FISCAL POLICY AND ECONOMIC GROWTH:

EMPIRICAL EVIDENCE FROM OECD COUNTRIES

Nikos Benos

University of Cyprus

July 2004

Abstract: This paper decomposes public spending and tax revenue into various sub-categories and estimates the impact of each of them on economic growth. The results provide some support for theoretical models of endogenous growth. Specifically, the main findings are: a) government spending on education, health and fuel-energy display a hump-shaped relationship with per capita growth; b) public expenditures on housing-community amenities, social security-social assistance and transport-communication are characterized by a U-shaped relation with growth; c) the effect of public spending on education and social expenditures on growth is stronger the poorer a country is, while the opposite is true for expenditures on health; d) there is a non-linear impact of distortionary taxation on growth, but the form on non-linearity is sensitive to changes in estimation method, since sometimes we find a hump-shaped and sometimes a U-shaped relationship; e) budget surplus has a positive effect on growth. These results are derived by estimating both single growth equations and systems of equations, which endogenize social spending.

Keywords: Panel Data. Fiscal Policy. Taxation. Government Expenditures.
JEL Classification: C23, C33, E62, H2, H5.
Correspondence to: Nikos Benos, Department of Economics, P.O. Box 20537, CY-1678 Nicosia, Cyprus. Tel. +357-22892439. Fax: +357-22892432. E-mail: nbenos@ucy.ac.cy
Acknowledgements: I would like to thank Apostolis Philippopoulos, Sarantis Kalyvitis, Lonnie Magee, Thanasis Stengos, Stelios Arvanitis and Nikos Magginas for their very helpful comments and suggestions. All errors are mine.

1. INTRODUCTION

Endogenous growth models are widely used in macroeconomics mainly because they are consistent with the fact that the growth rate of output, the capital-output ratio, the real interest rate etc. are constant over time (see Kongsamut et al., 2001). This literature also stresses the role of economic policy in the long-run growth process. Different authors have focused on different types of policy as engines of balanced growth (see Section 2 for details).

Much empirical work has been done to test the predictions of theoretical models, but the results differ greatly between various studies. Levine-Renelt (1992) have emphasized the sensitivity of the findings to changes in the set of control variables. The same point was made by Agell et al. (1997) using data for 23 OECD countries for 1970-1990. They initially showed that average annual growth rate is negatively related to the average share of tax revenues in GDP. However, when they included initial GDP per capita and the share of population younger than 15 and older than 65 as explanatory variables, the relation between taxes and growth turned positive. A problem with most of such studies is that they do not test the effects of fiscal policy taking into account the structure of both taxation and expenditure, i.e. they focus on the one side of government activity ignoring, at least partially, the other (Easterly-Rebello 1993, Cashin 1995, Devarajan et al 1996, Trish 1997). A notable exception is Kneller-Bleaney-Gemmell (1999, 2001) (KBG from now on), who, following Helms (1985) among others, recognized that any study, which does not take into account both sides of the budget, suffers from substantial biases of the coefficient estimates. KBG (1999) confirmed this point for a panel data set for 22 OECD countries covering the period 1970-1995.

Another problem of most empirical work on the relationship between fiscal policy and economic growth is that not much attention is paid on distinguishing the effects of policy on the transition for those on the steady-state. This is important, since the neoclassical and endogenous growth models differ only in their predictions about the long-run effects of policy. The relevant conclusion in KBG (2001) is that five-year averaged data are not sufficient to capture the long-run effects of fiscal policy and longer lags are required.

Finally, the potential endogeneity of regressors in growth equations is not examined thoroughly in most papers on the effects of fiscal policy on growth. However, the empirical results do not seem to change when this is taken into account (KBG, 2001).

In our work, we take the above remarks into account and refine existing research further, disaggregating government spending into its various components and including other variables potentially important for growth. We search for results that are robust to changes in specification and estimation method and find that some types of government expenditures and taxation matter for growth. Specifically, government spending on education, health and fuel-energy display a hump-shaped relationship with per capita growth. Moreover, public expenditures on housing-community amenities, social security-social assistance (social spending) and transport-communication are characterized by a U-shaped relation with growth. So, education expenditures and spending on health and fuel-energy are beneficial for economic growth up to a point and then inhibit growth, while the opposite holds for spending on housing-community amenities, social security-social assistance and transport-communication. Furthermore, the effect of public spending on education and social expenditures on growth is stronger the poorer a country is, while the opposite is true for spending on health. Also, we detect a non-linear impact of distortionary taxation on growth, but the form of non-linearity is sensitive to changes in estimation method, since sometimes we find a hump-shaped and sometimes a U-shaped relationship between distortionary taxation and the growth rate. Finally, budget surplus is found to have a positive effect on growth.

