useful to give a better interpretation of our estimation results.

As already mentioned, the analysis of the disaggregated government budget may offer useful insights about the suitability of items in the budget to promote growth. Therefore, we look at both sides of the government budget, considering public revenues and economic and functional spending items. By regressing economic growth on budgetary

items and on a set of other relevant variables, we evaluate whether the allocation of taxes and public expenditures has been useful to promote growth in a panel of European countries for the period 1970-2006. We are able to identify the negative impact of public consumption and social security contributions on economic growth, and the positive impact of public investment. Our regression results point to an overall situation of excessive expenditure in the oldest members of the EU in contrast to a negative impact of social transfers, subsidies, public wages and direct taxation in the new members. On functional expenditure the study points to a negative impact of health and social protection expenditures on production and the growth-enhancing behaviour of public expenditure in education.

Unlike previous studies, we try to better accommodate our results to the developments of economic theory by identifying the channels through which each budgetary category may impact on production growth. Our regressions for labour productivity and TFP, as alternative dependent variables, reveal that the main impact of fiscal variables comes through alterations in the pattern of investment of the economy. We are able to identify the existence of a crowding-in effect of public investment into private investment that provokes an overall positive effect of public investment on economic growth, despite its negative impact on multifactor productivity. Social expenditures and public investment seem to also affect the labour market while public consumption and public wages have a significant impact on multifactor productivity.

1. Introduction

The traditional neoclassical growth model did not allow for fiscal policies to affect the long-term growth rate of the economy. However, several extensions of neoclassical growth theory, proposed by Aschauer (1989), Barro and Sala-i-Martin (1995), and Mendoza et al. (1997) have introduced modifications that allow public expenditure and taxation to play a crucial role in long-term economic growth. Under the denomination of endogenous growth models there is a large strand of literature that s includes a variety of possibilities to model economic growth: from the simple approach of the AK technology to models with externalities, interdependence in an open economy to a new generation of models with endogenous technical change.[1]

Fiscal variables have been considered in the related literature in diverse forms and with heterogeneous consequences (Corsetti and Roubini, 1996, and Domenech and Garcia, 2002). Nevertheless, there are some issues in which economic theory seems to have reached a certain level of agreement, for example the role of public capital on growth or the perverse effect of capital taxation relative to other types of taxation. However, other questions are still open for consideration, and a good example is the role of public expenditure on human capital accumulation.

The analysis of the disaggregated government budget may offer useful insights about the suitability of items in the budget to promote growth. In this paper we look at both sides of the budget, public revenues and economic and functional spending items. By regressing economic growth on budgetary items and on a set of other relevant variables we evaluate whether the allocation of taxes and public expenditures has been useful to promote growth in a panel of European countries for the period 1970-2006.

The shortcoming of poor data availability affected the first attempts to use panel data models to relate growth and fiscal variables (Barro, 1991, Levine and Renelt, 1992, and Easterly and Rebelo, 1993). Recently, the amount and quality of data have improved, and the large number of empirical studies about the determinants of economic growth provides valuable information about the variables that should be included in such a

[1] Acemoglu (2006) includes a detailed explanation of the evolution of endogenous growth models.

model and about the interpretation of the estimated coefficients (Kneller et al., 1999, Odedokun, 2001, and Bose et al., 2003).

The actual debate includes the choice of the estimation method and the definition of the long-term coefficients (Bassanini and Scarpetta, 2001, Romero de Avila and Strauch, 2007, Gupta et al., 2005). Based on the analysis of previous results and the developments of econometric theory (Arellano and Bover, 1995, Blundell and Bond, 1998, and Woolridge, 2002) we propose a dynamic model estimated by GMM methods that has not previously been applied to this particular problem. From the estimated dynamic coefficients, we determine long-term relations using the assumption assuming that the economy is in its steady state.

In addition, we want to propose a broader framework that explains more accurately the relationship between the composition of the public budget and economic growth. The results of many empirical and theoretical studies suggest that the public budget has an impact on economic growth, not only through an effect on productivity, but also by altering the conditions in the production factor markets, labour and productivity.

Unlike previous studies, we further analyse the mechanisms through which public budget composition alter long-term growth. Therefore, we also assess the relevance of the fiscal variables for labour productivity and total factor productivity. Such an approach allows us to discriminate between the impact on growth via productivity, and the effects of the alterations induced in the labour and private capital markets by distortionary taxation and public expenditure policies.

The analysis yields interesting results about the channels through which the composition of the public budget affects economic growth. Of particular interest is the conclusion regarding the distortions induced by public investment in the capital markets, the so-called crowding-in effect, which served to maintain significant levels of public investment. Moreover, public consumption is detrimental to growth because it reduces the incentives for private investment, while public employment retards productivity growth. On the revenue-side, contributions to social security seem to be an obstacle for higher growth.

We also associate a significant dependence of productivity on public expenditure towards education as well as the role of social security and health issues in growth and in the labour market. In addition we present results for the 12 countries that have recently joined the European Union. In general, estimations suggest that public expenditure seems to be less productive in these economies than in the older 15 EU members.

The remainder of the paper is organised as follows. Section two addresses the theoretical underpinnings. Section three discusses the existing and our proposed empirical specifications. Section four presents the empirical analysis. Finally, section five contains concluding remarks.

2. Theoretical underpinnings

We will extend the simplest model of endogenous growth to assess several forms under which public taxation and expenditure could affect economic growth. Our purpose is to create heterogeneous types of public expenditure and taxation that affect economic growth through several channels that may be identified later in a growth regression.

Assuming an economy in which there are four types of public expenditure and three types of taxation in an extended version of the AK model. The expenditure categories are represented by a public input in the production function (G_1), a capital-enhancing type of public expenditure, (G_2), a labour-enhancing type of public expenditure (G_3), and a publicly provided consumption good (G_4). Taxation is distributed among taxes on consumption (τ_c), taxes on corporate profits (τ_π) and taxes on labour income (τ_l).

Public expenditure modelled as a separate input in the production function has been used very often in economic theory since the proposals by Aschauer (1989) and Barro and Sala-i-Martin (1992).[2] We will assume a Cobb-Douglas technology with constant returns to scale over all inputs. Many public infrastructures could be included in this type of public expenditure. In this framework, considering public expenditure as a

[2] Tanzi and Zee (1997) include a useful literature review on the fiscal policy determinants of long-run growth with the main channels under which taxes and public expenditure policies have been considered to affect production growth.

separate input in the production function is equivalent to incorporate it as a part of the technological constraint that determines total factor productivity:

$$Y_t = AK^{\alpha}{}_t L^{\gamma}{}_t G^{\delta}{}_{1,t} \tag{1}$$

where K_t and L_t are private capital and labour supply respectively. Some authors have also proposed more complete frameworks introducing the effects of congestion and network externalities[3], but for the sake of simplicity we will follow the original proposal by Aschauer (1989).[4]

The capital-enhancing type of public expenditure (G_2) responds to the cost-function approach of public expenditure proposed by several authors.[5] The inclusion of public investment as a separate argument in the production function, as in G_1, may violate the standard marginal productivity theory. Demetriades and Mamuneas (2004) study the reaction of output to a type of public expenditure that affects the cost function of the private sector.[6] In our case, we will make use of the simplest way of affecting the price of public capital, by considering G_2 to be a subsidy to the purchase of private capital, as proposed by Devarajan et al. (1998). Public investment in transport, for example, may influence the price of private capital goods with high transportation costs. Being s a parameter lying in the interval (0,1) representing the non-subsidized share of private capital, the subsidised private capital paid through the capital-enhancing type of public expenditure will be[7]

[3] For example, Fernald (1999) introduces transport services as a third input in the production function depending on the level of public investment and the rate of utilisation.
[4] Alternatively, we could model G_1 as a determinant of the technology term, A. The analysis would be identical with the additional advantage of making a negative impact of the underlying public expenditure type of multifactor productivity growth more intuitive. Instead, we choose to model G_1 as a separate input with the purpose of providing continuity to the literature initiated by Aschauer (1989).
[5] Romp and de Haan (2007) include a survey of the literature in which they highlight the main advantages of modelling public capital by including it in a cost-function in contrast to other alternatives, like the production function.
[6] The introduction of this type of public expenditure usually responds to rigidities in the capital markets: Demetriadis and Mamuneas (2004) consider adjustment costs; Moreno et al. (2003) assume short term rigidities; and Devarajan et al. (1998) instead introduce it as a response to the existence of a positive externality attached to the subsidised capital.
[7] Our model assumes that public expenditure on G_2 provides an incentive to private investment, although it could also have the opposite effect. Alesina et al. (2002), for example, present evidence of the negative impact of public wages expenditure on private investment and profits.

$$G_{2,t} = (1 - s_t) K_t \,. \tag{2}$$

G_3 is the labour-enhancing type of expenditure and is modelled following Agenor (2007). It represents those types of public expenditure that may induce the entry of more labour force on the market, or increase human capital, such as public expenditure on education or social programmes. We assume a labour supply that depends on the level of public expenditure on G_3, the level of population and the real wage:

$$L_t = \tilde{w}_t^{\mu} G^{\nu}_{3,t} N^{\eta}_{t} \tag{3}$$

where N_t represents population and $\tilde{w}$ is the equilibrium real wage of labour supply, net of income taxes. The parameters μ and η are assumed to lie in the interval (0,1), but we have to also accept the possibility of negative values of ν, since public policies that create disincentives to the entry of additional labour supply on the labour market can exist. Those policies could be unemployment subsidies or wage pressures induced by the public salaries.[8]

Finally we consider a type of public expenditure that is directly consumed by the households, entering therefore in their utility function (G_4). We assume a Cobb-Douglas type utility function for the representative infinitively lived agent, as in Turnovsky (1996)[9], although we do not consider congestion:

$$U_j = \sum_{t=j}^{\infty} \beta^t C_t^{\theta} G_{4,t}^{(1-\theta)} \,. \tag{4}$$

On the other side of the public budget, we will consider three types of taxation: taxes on consumption, taxes on corporate profits, and taxes on labour income; all three under the form of a constant tax rate represented respectively by the parameters τ_c, τ_π and τ_l.

[8] Dhont and Heylen (2007) present theoretical and empirical evidence of the negative impact of subsidies, productive government expenditures and income taxes on labour supply in Europe in contrast to the US.
[9] Ganelly and Tervala (2007) also include a type of public expenditure in the household's utility function together with productive public investment entering in the production function, in an open economy framework. In addition, they are able to estimate the impact of the distribution of public expenditure also on foreign behavior and exchange rates.

We will not consider taxation on capital income since its share in public revenues is insignificant in the set of countries in which we focus our analysis, and since Chamley (1989) there is a relative consensus in the literature about its perverse effects.[10]

The representative household is the owner of the capital and of the firms and provide labour supply. She get revenues from all those three activities, since in our economy with a publicly provided input, firms obtain positive profits. She has to choose the share of their income that they want to consume or to invest in additional capital for the next period, and in addition they have to pay taxes on labour income, on corporate profits and on consumption. If we assume a linear tax rate in every case, the households would face the following budget constraint:

$$(1+\tau_c)C_t + s_{t+1}K_{t+1} = (1-\tau_l)w_t L_t + (1-\tau_\pi)\pi_t + r_t K_t \qquad (5)$$

where τ_c, τ_l and τ_π are the previously defined tax rates on consumption, labour income and corporate profits respectively, assuming total depreciation of the physical capital, K. π_t represents corporate profits and r is the equilibrium price of private capital paid by firms to its owners. The representative agent takes the decisions of the government about taxes and public expenditure as exogenous. In every period, she decides on how to distribute her income between private capital and current consumption. Wages and cost of capital are determined by the market. She consumes to maximise her utility function (4) subject to the budget constraint (5) and her consumption path would be driven by the following Euler equation:

$$\frac{C_t}{C_{t-1}} = \frac{G_{4,t}}{G_{4,t-1}}\left[\frac{\beta\alpha}{s_t}\{(1-\tau_\pi)\delta + (1-\tau_l)\gamma + \alpha\}\frac{Y_t}{K_t}\right]^{\frac{1}{1-\theta}}. \qquad (6)$$

Therefore, the dependency of the process of capital accumulation on corporate profits and labour income taxes, as well as the consumption public good G_4 it is revealed. In this environment, a constant tax rate on consumption does not represent an obstacle for investment or growth.