The rest of the paper proceeds as follows. Section 2 outlines the basic implications of the endogenous growth models for fiscal policy and of the government budget constraint for empirical testing. Section 3 summarizes the existing empirical work on fiscal policy and growth. Section 4 presents our data, methodology and results. Section 5 concludes the paper.

2. PREDICTIONS OF GROWTH MODELS WITH FISCAL POLICY

Neoclassical growth models imply that government policy can affect only the output level but not the growth rate (e.g. Judd, 1985). However, endogenous growth models incorporate channels through which fiscal policy can affect long-run growth (see e.g. Barro 1990, Barro-Sala-i-Martin 1992, 1995).

The latter models classify generally the fiscal policy instruments into: a) distortionary taxation, which weakens the incentives to invest in physical/human capital, hence reducing growth; b) non-distortionary taxation which does not affect the above incentives, therefore growth, due to the nature of the utility function assumed for the private agents; c) productive expenditures that influence the marginal product of private capital, henceforth boost growth; d) unproductive expenditures that do not affect the private marginal product of capital, consequently growth.

The endogenous growth models predict that an increase in productive spending financed by non-distortionary taxes will increase growth, whilst the effect is ambiguous if distortionary taxation is used. Also, an increase in non-distortionary spending financed by non-distortionary taxes will be neutral for growth, while if distortionary taxes are used the impact on growth will be negative.

Various extensions of the basic endogenous growth models have been worked out, allowing publicly-provided goods to be productive in stock or flow form (see e.g. Cashin 1995), different forms of expenditure to be productive (e.g. Devarajan et al. 1996, Sala-i-Martin 1997, Glomm-Ravikumar 1997, Kaganovich-Zilcha 1999), various forms of taxation (Ortigueira, 1998), asymmetric equilibria ex-post (e.g. Glomm-Ravikumar 1992, Chang 1998) etc.

Turning to the specification issue mentioned in the introduction of the paper, we refer shortly to the analysis by KBG (1999) (for details see pp. 174-175 of their paper). They basically concluded that the equation being estimated typically by the researchers who investigate the effect of fiscal policy on growth takes the form

$$G_{it} = a + \sum_{i=1}^{k} b_i E_{it} + \sum_{j=1}^{l-1} \left(c_j - c_l\right) F_{jt} + u_{it} \qquad (1)$$

In (1), G_{it} is the growth rate of country i at time t, which is a function of non-fiscal variables, E_{it} , and fiscal variables, F_{jt}. Additionally, a and b_i represent the constant term and the slope coefficient of the non-fiscal variable i (there are k such variables) respectively. Also, c_j is the coefficient of the growth impact of the variable F_{jt}, one of $l-1$ fiscal variables, and c_l measures the effect on growth of the lth fiscal variable, which finances the change in one of the $l-1$ fiscal policy instruments.

From equation (1), we see that the hypothesis test of zero coefficients for F_{jt} usually conducted in empirical studies, tests the hypothesis that $c_j - c_l = 0$, and not $c_j = 0$, as implicitly assumed. So, we actually estimate the impact of a change in one fiscal variable when there is an offsetting change in the omitted lth fiscal variable, which implicitly finances the variation in the variable of interest. If the omitted category is modified, the coefficient of F_{jt} will be different. This implies that the researcher has either to omit a fiscal instrument with negligible effect on growth, i.e. one for which $c_l = 0$, or to omit two fiscal variables for which the hypothesis that $c_j = c_l$ can not be rejected. So, it is necessary to test down from the full-fledged specification to less complete specifications omitting only variables with negligible growth effects.

3. PREVIOUS EMPIRICAL WORK

Many studies of the relationship between fiscal policy and growth were conducted before the relevant endogenous growth models were developed, i.e. from the early 1980s. For example, Landau (1983) using cross-sectional data from 104 countries found a negative relation between public consumption as share of GDP and growth per capita using Summers-Heston data, while Kormendi-Meguire (1985) using cross-section/time-series data for 47 countries found no statistically significant relation of the same variables for the post-World War II period. Barth-Bradley (1987) found a negative relation between real GDP growth and the share of consumption spending in GDP for 16 OECD countries for 1971-1983. Barro (1989), with data from 98 countries in the post-World War II period, found that government consumption decreases per capita growth, while public investment does not affect growth. Levine-Renelt (1992) found that most results from earlier studies on the relationship between long-run growth and fiscal policy indicators are fragile to small changes in the conditioning set.