[10] This result has been questioned by other studies, for example, by Correia (1996) and Huffman (2001).

From equations (1) to (6) we can determine the effect of a permanent increase on any of the fiscal variables. After log linearising and plugging in the expressions for labour and capital in equation (1) we can write the following derivatives, for each of the four types of public expenditure:

$$\frac{\partial y_t}{\partial g_{1,t}} = \frac{\delta(1+\mu)}{\Phi} \quad , \tag{7}$$

$$\frac{\partial y_t}{\partial g_{2,t}} = \frac{\alpha(1+\mu)}{\Phi} \quad \frac{(1\text{-}s_t)}{s_t} \tag{8}$$

$$\frac{\partial y_t}{\partial g_{3,t}} = \frac{\nu\gamma}{\Phi} \quad , \tag{9}$$

$$\frac{\partial y_t}{\partial g_{4,t}} = \frac{(1-\theta)(1+\mu)\alpha}{\Phi} \quad . \tag{10}$$

where $\Phi = (1-\alpha)(1+\mu)-\alpha\mu$ and the fiscal variables in small letters denote growth rates obtained from log-linearisation.[11]

The derivative of the growth rate with respect to $g_{4,t-1}$ has an identical absolute value as the one for $\frac{\partial y_t}{\partial g_{4,t}}$ but with the opposite sign. That means that a permanent increase in public consumption only produces a short-term effect in the economic growth rate which will be corrected in the period after. In contrast, the effects of a change in the growth rates of the capital enhancing public expenditure, G_2, the labour enhancing public expenditure, G_3, and the public production factor, G_1, are permanent and depend on the elasticities of substitution of the respective factors.

Identically to public consumption, a permanent change in the tax rate of consumption taxes would not induce changes in the long-term growth rate, since consumers would

[11] For example, $y_t = (dY_t / dt) / Y_t$.

not change their pattern of investment and consumption, even though there would be short-term fluctuations. Indeed, this is explained because the intertemporal elasticity of substitution between present and future consumption remains unchanged if the representative consumer takes the change in the tax rate as permanent.

However, changes on the other two direct taxes, labour income tax and corporate income tax, have implications for the growth rate of production since they alter the decisions of the agent on consumption and investment. In the case of labour income tax, it also influences the labour supply. The derivatives of the growth rate of production with respect to a marginal decrease in the labour and corporate profits tax rates respectively are:[12]

$$\frac{\partial y_t}{\partial (1-\tau_{l,t})'} = \frac{\alpha(1+\mu)}{\Phi} \frac{\gamma}{(1-\tau_{\pi,t})\delta + (1-\tau_{l,t})\gamma + \alpha} + \frac{\mu\gamma}{\Phi(1-\tau_{l,t})}, \qquad (11)$$

$$\frac{\partial y_t}{\partial (1-\tau_{\pi,t})'} = \frac{\alpha(1+\mu)}{\Phi} \frac{\delta}{(1-\tau_{\pi,t})\delta + (1-\tau_{l,t})\gamma + \alpha} \quad . \qquad (12)$$

Both types of direct taxes have a negative impact on economic growth, as can be seen from (11) and (12). Labour taxation produces a – smaller – disincentive on private investment because of the increases in labour costs which are induced by the tax (represented by the first term inside the brackets in (11)). But its main impact on growth would be produced by the reduction in the labour supply represented by the second term of equation (11), which is a consequence of the smaller wages, net of taxes, perceived by the workers. Corporate profits taxation acts through a reduction on private investment because of the disincentive to invest introduced by the tax.

We have included several types of public expenditure and taxes, not only to see how the magnitude of the impact on economic growth differs according to the channel through which they act, but also to assess how they may be identified in growth regressions. We have already seen that although G_4 provokes an immediate impact on economic growth, the long-term effect is insignificant. G_1, G_2 and G_3 induce permanent effects on growth,

[12] Where we have, for instance, $(1-\tau_{l,t})' = d(1-\tau_{l,t})/dt$.

but through different channels. If we consider the effects on labour productivity instead of on production growth (defined as production per worker), the effects of G_1, G_2 and G_4 would remain practically unaltered vis-à-vis equations (7), (8) and (10) However, instead of equation (9), G_3 will have an opposite impact on labour productivity in comparison to that on production:

$$\frac{\partial lab_t}{\partial g_{3,t}} = \frac{\nu}{1+\mu}\left(\frac{\gamma}{\Phi} - 1\right). \qquad (13)$$

This is an expected result, as a determined type of public expenditure boosts (or diminishes) production growth by increasing (decreasing) labour supply. However, we should expect an opposite effect on labour productivity because of the decreasing returns to scale to a single factor of the Cobb-Douglas production function.

Finally, if we consider Total Factor Productivity (TFP), defined as the Solow residual, G_2, G_3 *and* G_4 would have no effect on multifactor productivity while G_1 still has an effect given by $\frac{\partial TFP_t}{\partial g_{1,t}} = \delta$.

Identically to the situation described for public expenditure, taxation on labour income will have an impact on labour productivity growth (*lab*) which is significantly different from the one that it produces on production growth, because of the decreasing returns to scale in a single factor of the production function:

$$\frac{\partial lab_t}{\partial (1-\tau_{l,t})'} = \frac{\alpha}{\Phi}\frac{\gamma}{(1-\tau_{\pi,t})\delta + (1-\tau_{l,t})\gamma + \alpha} + \frac{\mu}{(1+\mu)(1-\tau_{l,t})}\left(\frac{\gamma}{\Phi} - 1\right). \qquad (14)$$

Indeed, the effect of the tax on labour productivity through the alterations of labour supply represented by the second term inside the brackets in (12), has an opposite sign since a reduction in labour supply would induce a smaller production growth, but a larger productivity of labour and vice versa.

The following table summarizes the main relationships of the seven fiscal variables analysed in the model with production, labour productivity and multifactor productivity:

[Table 1]

3. Empirical specifications

3.1. Existing literature

Barro (1991) is the first main reference to use cross-sectional data to estimate the effect of fiscal variables on economic growth. He uses a sample of 98 countries and a significant variety of variables to estimate their long-term impact on economic growth. The estimated static equation employs the growth rate of GDP for a long period, as the dependent variable (of a minimum of fifteen years). Regarding fiscal variables, the study finds a negative significant correlation of public consumption with growth and no significant effect for public investment.

Other studies refined the methodology by including the time dimension of the panel (Easterly and Rebelo, 1993) and also the first critics about the accuracy of the results obtained. Levine and Renelt (1991) provide a review of cross-country growth regressions and enumerate the significant discrepancy that exists in the results, while Levin and Renelt (1992) show that the results obtained with the growth regressions are very sensitive to small variations in the conditioning information set.

A first attempt to answer the critics was made by Devarajaan et al. (1996), who make use of economic theory and claim that the effect on growth induced by some kind of public expenditure may depend on the initial level of expenditure. That is probably one of the reasons why subsequent work did not include developed and developing countries in the same panel, which had been quite a common practice in previous studies. Indeed, the use of a more homogeneous panel country sample seems to be a more adequate approach.

Kneller et al. (1999) pointed out and explained the inconsistencies in the results of previous studies. They claimed that the estimated coefficients attached to the fiscal

variables have to be interpreted by using some financing assumption. In other words, the elements of the public budget that are not included in the regression, represent the implicit financing assumptions of the effects of the included variables.[13] To avoid perfect multicollinearity, at least one of the components of the public budget must be omitted. If we estimate a coefficient attached to the included components of the budget, this estimated coefficient assumes that the increase or decrease in the respective fiscal variable is financed by an equivalent alteration in the omitted variables

Kneller et al. (1999) also address two traditional critics to growth regressions: the possible endogeneity of the fiscal variables and the consequences of the 5-year averaging that was usually applied to growth series in order to control for the business cycle effects. They compare the results from the fixed-effects linear model estimated by OLS, with those from an instrumental variable estimation to conclude that the previous results were not produced by the endogeneity of the variables. Moreover, they also find that the results are sensitive to the 5-year averaging of GDP growth. On the other hand, Odedokun (2001) uses the 5-year moving average, arguing that it is an optimal method to cater for the endogeneity of fiscal variables.[14] Additionally, and also using 5-year averages, Folster and Henrekson (2001) report significant negative growth effects for total government spending in an OECD country sample.[15]

Bleaney et al. (2001) confirm the volatility of the results when the variables are expressed as a 5-year moving average. By comparing the estimation of their baseline model with its dynamic counterpart, they conclude that the sensitivity of the estimations, when variables are expressed as 5-year moving averages, is due to the fact that the effects of fiscal variables on growth show up in the long-term. They also interpret the differences in the coefficients with the models estimated with annual data

[13] This idea was already described by Miller and Russek (1997) and applied to two samples of 16 developed and 23 developing countries although they do not test to what extent the ignorance of the budget constraint of the government may be a source of bias, which is the main focus in Kneller et al. (1999).
[14] He divides his sample of developing countries into four groups and finds a negative effect from public expenditure on growth (except for grants), a negative effect from current expenditure and, in the case of mineral exporting and high-income countries also a negative effect from capital expenditure. The effects of transport and health are quite variable, while education would promote growth in all groups. The effects of external grants are also unclear.
[15] Agell et al. (2006) question these results notably on the basis of endogeneity issues.

as a result of the existence of endogeneity of fiscal variables that would bias the estimation of the coefficients with annual data.

Bassanini and Scarpeta (2001) rely on the Pooled Mean Group Estimator, developed by Pesaran et al. (1999), which constrains the long-term relationship of the explanatory variables with economic growth to be identical across countries while allowing the possibility for heterogeneous short-term effects, which are estimated separately. Their argument is that the divergence of previous results could be provoked by the existence of heterogeneity among countries in the short-term. They estimate a positive impact of public expenditure on growth, but also a stronger negative impact of taxation that imply a negative total effect of increasing the size of the budget. An increase in public investment would enhance growth regardless of the increase in taxation necessary to finance such investment effort.

Romero de Avila and Strauch (2007) also estimate short-term and long-term effects of the fiscal variables on growth in the same equation, but using a different approach, which is based on Jones (1995). The method relies on the specification of an equation based on an AK model with non-stationary fiscal variables (in levels) to discriminate the long-term effect on growth from the short term effect attached.[16]

Finally, Gupta et al. (2005) consider the possibility of an autoregressive term to account for the dynamic behaviour of growth, rather than using data-averaging. They are able to show that for a panel of developing countries, the importance of discriminating government deficit on the basis of the source of the loans. In other words, whether the deficit is financed by issuing public debt or from an international loan, since the issue of domestic debt may induce additional distortion in the factor markets. Table 2 summarizes some of the existing approaches and results.

[Table 2]

[16] Tomljanovich (2004) uses a similar analysis for the US States.

3.2. Dynamic impact of public finances on long-term growth

Traditionally, the relationship of economic growth to fiscal variables has been estimated under the form of a static model in which the use of variables expressed in large frequency periods – usually five years – accounts for the long-term relationship.[17] However, and as discussed above, some studies revealed the volatility of the results due to the averaging process of the variables.[18] Two main weaknesses have been identified as the source of the lack of robustness of the results: the endogeneity of the fiscal variables used to explain economic growth and the definition of the long-term relationship under the data averaging.

The endogeneity issue has been accounted for in several studies with the use of IV techniques.[19] The use of yearly data to estimate long-term relationships implies setting up a new framework yielding more reliable estimates. As already mentioned, several authors have proposed alternative models. Bassanini and Scarpetta (2001) propose the use of the Pooled Mean Group Estimator to discriminate short-term idiosyncratic effects from long-term common effects. Romero de Avila and Strauch (2007) also consider the discrimination of long-term effects, but rely on the non-stationary behaviour of the fiscal variables in levels and their cointegrating relationship with growth. Gupta et al. (2005) instead propose the estimation of an AR(1) model with the fiscal variables expressed in the usual static form, as percentages of GDP.

Our view is that the relationship of fiscal variables to growth is dynamic by nature, and the lack of precision of previous estimates could be related to the omission of these dynamics. In addition to the autoregressive behaviour of economic growth, fiscal variables may induce an impact on growth distributed across several periods. That may be particularly relevant for several categories of public expenditure, which might induce a certain impact in the economy in the period in which they are actually realised, and a different impact in subsequent periods.

[17] While some studies use 5-year averaging in all variables (Kneller et al. 1999, and Bleaney et al 2001), others regress five-year forward looking moving average of GDP growth (t+1,t+5) on yearly expressed fiscal variables (at time t) to refrain from endogeneity (Devarajan et al., 1996, and Odedokun, 2001).
[18] See Levine and Renelt (1992), Kneller et al. (1999).
[19] See Bleaney et al. (2001) and Gupta et al. (2005).

This motivates our proposal to model the growth equation as an Autoregressive Distributed Lag (ARDL) model, including lags of dependent and fiscal variables:

$$y_{i,t} = \mu_i + \nu_t + \sum_{j=1}^{p} \lambda_j y_{i,t-j} + \sum_{s=0}^{q} \delta_s fiscal_{i,t-s} + \rho_i other_{i,t} + \varepsilon_{i,t} \qquad (15)$$

where the index i (i=1,…,N) denotes the country, the index t (t=1,…,T) indicates the period. μ_i and ν_t are the unit specific and the time specific effect respectively. The unit specific effect accounts for the time-invariant idiosyncratic characteristic of every country, such as its initial level of GDP or human capital, natural resources, etc.[20]

In (15) y indicates the logarithmic growth rate of per capita output, *fiscal* is a set of fiscal variables and *other* is a set of non-fiscal variables to be included in the growth regression.

We propose to estimate equation (15) using the GMM estimator developed by Arellano and Bond (1991). The GMM estimate controls for endogeneity by using the lagged values of the levels of the endogenous and of the predetermined variables as instruments. It is necessary to test for the validity of the instruments as well as for the presence of serial correlation in the residual once the specification has been estimated.[21]

Estimates have been obtained using the one step procedure, since the two step procedure has been found to yield biased downward standard errors for small samples. Arellano and Bond (1991) also develop a one step robust procedure for the cases in which heteroskedasticity exists, but we think that there is no need to use the robust estimator in this study due to the characteristics of the data. The Sargan test of over identifying restrictions over-rejects in the presence of heteroskedasticity with the one step procedure. In our case this would not be a drawback since the data are not suspected of heteroskedasticity and in any case the Sargan test cannot reject the null

[20] The time-specific effect has been finally removed from our estimated equation. Preliminary results including time-dummies (available upon request) reveal that there are no significant time effects in our sample period.

[21] Although Arellano and Bover (1995) and Blundell and Bond (1998) improve the efficiency of the "difference GMM" estimator by introducing additional assumptions of no correlation between the fixed-effects and the first differences of the instrumenting variables, a hypothesis which we do not assume.

hypothesis that the over-identifying restrictions are valid. But the estimated coefficients from equation (15) are still difficult to interpret. We cannot asses with certainty whether one variable has a relevant impact on growth, particularly if we estimate coefficients with opposite signs for several lags of the same fiscal variable. For that reason, we want to derive a unique coefficient that includes all the lags of every explanatory variable as well as the autoregressive terms.

We will assume an economy in its steady state in which all variables grow at a constant rate in order to get a unique long-run coefficient for each fiscal variable. If we impose identical values for the variables over time we can work out long-run coefficients:

$$long-run = \frac{\sum_{s=0}^{q} \delta_s}{1-\sum_{j=1}^{p} \lambda_j}. \qquad (16)$$

Standard errors for the coefficients obtained with this procedure may be easily computed applying a delta method which consists of expanding a function of a variable about its mean with a one-step Taylor approximation and then taking the variance. A general discussion of this method can be found in Wooldridge (2002) and Papke and Wooldridge (2004).

4. Empirical analysis

4.1. Data

Our dataset covers the period 1971-2006 for 15 EU Member States, although we also use a smaller time sample for the 12 new Member States that have joined the EU after 2003.[22] The fiscal variables refer to the consolidated general government and are expressed as ratios of GDP.

[22] The EU15 countries are: Belgium, Germany, Greece, Spain, France, Ireland, Italy, Luxembourg, Netherlands, Austria, Portugal, Finland, Denmark, Sweden and United Kingdom. The new member states are: Czech Republic, Estonia, Cyprus, Latvia, Lithuania, Hungary, Malta, Poland, Slovenia, Slovakia, Romania and Bulgaria

Regarding public expenditure, we focus our analysis on the economic classification while we also use a smaller time sample for the main functional categories of public expenditure. Our analysis excludes those variables that have a residual importance on the public budget or whose interpretation is not clear. As for the functional categories of public expenditure, we focus our attention on four out of the ten categories (according to the COFOG classification), that account for broadly two thirds of the total budget.

In addition we have included four control variables: labour force growth, private investment, terms of trade and population growth. The inclusion of the production factors related to capital increase (proxied by private investment) and labour force growth follow from the theoretical model presented before and are in line with the related literature. Population growth may determine the growth of the dependent variables as long as it is expressed in per capita terms. Several studies have suggested the relevance of terms of trade or the presence of a similar variable representing the economic openness of a country.[23]

Our data source is the European Commission Ameco database and in the Data Appendix we illustrate each fiscal variable in terms of GDP ratios at the beginning and at the end of the samples and provide correlations between the main variables. Table 3 reports the descriptive statistics for the full panel sample, while Figure 1 presents some trends, regarding country groups, for GDP and selected fiscal variables. We can see how expenditure and taxation in the group of countries that have grown faster have followed a different pattern of behaviour with respect to the group of countries with smaller growth. In the early nineties, the Group A countries start to growth faster than the richer countries in Group B. This coincides in time with a change in the trends for public consumption and public investment, also growing faster in Group A from this point onwards. However, it also coincides with a relative increase of public revenues: social contributions and direct taxation. This analysis does not guarantee that the causal relation goes from the fiscal variables to production and not the other way around, but it suggests that it could be important to scrutinise the relationship more closely.

[Table 3]

[23] See, for instance, Odedokun (2001), Bose et al. (2003) and Gupta et al. (2005)

[Figure 1]

The unit specific term in our panel model takes into account the effect of time invariant variables, whose impact have been suggested by previous analysis, such as initial levels of GDP or human capital.[24]

Based on preliminary estimations, we have not included time dummies in our model. These would show no statistical significance and would induce no relevant changes in the estimations, apart from slightly larger values for the standard errors in general.

4.2. Initial results for growth specifications

Table 4 reports the results for the EU15 data set for the period 1971-2006. A key point to make a correct interpretation of the estimated coefficients is the importance of the omitted variable on each regression, as described in Kneller et al. (1999). Therefore, in columns 1 to 4 in Table 4 we compute the impact of an increase of several categories of public expenditure on economic growth. The omitted variables represent the underlying assumption about how to finance the additional expenditure in the particular type of public spending item. In all cases, the omitted variables are the remainder of the public expenditures. That means that the interpretation of the coefficient associated with public consumption, for example, reflects the increase in growth that would induce an increase[25] in public expenditure in consumption associated with an equivalent decrease in the rest of public expenditure to finance it.

[Table 4]

In columns 5 and 6 we aim to seek the effect on growth of different kinds of taxes. The omitted variables are the remaining public revenues. Therefore, the estimated coefficients reflect the impact on economic growth induced by an increase of one

[24] As proposed by Kneller et al. (1999), Bose et al. (2003) and Reed (2006) among others.
[25] That is, the increase in the logarithmic growth rate of per capita GDP induced by a one point increase in public expenditure, expressed as a percentage of GDP. The estimated coefficients are relative to those of the omitted variable. In this respect, the comparison of the several models on each table may be useful to yield conclusions about the variables driving changes on growth and productivity.

percentage point in the particular type of revenue, financed by an equivalent reduction in the remaining (omitted) sources of revenues. The interpretation of the other fiscal variables (deficit, total public expenditure) follow a similar argument and the estimated coefficients assume that the alterations of the variables would imply the fulfilment of the budgetary identity by modifying the elements of the budget items that are not present in the estimation.

The coefficients shown in Table 4 are the long-term coefficients computed through equation (16) from the coefficients estimated in equation (15) using the Arellano and Bond (1991) GMM estimator. Column 1 reveals a clear negative relationship of public consumption with economic growth. A slightly statistically significant and negative coefficient has also been estimated for social transfers, while for the other determinants of current public expenditure, wages and subsidies, we cannot find a coefficient significantly different from zero.

Public investment enhances economic growth in the long-term, as revealed by the estimated coefficient of around 0.65 (see column 4). That means that an increase in public investment of a percentage point of GDP, financed by an equivalent decrease in current public expenditure (omitted variables), would induce an increase in the growth rate of per capita GDP of around 0.65 percentage points.

The overall effect of public revenues is estimated to be negative as shown by the coefficients attached to that variable in columns 1 to 4. The estimated coefficient is relative to the omitted variables of public expenditure Therefore it is not surprising that the coefficient estimated in column 4 is larger in absolute value since the omitted variables include all public expenditure except public investment.

In columns 5 and 6 we disaggregate the implications of public taxation in economic growth. The estimated coefficients are not extremely significant, which could be an indicator that governments properly accommodated tax distribution. Nevertheless, the significantly negative coefficient attached to social contributions could reveal that a slight decrease in this revenue item reallocated to higher indirect taxation could have helped to promote economic growth in our sample (although the estimated coefficient for indirect taxes is not statistically significant).

The negative coefficient attached to total public expenditure in columns 5 and 6 is not a surprise, taking into account the results described in columns 1 to 4. In the light of the results, there could have been a situation of overspending in our panel sample that has retarded economic growth.

With regards to the control variables, their respective estimated coefficients are in line with previous studies. The budget deficit always has a positive effect on long-term growth, even if it is not always statistically significant. For instance, Kneller et al. (1999), also find a positive coefficient attached to the budget deficit for a panel of OECD countries.

The positive coefficient attached to private investment follows from standard economic theory, in which an increase in the amount of production factors will naturally induce an increase in production. The same reasoning can be applied to the variable labour force, although a negative coefficient has been estimated by previous studies with data from developing countries (Odedokun, 2001, Bose et al., 2003), this may be a consequence of the definition of the dependent variable in per capita terms.