In the next generation of studies, Easterly-Rebello (1993) (ER from now on) used cross-section data for 100 countries for 1970-1988 and panel data for 28 countries for 1870-1988. They found that public transportation, communication and educational investment are positively correlated with growth per capita and aggregate public investment is negatively correlated with growth per capita, although they admitted that many fiscal policy variables are highly correlated with initial income levels and fiscal variables are potentially endogenous. Cashin (1995) estimated a positive relationship between government transfers, public investment and growth and a negative one between distortionary taxes and growth from panel data for 23 developed countries between 1971 and 1988. Devarajan et al (1996) showed that public current expenditures increase growth, whilst government capital spending decreases growth in 43 developing countries over 1970-1990. Kneller et al. (1999, 2001) showed that the biases related to the incomplete specification of the government budget constraint present in previous studies (see section 2 above) are significant and after taking them into account, they found for a panel of 22 OECD countries for 1970-1995 that: (1) distortionary taxation hampers growth, while non-distortionary taxes do not; (2) productive government expenditure increases growth, while non-productive expenditure does not; (3) long-run effects of fiscal policy are not fully captured by five-year averages commonly used in empirical studies. Several other studies also examined the relation of fiscal policy and growth, e.g. by Trish (1997), De la Fuente (1997), Brons et al. (2000). Poot (2000) in a survey of published articles in 1983-1998 did not find conclusive evidence for the relationship between government consumption and growth, while he found empirical support for the negative effect of taxes on growth. Also, he reported definitive results on the positive link between growth and education spending, while the evidence on the negative growth impact of defense spending is moderately strong. The final piece of evidence Poot presented concerns the rather robust positive association of infrastructure spending and growth.

It therefore seems that there is widespread non-robustness of coefficient signs and statistical significance even within similar specifications for similar variables. There are some possible explanations for these differences. The most important, in our opinion, is the absence of a generally accepted theoretical framework to guide the empirical research. This framework would pin down the most important determinants of growth, being fiscal policy variables or not. If such a framework were available, we could test the statistical significance of the postulated fiscal and non-fiscal determinants of growth and avoid the omitted variable bias that our results possibly suffer. Another problem of most empirical studies of growth and fiscal policy concerns the misspecification of the growth equation in relation to the government budget constraint (for details refer to Section 2 of the paper and references therein).

In addition, existing empirical studies on fiscal policy and growth differ in terms of countries included in the sample, period/method of estimation and measures of public sector activity. Data quality is also a problem since, for example, various countries have different conventions for the measurement of public sector size and there are limited data at the required level of disaggregation. Also, the dynamic effects of fiscal policy are either ignored completely or not modeled carefully in existing empirical work, i.e. not sufficient attention is paid on distinguishing the transitional from the long-run effects of fiscal policy. Moreover, it is likely that there is dependence between explanatory variables and the rate of growth (Wagner's law) and correlation of the fiscal variables with initial GDP. Furthermore, the linear structure imposed on most empirical models is convenient but not necessarily realistic and consistent with the underlying theory. In addition, examination of the sample searching for outliers as well as testing for parameter heterogeneity is not conducted in most studies.

In this paper, we try to deal with most of these shortcomings. First, we include a richer menu of policy effects and sub-categories of spending-taxes than previous studies as potential determinants of growth. Regarding the misspecification of the growth equation related to the government budget constraint, we conduct our estimations from a general to specific specification by omitting variables with statistically insignificant growth effects. Furthermore, we test for lagged effects on growth of variables for which theory and intuition would suggest so and allow the data to determine the appropriate number of lags in static and dynamic panel data models. Besides these, we employ estimation methods appropriate for panel data of satisfactory quality, which however limits our sample in terms of both the cross-section and time-series dimensions. As for potential endogeneity problems arising due to Wagner's Law, we apply GMM estimation techniques using predetermined values of the right-hand side variables as instruments, not simply IV estimation used in most of the literature. Also, we incorporate nonlinear effects of government spending and taxation variables on growth, whenever this is theoretically plausible. Furthermore, we allow for parameter heterogeneity of variables' coefficients across countries. We also endogenize social spending, the single most important, quantitatively, component of public spending, i.e. we estimate a system of simultaneous equations determining jointly social spending and per capita growth. Finally, we use annual data, not multiple-year averages as in most of the relevant papers.

4. EMPIRICAL RESULTS

4.1 Data

As mentioned in Section 2, the basic models of endogenous growth assume a classification of fiscal instruments into 4 types, i.e. productive/unproductive expenditures and distortionary/non-distortionary taxation. So, we aggregate the various types of expenditures and revenues in the functional classification of IMF and OECD into these four categories adding "other expenditures" and "other revenues" in the cases where the classification by these organizations is not given. Our classification is shown in Table 1.

Table 1. Theoretical/Functional classification of fiscal policy instruments

Theoretical classification	**Functional classification**
Distortionary taxation	Taxes on income and profits
	Social security contributions
	Taxes on payroll and workforce
	Taxes on property
Non-distortionary taxation	Taxes on domestic goods and services
Other revenues	Customs and import duties
	Taxes on exports
	Other taxes on international trade and Transactions
	Other taxes
	Non-tax revenues
	Grants
Productive expenditures	Social security benefits-social assistance grants (social spending)
	Expenditure on public order-safety
	Expenditure on education
	Expenditure on health
	Expenditure on housing-community amenities
	Expenditure on fuel-energy
	Expenditure on transportation-communication

Unproductive expenditures	Expenditure on general public services
	Expenditure on defense
	Expenditure on recreational-cultural-religious affairs
	Expenditure on agriculture-forestry-fishing-hunting
	Expenditure on mining-manufacturing-construction, except fuel-energy
	Expenditure on other economic services
	Expenditure on other functions

Note: functional classifications refer to the classifications given in the data sources.

The theoretical classification is done according to the definitions of the four types of fiscal instruments in the beginning of Section 2. However, regarding the classification of government spending, we will estimate the impact on growth of the various categories characterized as productive expenditures separately. This way, we will actually test whether they belong to this category.

We use an unbalanced panel data set covering 16 OECD countries. The observations are annual and their number differs for each country according to data availability, but they are 118 in total and cover the period 1970-1997. They are from OECD Statistical Compendium, the SourceOECD electronic database and the IMF Government Finance Statistics.

Table 2 displays the basic descriptive statistics for the variables used in the estimations, the only difference compared to most studies being that the median is used instead of the mean as measure of the central tendency of the distribution of each variable (for variables' definitions see the Appendix). We see that the per capita income of the countries in our sample grew at about 2.2% per annum. Spending on education and health is about the same, approximately 5.5% on each of them. Social spending was almost three times as much, about 14%, while spending on transport-communication was around 2.6% of GDP. Public expenditures on housing-community amenities and fuel-energy were equal to 1.2% and 0.3%. Besides these, government spending on public-order safety and defense amounted to 1.6% and 2.6% of GDP respectively, while general public services, non-productive expenditures and other expenditures accounted for 3.2%, 14.9% and 5.5% of GDP respectively. These expenditures were financed mainly by distortionary taxes, which amounted to 22.3% of GDP, non-distortionary taxes and other revenues equal to 9.9% and 13.8% of GDP respectively. The budget was on surplus of 2%. However, for most variables there is huge variation between countries, as is evident from the last three columns of Table 2. For example, growth ranges from –2.6% to 6.2%, social spending from 2.4% to 21.1% of GDP, spending on education can be as low as 3.8% and as high as 8.1% of GDP and health expenditures are between 3.4% and 7%. Furthermore, distortionary taxation is from 12.5% to 30.5% and we observe deficit equal to 13.4% and surplus of 17% of GDP.

As far as the non-fiscal variables are concerned, the degree of openess was 50.6%, investment spending was around 21.3% of GDP, labour force participation was 71.3%, and employment growth was only 0.6% per year. Also, the replacement ratio was rather low, 24.6%, while the wage share and dependency ratio were equal to 63.5% and 85.9% respectively. However, in all cases there is large variation in the value of these variables across countries.