The coefficient attached to the terms of trade is usually positive for developing countries since trade is assumed to be growth-enhancing. However in our sample of European countries, international trade is largely developed and the estimated negative coefficient may be provoked by the perverse impact of the faster capital accumulation on trade importance as mentioned by Acemoglu and Ventura (2001).[26]

Some of our results are in line with previous studies. Of course, we also expect different results from studies including diverse panel samples, particularly when we compare developed and developing countries. For example, Devarajan et al. (1996) find a negative coefficient associated to public capital expenditure in their panel of 43 developing countries, for the period 1970-1990, revealing a possible situation of overspending in public capital during this period. Odedokun (2001) also finds a negative coefficient attached to public capital expenditure on his sub-sample of

[26] Miller and Russek (1997) estimate a positive coefficient associated to their variable openness while Gupta et al. (2005) find a negative coefficient attached to the terms of trade.

developed countries. On the other hand, Romero de Avila and Strauch (2007) and Bassanini and Scarpetta (2001), both using data very similar to ours, estimate a positive coefficient for EU and OECD countries. Additionally, Gupta et al. (2005) also find a positive coefficient for public capital expenditure in their sample of 39 low-income economies.

Odedokun (2001) estimates a positive coefficient attached to the public expenditure in wages while Gupta et al (2005) estimate a negative coefficient attached to wages and salaries. However our study shows no significant coefficients attached to this variable.

Our negative coefficient attached to social transfers can be related to the results by Kneller et al. (1999), who estimate a negative coefficient associated to their variable 'non-productive expenditures', whose main component is social security and welfare policies. For this budgetary item, our results are also in line with the ones reported by Romero de Avila and Strauch (2007). However, Cashin (1994) estimates a positive coefficient associated to this variable for a panel of 23 developed countries, using fixed and random effect estimation.

Regarding the composition of public revenues, several studies find a negative impact of general taxation on growth: Bose et al. (2003) for developing countries, Reed (2006), and Basanini and Scarpetta (2001) for developed economies.

Kneller et al. (1999) estimate a negative effect of 'distortionary taxation', which included direct taxes and social security contributions, for OECD countries. They find no significant effect for non-distortionary (indirect) taxation. Their results are in line with our estimations while the positive coefficient estimated for direct taxation by Romero de Avila and Strauch (2007) does not coincide with our results.

4.3. Time consistency of the results

Some studies suggest the possibility that there has not been a constant relationship between fiscal variables and growth, especially because of the change on the impact of public investment in growth and in productivity (Caselli et al., 2000 and Afonso and St. Aubyn, 2007). The two aforementioned studies are able to identify a break in the return

to private and public investment in a set of European countries at the beginning of the nineties. Therefore, we want to assess the evolution of the impact of our fiscal variables in economic growth by splitting our sample into two, with the break point in 1990. Tables 5 and 6 present the results for the two sub-periods: 1971-1989 and 1990-2006.

[Table 5]

[Table 6]

With regards to public expenditure, the behaviour of public consumption, social transfers, subsidies, and total public expenditure seems reasonably steady over time. On the contrary, compensation of employees and especially public investment has changed their impact on growth towards a less beneficial situation. In the second half of the sample a situation of overspending appears to exist in public wages, which could be growth retarding. Public investment has passed from being growth enhancing in the first sub-period of the sample to have a statistically null effect in the second sub-period (see column 4).

There are also some changes in the revenue side. The increase in revenues from direct taxation and social contributions in the first two decades of the time sample may have been excessive, making indirect taxation more desirable to promote growth.

4.4. Using 5-year growth averages

As mentioned before we have used a new approach in our paper. The standard approach of static modelling previously used to estimate the effects of fiscal variables in economic growth, under the argument that the omission of the dynamic in the relationships between the variables, may lead to biased estimates. Therefore, it is interesting to assess to what extent our methodology produces different results, under a static specification and using a five-year forward-looking moving average of per capita GDP growth as dependent variable, as done, for example, by Devarajan et al. (1996) or Odedokun (2001).

Table 7 presents the results, and we can observe relevant differences in some coefficients. In particular the smaller absolute value for public consumption, the level of significance of public wages, public subsidies and public investment, and the sign attached to indirect taxation. In terms of the control variables we can also see some variations in the signs and levels of significance.

[Table 7]

Our argument is that the averaging process is not able to capture the dynamics that we can show to exist in the impact of the fiscal variables on growth. This causes the estimated coefficients under the traditional static models to present a significant bias.

4.5. Labour and total factor productivity

Tables 8 and 9 report the results of estimating equation (15) using respectively labour productivity and multifactor productivity as dependent variables. The objective is to be able to identify which types of public expenditures and revenues enhance economic growth by boosting labour supply, private capital or factor productivity. Our methodology also allows to identify fiscal variables that may have an impact on economic growth in the short-term, but have no long-term effect, as it happened to G_4 (publicly provided consumption good) or τ_c (consumption tax) in our theoretical model.

In Table 1 we summarised the description of the link that we established between the type of public expenditure and the result of estimations in Tables 4, 8 and 9. However, we have to consider the possibility that some fiscal variables may simultaneously affect economic growth through several channels.[27] Our tables report the long-term coefficients computed according to equation (16). Therefore, they do not reflect the short-term dynamics that could appear in the direct estimations of equation (15) and that could serve to identify which fiscal variables could behave like G_4 and τ_c.[28]

[27] For the sake of simplicity our theoretical framework only includes one channel of impact for every type of public expenditure and taxation. Public expenditure on wages, for example, could simultaneously behave as the productivity-enhancing and the capital-enhancing types of public expenditure. Social contributions may have a short-term effect similar to the one described in the case of consumption taxes in addition to the long-term effect attached to the profit-tax described in our theoretical model.
[28] The estimations that used to compute the long-term coefficients are available on request.

[Table 8]

The comparison of tables 4 and 8 should allow us to identify which categories of public expenditures and taxation have an impact on production through alterations in the labour market, similar to the one described for G_3 and τ_l in section 2. Those would be the fiscal variables for which the estimated coefficients are significantly different in both tables. We observe no big differences between both estimations. We are only able to identify some changes in the estimates for social transfers, public investment and slightly in social contributions.

The capital-enhancing type of public expenditure (G_2) and revenues of the type of the corporate profits taxation (τ_π), in contrast to G_3 and τ_l, should appear with similar coefficients in Tables 4 and 8, since their effect on GDP and labour productivity is almost identical. All of them (G_2, τ_π, G_3 and τ_l) have no effect on TFP.

Table 9 presents the estimations using Total Factor Productivity growth as dependent variable and any variable showing a significant coefficient behaves as the productivity-enhancing type of public expenditure (G_1) described in section 2. Those types of public expenditure should, in addition, yield a similar result when used as regressors in estimating GDP or labour productivity growth. If this is not the case, the underlying variable may impact economic growth through another channel in addition to the effect on multifactor productivity.

[Table 9]

However, this seems to be the case for public consumption, public wages and public investment. The absolute estimated coefficient attached to public consumption is clearly smaller than the one estimated in Tables 4 and 8. Public wages appear with a negative coefficient only in Table 9. According to our model, this would mean that both variables should have a simultaneous impact on growth, through multifactor productivity. The sign of the capital-enhancing effect would be positive in the case of public wages and negative in the case of public consumption.

The effect of public investment should also be examined carefully. It seems as if the level of investment is too high and this negatively affects multifactor productivity. But this negative impact would be counterbalanced by both a higher propensity to invest (the so-called crowding-in effect) and an increase in the labour supply induced by public investment.

With regard to the tax variables, we do not find many surprises in the results. As expected, taxes have no relevant effect on multifactor productivity. But it also seems that neither do they have a visible impact on labour supply according to the estimates for labour productivity growth, even for labour tax. The main effect would be caused by alterations in the pattern of consumption and private investment. Table 10 summarises the link of the findings on the estimations in this sub-section with the theoretical framework developed in section 2. This table has been constructed from the comparison of Table 1 with the results shown in Tables 4, 8 and 9. The variables used in our estimations are attached to one or more theoretical categories of public expenditure or taxation according to their relationship with GDP, labour productivity and total factor productivity.

[Table 10]

4.6. EU new Member States

Table 11 presents the results of the estimates for the sub-sample of 12 EU new Member States. Since the data availability for this set of countries is less extensive we can only do estimates for the second sub-sample period, 1990-2006.

[Table 11]

The level of expenditure-to-GDP ratios is similar to the sample of EU15, but it seems as if public expenditure has been slightly less growth friendly in this set of 12 countries for the period considered. A remarkable difference is the effect of indirect taxation, while in the EU15 sample the results seem to point to a reallocation of tax revenues towards indirect taxation, in the EU12 sample the coefficient accompanying indirect taxation is

negative and statistically significant. The negative effect of social contributions is also quite noticeable. The main drawback of this table is the relative small set of observations used due to the lack of data for some of those countries at the beginning of the sample period.

4.7. Functional spending

Table 12 shows the results of regressing growth on the main four functional categories of public expenditures: economic affairs, health, education and social protection.[29] The omitted variables are the remaining types of public expenditure in every case.

[Table 12]

The results reveal that there is a certain level of overspending in health and eventually in social protection, while public expenditure in education seems to be extremely productive in the long-run.

These results do not contradict previous findings for other sets of countries. For example Odedokun (2001) estimates a positive coefficient attached to education in the whole sample and a negative coefficient attached to health, but only in the sample of developed countries. Bose (2003) also finds a positive coefficient attached to education while for OECD countries Bleaney et al. (2001) estimate a positive coefficient attached to the variable "productive expenditures" that includes education, health, transport and communications and general public services among others. While Kneller et al. (1999) find an insignificant coefficient attached to the variable "non-productive expenditure", we now estimate a negative coefficient for social protection, and this was also the case for social transfers in the economic classification. Interestingly, we find a positive and statistically significant coefficient for economic affairs. These two spending functions, together with recreation, are included in the variables "unproductive expenditure" in Kneller at al. (1999).

[29] The other functional categories of public expenditure according to the COFOG classification are: General Public Services, Defence, Public Order and Safety, Environment Protection, Housing and Community amenities and Recreation, Culture and Religion. We have omitted them from the analysis in order to focus the attention to the categories yielding more interesting results. Our four categories accounts for almost 2/3 of total public expenditure and more that 30 percent over GDP.

5. Conclusion

The link between the composition of the expenditure and revenue sides of the budget and economic growth has been the focus of recent developments in endogenous growth theory. Several studies have proposed different channels through which public expenditure and taxation could affect economic growth and productivity. In particular, fiscal policy has been assumed to be able to affect production by altering the pattern of consumption and investment of the economy by introducing incentives and disincentives in the utility and productivity of the individuals that affect the equilibrium in the labour market, and, in the case of public expenditure, also as a separate input that comes in the production function. We want to introduce this debate also into the empirical literature by comparing the results of estimating three alternative dependent variables in a growth regression.

On the empirical side, the latest efforts have tried to find a commonly accepted framework to model the impact of the distribution of the public budget on economic growth, as a response to several drawbacks found in the traditional methods used in the nineties. Panel data models seem to be a generally accepted framework to estimate the impact of fiscal policies on economic growth as long as there is some degree of homogeneity among the units included in the sample. We propose the estimation of a dynamic panel data model with lags of the explanatory variables (ARDL) from which we will be able to compute long-term relationships. This methodology allows us to deal with the main critics done to previous studies: the presence of endogeneity, the dynamic behaviour of the relations and the omitted variable issue.

Using data for the 27 countries in the EU for the period 1971-2006, we are able to identify the negative impact of public consumption and social security contributions on economic growth, and the positive impact of public investment. Our regression results suggest that an overall situation of excessive expenditure may exist in the oldest members of the EU in contrast to a negative impact of social transfers, subsidies, public wages and direct taxation in the new members. On functional expenditure the study points to a negative impact of health and social protection expenditures on production and the growth-enhancing behaviour of public expenditure in education.

Unlike previous studies, we try to better accommodate our results to the developments of economic theory by identifying the channels through which each budgetary category may impact on production growth. Our regressions for labour productivity and TFP, as alternative dependent variables, reveal that the main impact of fiscal variables comes through alterations in the pattern of investment of the economy. We are able to identify the existence of a crowding-in effect of public investment into private investment that provokes an overall positive effect of public investment on economic growth, despite its negative impact on multifactor productivity. Social expenditures and public investment seem to also affect the labour market while public consumption and public wages have a significant impact on multifactor productivity.