Table 2. Descriptive statistics

Variable	**Median**	**Std Deviation**	**Minimum (Country)**	**Maximum (Country)**
YG	0.022047	0.018627	-0.025602 (Australia)	0.062007 (Denmark)
Y0	13789.13965	3078.38282	5503.13916 (Portugal)	18182.57031 (Denmark)
EDY	0.053209	0.010120	0.037879 (Spain)	0.080817 (Belgium)
HY	0.054778	0.0064158	0.033999 (Portugal)	0.069711 (Germany)
HSY	0.012403	0.0055780	0.0049512 (Australia)	0.033656 (U.K)
SSY	0.14007	0.039106	0.023948	0.21136

			(Belgium)	(Denmark)
TCY	0.025815	0.0096733	0.012104 (U.K)	0.058037 (Belgium)
ENY	0.0026732	0.0014011	0.00032526 (Australia)	0.010450 (U.K)
GPSY	0.033095	0.010255	0.012743 (Spain)	0.056826 (Germany)
POY	0.015873	0.0036418	0.0097834 (Denmark)	0.026072 (Portugal)
DEFY	0.022315	0.0093213	0.012798 (Spain)	0.052743 (U.K)
NPRGY	0.13289	0.034561	0.097166 (Australia)	0.21731 (Denmark)
OGY	0.051493	0.029436	0.012692 (Germany)	0.11678 (Italy)
GY	0.48416	0.074157	0.33653 (Australia)	0.62411 (Denmark)
DTY	0.22303	0.044482	0.12491 (Portugal)	0.30513 (Denmark)
NDTY	0.098604	0.029173	0.063848 (Australia)	0.17124 (Denmark)
OTY	0.13799	0.057724	0.014864 (Italy)	0.27140 (Denmark)
BY	0.020001	0.076116	-0.13422 (Italy)	0.17012 (Denmark)
LFP	0.71277	0.071973	0.56544 (Spain)	0.84089 (Denmark)
EMG	0.0059824	0.034819	-0.044297 (Spain)	0.31349 (Germany)
IY	0.21313	0.030906	0.15779 (Belgium)	0.29361 (Portugal)

OPEN	0.50633	0.20037	0.28900 (Australia)	1.46796 (Belgium)
ULC	100.36660	53.01275	73.70421 (Denmark)	293.25250 (Australia)
RR	0.24631	0.084770	0.032762 (Belgium)	0.46408 (Denmark)
WS	0.63463	0.037316	0.52520 (Italy)	0.70447 (U.K)
DR	0.85880	0.15137	0.69093 (Denmark)	1.46004 (Spain)

4.2 Methodology

4.2.1 Specification

4.2.1.1 A benchmark equation

Before we analyze the models of interest, we will estimate a benchmark equation in the spirit of the basic regression in Barro-Sala-i-Martin (1995, BS from now on) to check if our results resemble those of the authors. The difference of our work with that of BS is that we focus on the effect of economic policy variables on growth, instead of searching for the determinants of growth in general.

We use a framework that relates the per capita growth rate to two types of variables: a) initial levels of variables, initial GDP per capita in our case; b) control variables, some of which are chosen by governments and others by private agents, such as private investment, government expenditure on education, total government spending, an index of international competitiveness and an interaction term of initial GDP per capita and public spending on education. The equation estimated is the following:

$$YG = a_0 + a_1 * Y0 + a_2 * Y0EDY + a_3 * \sum_{b=0}^{c} EDY(-b) + a_4 * \sum_{b=0}^{c} IY(-b) + a_5 * \sum_{b=0}^{c} GY(-b) + a_6 * \sum_{b=0}^{c} ULC(-b) + u_{1it}$$

(2)

where *YG* is growth of per capita income, *Y0* stands for initial income per capita (both in $US and 1990 prices/exchange rates), *Y0EDY=Y0*EDY* is an interaction term, *EDY* represents public education spending as fraction of GDP, *IY, GY* stand for investment and total government expenditures as percentages of GDP respectively. The inclusion of *Y0EDY* tests the hypothesis that the effect of education spending on growth differs with the level of initial GDP per capita. Finally, *ULC* is an index of international competitiveness (for details on definitions of variables, data sources etc. see the Appendix).

Also, most variables are assumed to have both contemporaneous and lagged effects on growth and the summation operators are used to capture their long-run (cumulative) impact on growth. In this context, $b = 0,...,c$ is the number of periods (years in our case) during which *EDY, IY, GY,* and *ULC* influence growth. The estimation results are presented in Section 4.3.1.

4.2.1.2 Single-equation model

Equation (2) is not very informative for our purposes, since we want to test the predictions of endogenous growth models about the relationship of the structure of public spending/taxation and economic growth. In contrast, equation (2) includes only a few components of government spending and excludes taxation completely. As a result, our estimation procedures for (2) suffer from the misspecification of the budget constraint problem analyzed in Section 2.