This analysis can be improved in many ways: the impact of public expenditure on private investment and the labour market may be addressed in a more specific context. The definition of public expenditure may be extended to include other transfers from supranational levels of government. In particular our case could address the impact of the direct transfers from the European Commission to the private sector through agricultural and regional policies. Finally, the decomposition of public expenditure attending to the level of government could also yield interesting results, since the level of fiscal decentralisation and structures are still very heterogeneous in our set of European countries.

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Data appendix

Table A1 – Definition of variables and data sources

GDP data		
MArpcGDP	Five-year forward-looking moving-average of per capita GDP	Moving average from data at current prices
logpcGDP	Log of real per capita GDP growth rate	Growth rate from data at current prices
logLAB	Log of Labor productivity growth rate	Growth rate from data at current prices
TFP	TFP growth rate	Growth rate from data at current prices
General government public spending		
PEtot	Total expenditure; general government	Share on GDP from data at current prices
PEcons	Final consumption expenditure of general government	Share on GDP from data at current prices
PEemp	Compensation of employees; general government	Share on GDP from data at current prices
PEsoc	Social benefits other than social transfers in kind; general government	Share on GDP from data at current prices
PEsub	Subsidies; general government	Share on GDP from data at current prices
PEinv	Gross fixed capital formation; general government	Share on GDP from data at current prices
General government public spending, functional categories		
PEeco	Public Expenditure on Economic Affairs and services. General government. cofog gf04	Share on GDP from data at current prices
PEhlth	Public expenditure on health. General government. cofog gf07	Share on GDP from data at current prices
PEedu	Public expenditure on Education. General government. cofog gf09	Share on GDP from data at current prices
PEss	Social protection. General government. cofog gf10	Share on GDP from data at current prices
General government public revenue		
PRtot	Total revenue; general government	Share on GDP from data at current prices
PRdirtax	Current taxes on income and wealth (direct taxes); general government	Share on GDP from data at current prices
PRsoc	Social contributions received; general government	Share on GDP from data at current prices
PRindtax	Taxes linked to imports and production (indirect taxes); general government	Share on GDP from data at current prices
Control variables		
PrivInv	Private sector investment	% GDP
Labfrgr	Total labour force growth rate (Labour force statistics)	Growth rate constructed from data in 1000 persons
Tot	Terms of trade goods and services (National accounts)	Growth rate constructed from series 2000=100
Popgr	Total population growth rate	Growth rate from series of total population

Data source: European Commission AMECO database.

Table A2 – Fiscal variables, beginning of the sample (% of GDP)

	Year	Public spending							Public revenue				Deficit
		Tot	Cons	Emp	SocTr	Int	Sub	Inv	Tot	Dirtax	Indtax	SocC	
BEL		41.72	17.70	9.64	11.39	3.56	2.09	4.81	38.71	10.73	12.97	11.38	3.01
DEU		39.58	16.33	9.04	12.62	0.97	1.44	4.55	39.73	11.07	12.21	12.34	-0.15
GRC		24.56	11.01	8.17	8.76	0.88	1.17	2.82	24.56	3.44	11.90	7.82	0.00
ESP		21.66	10.16	6.22	7.72	0.52	0.97	2.97	21.14	3.45	7.00	7.96	0.52
FRA		36.53	17.28	10.60	14.12	0.94	1.89	3.70	37.11	6.30	14.24	13.89	-0.58
IRL		34.66	15.03	10.15	8.14	3.43	4.08	3.97	30.87	8.52	16.95	2.39	3.79
ITA		34.39	16.80	10.58	12.03	1.87	1.98	2.76	29.32	5.23	10.13	11.41	5.06
LUX	1971	28.29	11.99	6.11	12.74	0.91	1.11	3.55	30.23	10.13	8.29	8.18	-1.94
NLD		44.28	20.68	12.69	12.83	2.86	0.94	5.17	42.71	13.42	9.73	14.26	1.57
AUT		37.64	14.85	9.68	14.78	0.99	1.71	5.13	39.06	10.49	15.82	10.64	-1.42
PRT		18.64	12.10	6.68	3.51	0.46	1.10	2.17	20.67	4.47	8.97	5.19	-2.03
FIN		30.86	15.70	10.23	8.53	0.93	2.64	3.78	35.17	13.54	13.05	5.96	-4.31
DNK		42.17	21.71	14.27	10.81	1.31	3.22	4.21	47.13	23.47	17.37	2.37	-4.96
SWE		43.81	23.23	14.77	12.09	1.90	1.76	5.79	48.79	19.20	14.20	9.11	-4.98
GBR		41.34	18.60	11.40	8.74	3.80	1.68	4.53	42.82	16.32	13.27	6.07	-1.48
EU15		*34.67*	*16.21*	*10.02*	*10.59*	*1.69*	*1.85*	*4.00*	*35.20*	*10.65*	*12.41*	*8.60*	*-0.53*
CZE	1995	54.47	20.89	7.35	10.74	1.03	2.86	5.26	41.03	9.56	12.26	14.40	13.44
EST	1993	35.11	22.62	8.46	10.44	0.19	0.92	4.57	44.99	12.64	12.84	11.77	-9.88
CYP	1998	36.73	16.57	13.52	8.70	3.07	1.13	2.86	32.60	9.71	11.06	6.88	4.13
LVA	1990	31.67	7.70	2.85	5.71	0.14	13.69	1.14	38.37	11.13	19.54	3.71	-6.70
LTU	1995	35.72	21.70	9.95	8.44	0.36	1.06	3.34	34.12	8.68	12.43	7.46	1.60
HUN	1992	51.24	26.73	13.32	18.81	9.60	2.04	1.67	46.65	9.84	17.40	18.20	4.59
MLT	1998	42.65	19.83	14.28	12.45	3.18	2.16	4.89	32.83	7.81	11.33	7.37	9.82
POL	1991	47.71	24.34	9.75	16.33	4.36	2.49	2.69	43.30	11.01	14.96	10.67	4.41
SVN	2000	48.14	19.30	11.64	17.01	2.48	1.53	3.13	44.30	7.54	16.29	14.96	3.83
SVK	1993	77.59	25.20	10.97	13.82	2.71	4.47	5.44	46.85	9.77	13.22	12.33	30.74
ROM	1998	45.24	14.53	8.57	10.09	4.34	1.78	1.87	44.20	8.10	13.50	9.10	1.04
BGR	1991		19.01	7.74	14.00	16.43	1.99	2.21		22.55	9.58	10.02	
NMS		46.02	19.87	9.87	12.21	3.99	3.01	3.26	40.84	10.70	13.70	10.57	5.18

Table A3 – Fiscal variables, end of the sample: 2006. (% of GDP)

	Public spending							Public revenue				Deficit
	Tot	Cons	Emp	SocTr	Int	Sub	Inv	Tot	Dirtax	Indtax	SocC	
BEL	49.15	22.63	11.99	15.71	4.17	1.81	1.71	49.30	16.72	13.32	15.91	-0.15
DEU	45.71	18.49	7.26	18.60	2.81	1.13	1.41	43.99	10.84	12.14	17.38	1.71
GRC	46.06	15.78	11.95	17.65	4.87	0.13	3.65	43.15	8.68	13.05	14.92	2.91
ESP	38.45	17.94	10.01	11.58	1.64	0.99	3.87	40.25	11.72	12.33	12.96	-1.80
FRA	53.78	23.67	13.20	17.91	2.59	1.46	3.38	51.20	11.91	15.51	18.45	2.58
IRL	34.05	15.92	9.32	8.15	0.99	0.52	3.86	36.92	13.10	14.00	6.18	-2.87
ITA	50.10	20.30	11.05	17.15	4.62	0.92	2.29	45.62	14.48	14.79	13.02	4.48
LUX	40.42	15.93	7.71	13.99	0.16	1.60	4.07	40.52	13.23	12.58	11.00	-0.09
NLD	46.67	25.30	9.43	11.21	2.33	1.14	3.34	47.22	11.83	12.91	15.29	-0.55
AUT	49.20	17.90	9.28	18.34	2.85	3.19	1.05	47.95	13.16	14.02	16.01	1.25
PRT	46.15	20.75	13.50	15.09	2.81	1.38	2.29	42.24	8.85	15.35	12.46	3.90
FIN	48.56	21.40	13.29	15.89	1.54	1.25	2.62	52.33	17.11	13.62	12.31	-3.76
DNK	50.90	25.54	17.05	15.32	1.72	2.24	1.82	55.12	29.47	17.80	1.96	-4.22
SWE	55.38	26.74	15.65	16.69	1.81	1.61	3.16	57.49	19.98	17.05	13.17	-2.11
GBR	44.96	22.30	11.49	13.02	2.11	0.54	1.85	42.10	17.30	12.96	8.40	2.86
EU15	46.64	20.71	11.48	15.09	2.47	1.33	2.69	46.36	14.56	14.10	12.63	0.28
CZE	42.48	21.59	7.82	11.37	1.10	1.94	5.06	39.55	8.77	10.99	15.04	2.93
EST	33.20	16.73	8.89	8.98	0.15	0.95	3.58	36.97	7.24	13.42	10.44	-3.77
CYP	43.93	17.90	14.79	12.31	3.26	0.54	3.30	42.40	10.92	17.77	8.02	1.54
LVA	36.95	16.91	10.14	8.02	0.46	0.64	3.36	37.37	8.42	12.74	8.93	-0.42
LTU	33.59	17.34	10.52	8.58	0.45	0.71	4.16	33.32	9.68	11.21	8.81	0.28
HUN	52.96	22.78	12.07	15.08	3.94	1.26	4.48	43.73	9.45	15.09	12.78	9.24
MLT	45.22	21.11	13.85	12.96	3.65	1.93	4.63	42.67	12.26	15.50	7.98	2.55
POL	43.59	17.91	9.80	15.46	2.46	0.80	4.17	39.64	7.56	13.99	12.27	3.95
SVN	47.03	19.57	11.96	16.31	1.66	1.64	3.38	45.55	9.05	16.10	15.10	1.48
SVK	46.25	19.26	11.65	15.97	1.56	1.61	3.67	44.85	9.35	15.58	14.91	1.40
ROM	37.32	18.18	7.46	12.05	1.38	1.35	2.22	33.94	5.90	11.48	12.12	3.39
BGR	32.02	18.01	8.85	8.20	0.76	1.39	2.85	30.14	5.19	12.16	10.18	1.88
NMS	44.96	18.94	10.65	12.11	1.74	1.23	3.74	42.74	8.65	13.84	11.38	2.22
EU27	45.89	19.92	11.11	13.76	2.14	1.28	3.16	44.75	11.93	13.98	12.07	1.14

Table A4 – Functional distribution of public expenditure, beginning of the sub-sample (% of GDP)

		General Public Services	Defence	Public Order and Safety	Economic Affairs	Environ-ment protection	Housing and community amenities	Health	Recreation, Culture and Religion	Education	Social Protection	Total
BEL	1990	12.50	1.85	1.10	5.58	0.46	0.28	5.01	0.71	5.43	16.73	49.64
DEU	1991	6.33	1.75	1.43	5.07	0.94	0.93	5.53	0.83	3.93	17.37	44.11
GRC	1990	31.24	8.33	0.02	8.01	0.25	0.23	1.78	0.11	5.93	29.00	84.91
ESP	1999	5.99	1.12	1.84	4.47	0.88	1.11	5.20	1.43	4.43	13.26	39.74
FRA	1995	8.22	2.56	1.27	3.95	0.59	1.55	6.56	1.08	6.65	22.31	54.75
IRL	1990	9.99	1.40	1.75	5.82		1.74	5.78	0.45	4.87	12.13	43.92
ITA	1990	16.35	1.86	2.55	7.52	0.98	1.67	7.89	0.98	6.99	20.53	67.30
LUX	1990	4.58	0.76	0.75	5.17	1.11	0.89	4.18	1.14	4.28	14.89	37.75
NLD	1995	10.48	1.91	1.42	4.81	0.95	6.26	3.75	1.21	5.26	20.40	56.45
AUT	1995	9.07	1.00	1.51	5.01	1.39	1.04	7.66	1.16	6.28	21.94	56.05
PRT	1990	10.49	1.86	2.10	5.55	0.36	0.80	3.77	0.75	4.90	9.37	39.95
FIN	1990	5.30	1.53	1.28	6.38	0.24	0.69	5.78	1.45	6.23	19.05	47.91
DNK	1990	11.22	1.98	1.07	4.63	0.28	0.54	6.64	1.52	6.97	21.06	55.91
SWE	1995	12.00	2.47	1.42	6.02	0.17	2.82	6.31	1.87	7.08	26.91	67.08
GBR	1990	5.06	4.10	2.11	4.21	0.52	1.47	5.12	1.03	4.71	13.99	42.31
EU 15		10.59	2.30	1.44	5.48	0.61	1.47	5.40	1.05	5.60	18.60	52.52

Table A5 – Functional Distribution of Public Expenditure at the end of the sub-sample (% of GDP)

		General Public Services	Defence	Public Order and Safety	Economic Affairs	Environ-ment protection	Housing and community amenities	Health	Recreation, Culture and Religion	Education	Social Protection	Total
BEL	2005	9.06	1.10	1.65	4.86	0.60	0.35	7.07	1.29	6.09	17.86	49.91
DEU	2005	6.12	1.10	1.61	3.47	0.50	1.00	6.22	0.64	4.15	21.96	46.79
GRC	2005	8.78	2.83	1.29	5.35	0.66	0.45	4.64	0.36	2.74	19.57	46.66
ESP	2005	4.59	1.09	1.83	4.58	0.88	0.86	5.69	1.42	4.41	12.88	38.25
FRA	2005	7.23	1.92	1.39	2.91	0.82	1.83	7.34	1.49	6.18	22.67	53.78
IRL	2004	3.53	0.56	1.41	5.03		2.00	7.16	0.51	4.53	9.21	33.93
ITA	2005	8.75	1.49	1.96	3.80	0.77	0.76	6.86	0.82	4.74	18.09	48.05
LUX	2006	4.55	0.26	0.99	4.66	1.07	0.63	4.96	1.78	4.82	16.70	40.42
NLD	2005	7.83	1.40	1.75	4.58	0.85	1.15	4.36	1.43	5.14	16.96	45.46
AUT	2005	6.89	0.88	1.45	5.04	0.36	0.57	6.92	1.00	5.98	20.78	49.89
PRT	2005	6.85	1.35	2.02	4.30	0.55	0.63	7.18	1.13	7.42	15.78	47.20
FIN	2005	6.77	1.65	1.52	4.65	0.33	0.24	6.85	1.20	6.06	21.21	50.48
DNK	2006	6.48	1.57	1.00	3.57	0.52	0.59	7.00	1.55	7.60	21.49	51.37
SWE	2005	7.70	1.74	1.34	5.11	0.41	0.93	6.99	1.09	7.32	23.79	56.43
GBR	2005	4.90	2.55	2.57	2.79	1.01	0.95	7.12	0.90	5.81	15.99	44.61
EU 15		6.67	1.43	1.58	4.31	0.62	0.86	6.42	1.11	5.53	18.33	46.88

Table A6 – Correlation matrix for fiscal variables

	PE tot	PE cons	PE emp	PE soc	PE sub	PE inv	PRtot	PRdir tax	PRind tax	PR soc	Pdefi c	PE eco	PE hlth	PE edu	PE ss
PEtot	1.00														
PEcons	0.73	1.00													
PEemp	0.72	0.75	1.00												
PEsoc	0.82	0.50	0.40	1.00											
PEsub	0.52	0.45	0.40	0.50	1.00										
PEinv	-0.28	-0.30	-0.13	-0.36	-0.14	1.00									
PRtot	0.84	0.82	0.69	0.74	0.61	-0.27	1.00								
PRdirtax	0.44	0.64	0.61	0.34	0.46	-0.39	0.69	1.00							
PRindtax	0.56	0.57	0.76	0.39	0.32	-0.19	0.65	0.57	1.00						
PRsoc	0.21	0.00	-0.31	0.36	0.03	0.08	0.09	-0.57	-0.36	1.00					
Pdefic	0.32	-0.11	0.08	0.18	-0.12	-0.04	-0.24	-0.41	-0.15	0.22	1.00				
PEeco	-0.08	-0.34	-0.29	-0.09	-0.04	0.41	-0.25	-0.57	-0.48	0.47	0.29	1.00			
PEhlth	-0.08	-0.08	-0.28	0.08	-0.05	0.02	-0.09	-0.43	-0.28	0.58	0.01	0.50	1.00		
PEedu	0.10	0.06	-0.04	0.05	0.04	0.19	0.02	-0.45	-0.16	0.59	0.15	0.60	0.79	1.00	
PEss	0.31	0.01	-0.18	0.47	-0.01	0.11	0.16	-0.47	-0.18	0.80	0.28	0.54	0.58	0.69	1.00

Table A7 – Correlation coefficients between fiscal variables and dependent and control variables

	PE tot	PE cons	PE emp	PE soc	PE sub	PE inv	PRtot	PRdir tax	PRin dtax	PR soc	Pdefi c	PE eco	PE hlth	PE edu	PE ss
Logpc GDP	-0.52	-0.55	-0.22	-0.61	-0.29	0.29	-0.55	-0.12	-0.23	-0.53	-0.09	0.14	-0.35	-0.26	-0.62
Log LAB	-0.44	-0.49	-0.14	-0.55	-0.19	0.31	-0.51	-0.09	-0.24	-0.52	-0.01	0.19	-0.35	-0.21	-0.55
TFP	-0.04	-0.20	-0.05	0.01	-0.09	-0.21	-0.13	0.03	-0.10	-0.06	0.12	-0.10	0.00	-0.18	-0.08
PrivInv	-0.28	-0.30	-0.11	-0.31	0.16	0.18	-0.24	-0.42	-0.19	0.10	-0.13	0.16	-0.04	-0.07	-0.36
Tot	0.24	0.05	0.01	0.28	0.20	0.05	0.26	0.14	-0.02	0.26	0.02	0.26	0.28	0.10	0.28
labfgr	-0.59	-0.50	-0.40	-0.52	-0.36	0.25	-0.41	-0.14	-0.12	-0.32	-0.44	-0.08	-0.21	-0.32	-0.52
popgr	-0.59	-0.44	-0.37	-0.43	-0.11	0.56	-0.37	-0.07	-0.18	-0.33	-0.51	0.02	-0.21	-0.33	-0.40

Tables and figures

Table 1 – The relation of public expenditures and taxation types with alterative measures of economic growth

	Public Expenditure				Taxation		
	Productivity-enhancing (G_1)	Capital-enhancing (G_2)	Labour-enhancing (G_3)	Consumption good (G_4)	Consumption tax (τ_c)	Labour Income Tax (τ_l)	Corporate profits (τ_π)
GDP gr	+	+	+	Only short term eff.	Only short term eff.	-	-
Lab. Prod gr	+	+	-	Only short term eff.	Only short term eff.	+	-
TFP gr.	+	No effect	No effect	No effect	No effect	No effect	No effect

Note: Those relationships are computed assuming values for the parameters as in the underlying model. In particular: $\alpha > 0$, $0 > s > 1$ and $\nu > 0$ guarantee that the effect of the categories of public expenditure on GDPgr is positive.

Table 2 – Summary of some of the empirical literature

Autor (s)	Data period and coverage	Estimation method / model	Main results
Devarajan, Swaroop and Zou (1996)	43 developing countries, yearly data, 1970-1990	Fixed-effects (Five-year forward moving average dep. Variable)	Excess public capital expenditure for their data set.
Miller and Russek (1997)	39 developed and developing countries, yearly data, 1975-1984.	Fixed-effects and random-effects/Real per-capita GDP growth rate	For developed countries concludes that debt-financing increases in expenditure have no effects on growth, but tax-financing increases do. Education expenditure is positively linked with growth.
Kneller, Bleaney and Gemmell (1999)	22 OECD countries, yearly data, 1970-1995	Fixed-effects, random effects (Five-year averages)	Negative effect distortionary taxation Negative impact non productive expenditures (social transfers) Negative effect deficit
Bassanini and Scarpetta (2001)	21 OECD countries, 1971-1998	Pooled Mean Group Estimator (dynamic equation in levels)	Positive impact of public investment Unclear effect of public current expenditure. Negative impact of taxation
Bleaney, Gemmell and Kneller (2001)	22 OECD countries, yearly data, 1970-1995	Two-way FE, dynamic model (5-averages in static and levels in dynamic model)	Negative effect of distortionary taxation, positive effect of productive expenditure
Odedokun (2001)	103 countries in 4 groups, yearly data, 1970-1998	Fixed-effects (Five-year moving average of dep. var.)	Negative effect of current exp. And no significant effect of capital Negative impact of public consumption and wages Negative impact of defence, health, economic services. Positive impact of education
Folster and Henrekson (2001)	23 OECD countries, 1970-1995	Fixed-country and period effects (five-year averages)	Significant negative effect for total government spending; negative effect of total taxes.
Bose, Haque and Osborn (2003)	30 developing countries, decade averages, 1970-1990	OLS, 3SLS. (Decade average dep var.)	Identify the importance of education and government spending for economic growth in their set of countries. Also find a significant correlation with capital expenditure.
Romero de Avila and Strauch (2007)	15 European countries, 1960-2001	Long-term coefficients estimated by F-E (variables in levels)	Negative impact of total expenditure on growth. Positive impact of direct taxation, indirect taxation and public investment. Negative effect of government consumption, transfers, and social security revenues.
Gupta, Clements, Baldacci and Mulas-Granados (2005)	39 low income countries, yearly data, 1990-1999	Fixed-effects, GMM, A-Bond, IV (dep. var. in levels)	They highlight the impact of an equilibrated budget. Negative impact of public wages on growth.
Reed (2006)	US States, 1970-1999	F-E (5-year averaged data)	Negative impact of tax burden on GDP growth

Table 3 – Descriptive statistics for the full panel sample

	EU 15					EU New member states				
Variable	Obs	Mean	Std. Dev.	Min	Max	Obs	Mean	Std. Dev.	Min	Max
Dependent variables										
Pc GDP gr. (log)	525	0.0834	.054	-.087 (LUX,1975)	.278 (PRT,1977)	194	0.2337	.345	-.016 (LTU,1999)	2.29 (BGR,1997)
Labour prod gr. (log)	491	0.0795	.057	-.089 (LUX,1975)	.276 (PRT,1977)	163	0.2135	.338	-.010 (MLT,2001)	2.30 (BGR,1997)
TFPgr (log)	400	0.0122	.019	-.086 (ESP,1974)	.090 (FIN,1973)					
Moving Aver. GDP	525	0.0209	.013	-.017 (FIN, 1989)	.083 (IRL,1994)	187	0.0358	.032	-.094 (LTU, 1990)	.104 (LVA,2004)
Public Expenditure (economic classification), % of GDP										
Total	538	0.4615	.088	.186 (PRT, 1971)	.724 (SWE,1993)	131	0.4192	.067	.244 (LVA,1992)	.775 (SVK, 993)
Consumption	538	0.1962	.041	.097 (GRC, 1973)	.301 (SWE,1981)	199	0.1919	.033	.077 (LVA, 1990)	.287 (HUN,1993)
Compensation of employees	538	0.1178	.028	.060 (LUX,1973)	.200 (SWE,1980)	153	0.1036	.022	.028 (LVA, 1990)	.155 (CYP,2003)
Social transfers	538	0.1466	.033	.035 (PRT,1971)	.237 (FIN,1994)	151	0.1226	.028	.057 (LVA,1990)	.189 (HUN,1993)
Subsidies	538	0.0215	.011	.001 (GRC, 2006)	.084 (IRL,1978)	153	0.0163	.013	.003 (POL,2003)	.136 (LVA,1990)
Investment	538	0.0314	.009	.005 (GBR,2005)	.057 (SWE,1971)	148	0.0324	.010	.008 (BGR,1995)	.054 (SVK,1993)
Public Revenues, % of GDP										
Total	538	0.4347	.086	.205 (PRT,1973)	.622 (SWE,1989)	131	0.3878	.043	.239 (LVA,1992)	.508 (SVK,1994)
Direct taxation	538	0.1344	.057	.030 (GRC, 1973)	.312 (DNK,2005)	153	0.0903	.022	.051 (ROM,2006)	.225 (BGR,1991)
Social contributions	538	0.1191	.046	.014 (DNK,1976)	.207 (NLD,1983)	151	0.1150	.026	.037 (LVA,1990)	.190 (HUN,1993)
Indirect taxation	538	0.1294	.024	.057 (ESP, 1978)	.182 (DNK,1986)	149	0.1341	.020	.064 (LVA,1992)	.195 (LVA,1990)
Public deficit	538	0.0268	.041	-.077 (FIN,1976)	.157 (GRC,1990)	131	0.0313	.043	-.098 (EST,1993)	.307 (SVK,1993)
Public Expenditure (functional classification) , % of GDP										
Econ. Affairs	211	0..0474	.012	.015 (GRC,1994)	.115 (DEU,1998)					
Health	211	0 .0585	.012	.011 (GRC,1994)	.081 (ITA,1991)					
Education	211	0.0555	.012	.027 (GRC,2005)	.082 (DNK,2003)					
Social protection	211	0.1857	.042	.078 (IRL,2000)	.290 (GRC,1990)					
Control variables										
Private Invest. (% of GDP)	521	18.68	3.11	11.30	30.50	151	19.20	4.88	3.77 (LVA,1991)	31.73 (SVK,1998)
Terms of trade	538	99.75	8.71	63.91 (ESP,1983)	131.08 (IRL,1973)	174	99.63	5.14	80.08 (CZE,1991)	118.1 (ROM,2006)
Labour force gr.	491	0.0088	.016	-.056 (NLD,1983)	.280 (DEU,1991)	163	-0.0002	.022	-.085 (LVA,1995)	.088 (BGR,2000)
Population gr.	525	0.0052	.012	-.004 (DEU,1976)	.264 (DEU,1991)	204	-0.0007	.008	-.025 (EST,1993)	.026 (CYP,1991)

Note: BEL -Belgium; DEU - Germany ; GRC - Greece; FRA - France; ESP - Spain; ITA - Italy; IRL - Ireland; LUX - Luxembourg; AUT - Austria; NLD - Netherlands; PRT - Portugal; FIN - Finland; DNK - Denmark; SWE - Sweden; GBR - United Kingdom; CZE - Czech Republic; EST - Estonia; CYP - Cyprus; LVA - Latvia; LTU - Lithuania; HUN - Hungary; MLT - Malta; POL - Poland; SVN - Slovenia; SVK - Slovakia; ROM - Romania; BGR - Bulgaria.

Table 4 – 1971-2006, EU15. Long-term coefficients, dependent variable: *logrpcGDP*

	(1)	(2)	(3)	(4)	(5)	(6)
PE consumption	-0.7522***					
	(.225)					
PE compensation of employees		-0.1961				
		(.297)				
PE social transfers			-0.2976**			
			(.154)			
PE subsidies			.3222			
			(.240)			
PE Investment				0.6464**		
				(.327)		
PE total					-0.3262**	-0.5675***
					(.133)	(.075)
PR direct taxation					-0.0481 (.219)	
PR social contributions					-0.5853**	
					(.254)	
PR Indirect taxation						0.2896
						(.225)
PR total	-0.3913***	-0.5048***	-0.3089***	-0.6091***		
	(.086)	(.104)	(.078)	(.075)		
Public deficit	0.2540***	0.0942	0.1166	0.1103	0.5222***	0.7047***
	(.095)	(.089)	(.103)	(.076)	(.159)	(.114)
Private Investment	0.0030**	0.0028**	0.0037***	0.0020	0.0041***	0.0033***
	(.001)	(.001)	(.001)	(.001)	(.001)	(.001)
Terms of trade	-0.0011***	-0.0011***	-0.0012***	-0.0013***	-0.0014***	-0.0013***
	(.0003)	(.0003)	(.0002)	(.0003)	(.0003)	(.0003)
Labour force growth	0.4698***	0.4842***	0.1525	0.3733**	0.3681**	0.4285**
	(.159)	(.170)	(.169)	(.162)	(.176)	(.167)
Population growth	-1.2606***	-1.2803***	-0.9215***	-1.1706***	-1.1787***	-1.256***
	(.216)	(.230)	(.222)	(.219)	(.235)	(.229)
Observations	432	432	432	432	432	432

Notes: GMM Arellano-Bond dynamic panel-data estimation. The standard deviations are in parentheses. *, **, *** - statistically significant at the 10, 5, and 1 per cent.

Table 5 – 1971-1989, EU15. Long-term coefficients, dependent variable: *logrpcGDP*

	(1)	(2)	(3)	(4)	(5)	(6)
PE consumption	-0.6479 (.469)					
PE compensation of employees		1.0580** (.471)				
PE social transfers			-0.7007** (.287)			
PE subsidies			0.9096** (.378)			
PE Investment				1.3285*** (.500)		
PE total					-0.4127* (.247)	-0.6118*** (.164)
PR direct taxation					-0.2088 (.348)	
PR social contributions					-0.4652 (.488)	
PR Indirect taxation						0.3787 (.349)
PR total	-0.4494** (.185)	-0.7910*** (.178)	-0.4650*** (.143)	-.6578*** (.155)		
Public deficit	0.3791* (.214)	0.0360 (.175)	0.1342 (.205)	0.0308 (.166)	0.5927** (.302)	0.7662*** (.214)
Private Investment	0.0023 (.001)	0.0026 (.001)	0.0002 (.001)	0.0017 (.001)	0.0021 (.001)	0.0027 (.001)
Terms of trade	-0.0010** (.0004)	-0.0008* (.0004)	-0.0007* (.0004)	-0.0010** (.0004)	-0.0010* (0005)	-0.0011** (.0004)
Labour force growth	0.3143 (.204)	0.2446 (.192)	0.1241 (.189)	0.2140 (.196)	0.2058 (.225)	0.2774 (.205)
Population growth	-2.0810*** (.799)	-2.4296*** (.676)	-1.6851** (.667)	-2.0885*** (.706)	-2.2720*** (.737)	-2.3539*** (.743)
Observations	185	185	185	185	185	185

Notes: GMM Arellano-Bond dynamic panel-data estimation. The standard deviations are in parentheses.
*, **, *** - statistically significant at the 10, 5, and 1 per cent.

Table 6 – 1990-2006, EU15. Long-term coefficients, dependent variable: *logrpcGDP*

	(1)	(2)	(3)	(4)	(5)	(6)
PEconsumption	-1.0453*** (.359)					
PE compensation of employees		-1.1620*** (.399)				
PE social transfers			-0.8380*** (.197)			
PE subsidies			0.5400 (.530)			
PE Investment				-0.6913 (.454)		
PE total					0.1843 (.196)	-0.4205*** (.127)
PR direct taxation					-0.2882 (.286)	
PR social contributions					-0.9987*** (.319)	
PR Indirect taxation						0.8204** (.360)
PR total	0.0762 (.169)	-0.1427 (.137)	0.1773 (.143)	-0.3910*** (.103)		
Public deficit	0.2275 (.145)	0.1490 (.113)	0.2433** (.118)	0.2395*** (.087)	0.0357 (.204)	0.5434*** (.162)
Private Investment	0.0014 (.001)	0.0032** (.001)	0.0024* (.001)	0.0041*** (.001)	0.0046** (.001)	0.0028* (.001)
Terms of trade	-0.0002 (.0006)	-0.0002 (.0005)	-0.0008 (.0005)	-0.0008 (.0005)	-0.0008 (.0006)	-0.0007 (.0006)
Labour force growth	-0.0653 (.210)	0.0583 (.178)	0.0992 (.178)	-0.0590 (.175)	0.1664 (.215)	0.1151 (.208)
Population growth	-1.1395 (.730)	-1.9717*** (.653)	-0.9966* (.583)	-2.2152*** (.606)	-1.7711** (.755)	-1.9724** (.781)
Observations	208	208	208	208	208	208

Notes: GMM Arellano-Bond dynamic panel-data estimation. The standard deviations are in parentheses.
*, **, *** - statistically significant at the 10, 5, and 1 per cent.

Table 7 – 5-year moving averages

	(1)	(2)	(3)	(4)	(5)	(6)
PE consumption	-0.2016***					
	(.055)					
PE compensation of employees		-0.2864***				
		(.063)				
PE social transfers			0.0348			
			(.043)			
PE subsidies			-0.2832***			
			(.062)			
PE Investment				-0.0346		
				(.074)		
PE total					-0.0765**	-0.0082
					(.035)	(.016)
PR direct taxation					0.0489	
					(.057)	
PR social contributions					0.1266*	
					(.065)	
PR Indirect taxation						-0.1180**
						(.053)
PR total	0.0273	0.0281	-0.0387**	-0.0248*		
	(.020)	(.018)	(.019)	(.014)		
Public deficit	-0.0034	0.0076	0.0057	-0.0428**	0.0270	-0.0393
	(.022)	(.022)	(.026)	(.020)	(.041)	(.024)
Private Investment	-0.0025***	-0.0023***	-0.0019***	-0.0025***	-0.0026***	-0.0025***
	(.0002)	(.0002)	(.0003)	(.0003)	(.0002)	(.0002)
Terms of trade	0.00008	0.00007	0.00001	0.00005	0.00009	0.0001
	(.00007)	(.00007)	(.00007)	(.00008)	(.00008)	(.00008)
Labor force growth	0.0317	0.0233	0.0167	0.0289	0.0227	0.0259
	(.047)	(.046)	(.047)	(.048)	(.047)	(.047)
Population growth	-0.0303	-0.0312	-0.0218	-0.0312	-0.0253	-0.0283
	(.061)	(.061)	(.061)	(.062)	(.062)	(.062)
F-test joint significance (probability)	8.10	11.23	10.75	9.03	8.03	9.53
	(.0000)	(.0000)	(.0000)	(.0000)	(.0000)	(.0000)
Observations	458	458	458	458	458	458

Notes: GMM Arellano-Bond dynamic panel-data estimation. The standard deviations are in parentheses.
*, **, *** - statistically significant at the 10, 5, and 1 per cent.

Table 8 – EU15 1971-2006. Long-term coefficients. Labour Productivity as dependent variable

	(1)	(2)	(3)	(4)	(5)	(6)
PEconsumption	-0.7524***					
	(.201)					
PE compensation of employees		-0.0465				
		(.261)				
PE social transfers			-0.4112***			
			(.126)			
PE subsidies			0.3116			
			(.196)			
PE Investment				0.9010***		
				(.296)		
PE total					-0.3130***	-0.5904***
					(.098)	(.070)
PR direct taxation					0.0286	
					(.158)	
PR social contributions					-0.5006***	
					(.184)	
PR Indirect taxation						0.2916
						(.199)
PR total	-0.3850***	-0.5205***	-0.2450***	-0.5949***		
	(.077)	(.091)	(.061)	(.064)		
Public deficit	0.2590***	0.0500	0.1103	0.0985	0.5322***	0.6914***
	(.085)	(.079)	(.084)	(.067)	(.117)	(.104)
Private investment	0.0033***	0.0028**	0.0033***	0.0027**	0.0049***	0.0028**
	(.001)	(.001)	(.001)	(.001)	(.0009)	(.001)
Terms of trade	-0.0009***	-0.0009***	-0.0009***	-0.0009***	-0.0012***	-0.0011***
	(.0002)	(.0002)	(.0002)	(.0002)	(.0002)	(.0002)
Labour force growth	-0.8727***	-0.8858***	-1.1722***	-0.9503***	-0.9933***	-0.9712***
	(.147)	(.152)	(.147)	(.149)	(.141)	(.170)
Population growth	0.1726	0.2014	0.5321***	0.2737	0.3637**	0.2231
	(.179)	(.184)	(.175)	(.180)	(.171)	(.194)
Observations	429	429	429	429	443	443

Notes: GMM Arellano-Bond dynamic panel-data estimation. The standard deviations are in parentheses.
*, **, *** - statistically significant at the 10, 5, and 1 per cent.

Table 9 – EU15 1971-2006. Long-term coefficients. Total Factor Productivity growth as dependent variable.

	(1)	(2)	(3)	(4)	(5)	(6)
PEconsumption	-0.3382***					
	(.122)					
PE compensation		-0.4225***				
of employees		(.132)				
PE social			0.1227			
transfers			(.077)			
PE subsidies			0.0901			
			(.148)			
PE Investment				-0.3840***		
				(.147)		
PE total					0.0687	0.0281
					(.064)	(.033)
PR direct					-0.1706	
taxation					(.103)	
PR social					0.0837	
contributions					(.122)	
PR Indirect						0.0347
taxation						(.094)
PR total	0.1257***	0.1475***	-0.0082	0.0435		
	(.045)	(.047)	(.041)	(.030)		
Public deficit	0.1016**	0.0676*	-0.0235	0.0598	-0.0677	0.0036
	(.048)	(.038)	(.058)	(.037)	(.076)	(.052)
Private	0.0014**	0.0013**	0.0014**	0.0016***	0.0013**	0.0013**
Investment	(.0005)	(.0005)	(.0007)	(.0005)	(.0005)	(.0005)
Terms of trade	0.0006***	0.0006***	0.0005***	0.0006***	0.0006***	0.0005***
	(.0001)	(.0001)	(.0001)	(.0001)	(.0001)	(.0001)
Labor force	0.0784	0.0841	0.0739	0.0934	0.0400	0.0656
growth	(.086)	(.086)	(.093)	(.089)	(.093)	(.091)
Population	0.2179	0.1863	0.0300	0.0432	0.0899	0.1552
growth	(.255)	(.247)	(.284)	(.254)	(.261)	(.264)
Observations	336	336	336	336	336	336

Notes: GMM Arellano-Bond dynamic panel-data estimation. The standard deviations are in parentheses.
*, **, *** - statistically significant at the 10, 5, and 1 per cent.

Table 10 – Classification of public expenditure according to its impact on alternative measures of economic growth

Public Expenditure				Taxation		
Productivity-enhancing (G_1)	Capital - enhancing (G_2)	Labour-enhancing (G_3)	Consumption good (G_4)	Consumption (τ_c)	Labour Income (τ_l)	Corporate profits (τ_π)
PE cons (-) PE emp (-) PE inv (-)	PE cons (-) PE emp (+) PE inv (+)	PE soc trans.(-) PEinv (-)	 PE emp PE soc transf.	PR social contr PR Ind. tax		PR social contr. (-)

Note: We have taken into account the 5 percent significance levels to elaborate this table. Short-run relationships are not reported in tables 4 to 11 since they are not visible in the long-term coefficients.

Table 11 – 1990-2006, EU New Member States. Long-term coefficients, dependent variable: *logrpcGDP*

	(1)	(2)	(3)	(4)	(5)	(6)
PEconsumption	-2.1529*** (.713)					
PE compensation of employees		-6.1303*** (1.35)				
PE social transfers			-2.6550*** (.664)			
PE subsidies			-5.6468*** (1.59)			
PE Investment				-0.8509 (1.69)		
PE total					1.9644*** (.423)	1.5963*** (.491)
PR direct taxation					-2.0184** (.929)	
PR social contributions					-5.703*** (1.42)	
PR Indirect taxation						-3.0067** (1.22)
PR total	1.0835*** (.338)	1.3750*** (.286)	1.3504*** (.233)	0.6929** (.339)		
Public deficit	0.2049 (.541)	0.7727* (.458)	-0.2496 (.311)	-0.6669 (.503)	-2.7460*** (.515)	-2.3207*** (.625)
Private Investment	-0.0012 (.003)	-0.0001 (.002)	-0.0003 (.002)	0.0027 (.003)	-0.0007 (.002)	0.0022 (.003)
Terms of trade	0.0011 (.002)	0.0026 (.001)	0.0020 (.001)	0.0025 (.002)	0.0050** (.002)	0.0013 (.002)
Labor force growth	0.6654 (.486)	0.6760* (.375)	0.4936 (.316)	0.5662 (.515)	0.4088 (.379)	0.7878 (.484)
Population growth	-6.4068** (3.04)	-3.1397 (2.18)	-0.9116 (1.85)	-2.3032 (3.01)	-3.3242 (2.41)	-0.8210 (2.86)
Observations	98	98	98	98	98	98

Notes: GMM Arellano-Bond dynamic panel-data estimation. The standard deviations are in parentheses. *, **, *** - statistically significant at the 10, 5, and 1 per cent.

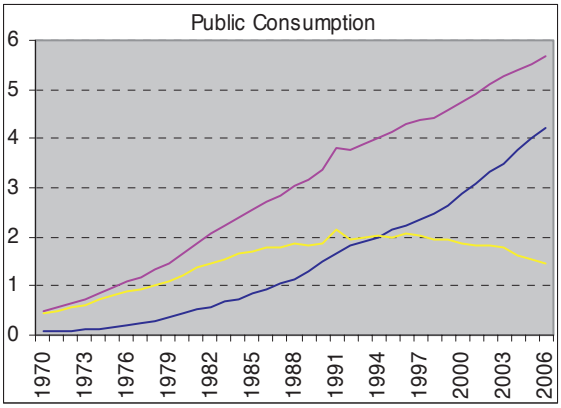
Table 12 – EU15 1990-2006. Long-term coefficients. Functional categories of public expenditure.

	(1)	(2)	(3)	(4)	(5)
PE Econ. Affairs	0.1144				0.5313**
	(.326)				(.234)
PE Health		-1.1363***			-1.4969***
		(.344)			(.317)
PE Education			0.8616		2.0220***
			(.551)		(.503)
PE Social Protection				-0.1400	-0.6380***
				(.170)	(.189)
Total Public revenues	-0.4732***	-0.3657***	-0.4913***	-0.3819***	-0.1410
	(.137)	(.128)	(.134)	(.129)	(.117)
Public Deficit	0.1965	0.2118*	0.0684	0.1317	0.1841
	(.140)	(.112)	(.131)	(.125)	(.120)
Private Investment	0.0029*	0.0039***	0.0029*	0.0030**	0.0031**
	(.001)	(.001)	(.001)	(.001)	(.001)
Labor force growth	0.2842	0.1637	0.2456	0.1792	0.1152
	(.205)	(.179)	(.199)	(.171)	(.156)
Terms of Trade	-0.0014*	-0.0003	-0.0014*	-0.0007	-0.0012**
	(.0007)	(.0006)	(.0007)	(.0006)	(.0006)
Population growth	-1.4517	-1.2518*	-1.4294	-1.138719	-0.7847
	(.913)	(.745)	(.872)	(.752)	(.630)
Observations	181	181	181	181	181

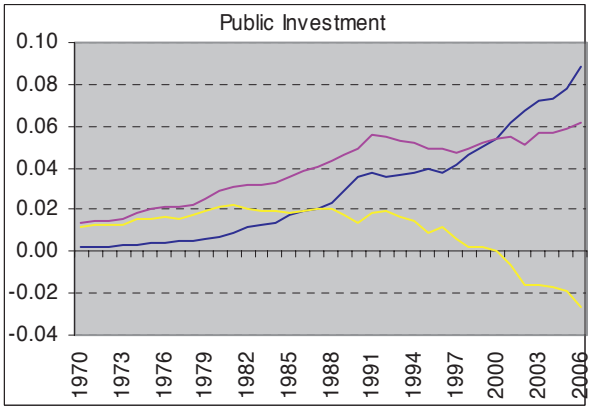
Notes: GMM Arellano-Bond dynamic panel-data estimation. The standard deviations are in parentheses. *, **, *** - statistically significant at the 10, 5, and 1 per cent.

Figure 1 – per capita GDP and per capita fiscal variables
(Fiscal variables in thousand Euro per capita, current prices. GDP in thousand Euro per capita, constant prices, basis=2000)

1a



1b



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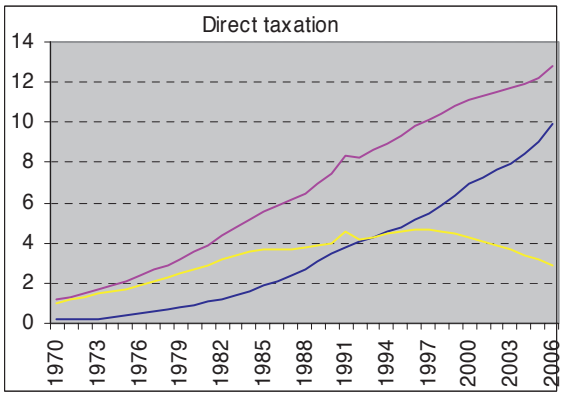

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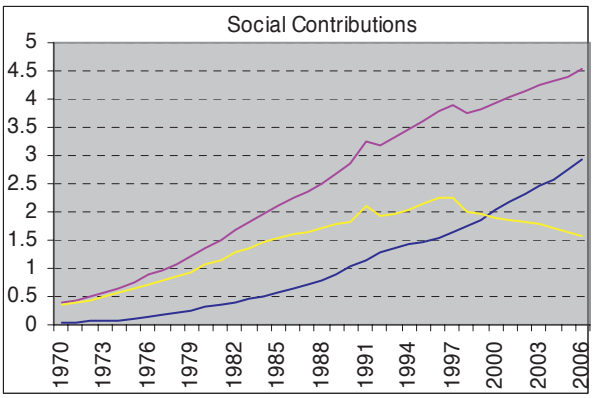

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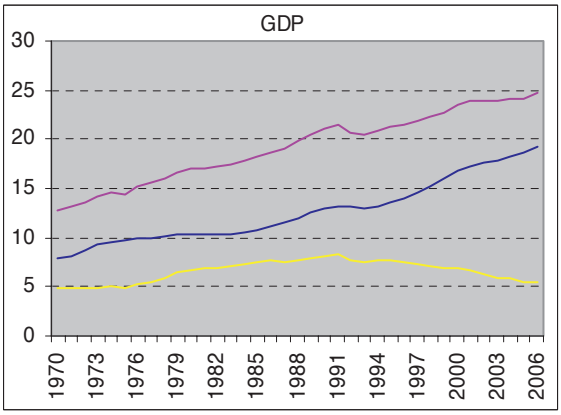

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