So, we proceed in the spirit of KBG (1999, 2001), but refine their work in several ways. First, in the equation to be estimated, we include all the elements of the government budget constraint for which we were able to get sufficient data and decompose government expenditures. Furthermore, we would like to test whether the effects on growth of unproductive government expenditures financed by non-distortionary taxation are statistically insignificant as implied by the theories of endogenous growth. Our only problem is that we do not have a sufficient number of observations on net borrowing to include this component of fiscal policy in the equation to be estimated and we omit it. However, in the first two models estimated, we use non-distortionary taxation and non-productive expenditures as implicit financing elements of a change in the rest of the fiscal variables. We confirm the hypothesis that unproductive government spending and non-distortionary taxation have non-statistically significant coefficients, therefore they share a common coefficient in (4). So, we impose a zero coefficient on both variables and omit them from the models presented below.[1]

Additionally, we incorporate initial GDP per capita terms as a fourth degree polynomial according to recent results of a nonlinear relationship between growth and initial income to isolate possible convergence effects (see Kalaitzidakis et al, 2001). We also include a measure of business cycle fluctuations, *BC*, to capture business cycle effects on growth.[2] Also, we include investment as proportion of GDP, *IY*, and employment growth, *EMG*, in our equation, since capital and labour are the main factors of production in all growth models. Furthermore, we take into account the impact of labour force participation, *LFP*, including it separately in our model, while KBG use labour force growth instead. We use the same index of competitiveness, *ULC*, as in (3) to account for external effects on the economy.

Also, we use the following interaction terms: *SY=SSY*Y*, *EY=EDY*Y*, *HEY=HY*Y*, where *SSY* is social spending as fraction of GDP, *Y* is GDP per capita in $US and 1990 prices/exchange rates and *EDY, HY* stand for government spending on education and health respectively as a proportion of GDP. The inclusion of these terms tests the hypotheses that the impact of expenditures on social security-social assistance, education and health varies with the GDP per capita of the countries. This way, we allow for heterogeneity of the coefficients of government spending on education, health and social services across countries.

Besides these, we use the squares of the government spending variables assumed to be productive to test the theoretical prediction of many endogenous growth models for non-linear effects of these variables on growth (see BS, Devarajan et al., 1996). The same non-linear form is used for distortionary taxation in order to investigate possible non-linear growth effects of distortionary taxes. The general form of these newly constructed variables is $X2 = X * X$, where X is the original variable.

In the second version of the estimated equation, we incorporate a lagged GDP per capita growth term, i.e. we estimate a dynamic panel model. Finally, we use the sums of

[1] For space considerations all estimation results are not reported, but they are available from the author upon request.
[2] The business cycle variable was constructed using the Hodrick-Prescott filter.

contemporaneous and lagged values of most right-hand side variables to detect their long-run impact on growth (see discussion in Section 4.2.1.1).

Consequently, the equation used to examine empirically the impact of fiscal policy on growth in Section 4.3.2 is the following:

$$YG = d_0 + d_1 * \sum_{e=0}^{f} SSY(-e) + d_2 * \sum_{e=0}^{f} LFP(-e) + d_3 * \sum_{e=0}^{f} OTY(-e) + d_4 * \sum_{e=0}^{f} OGY(-e) +$$
$$+ d_5 * \sum_{e=0}^{f} BY(-e) + d_6 * \sum_{e=0}^{f} DTY(-e) + d_7 * \sum_{e=0}^{f} EDY(-e) + d_8 * \sum_{e=0}^{f} HY(-e) + d_9 * \sum_{e=0}^{f} HSY(-e)$$
$$+ d_{10} * \sum_{e=0}^{f} POY(-e) + d_{11} * \sum_{e=0}^{f} ENY(-e) + d_{12} * \sum_{e=0}^{f} TCY(-e) + d_{13} * Y0 + d_{14} * Y02 + d_{15} * Y03 +$$
$$+ d_{16} * Y04 + d_{17} * \sum_{e=0}^{f} IY(-e) + d_{18} * \sum_{e=0}^{f} EMG(-e) + d_{19} * \sum_{e=0}^{f} ULC(-e) + d_{20} * \sum_{e=0}^{f} SY(-e) +$$
$$+ d_{21} * BC + d_{22} * \sum_{e=0}^{f} EY(-e) + d_{23} * \sum_{e=0}^{f} HEY(-e) + d_{24} * \sum_{e=0}^{f} SSY2(-e) + d_{25} * \sum_{e=0}^{f} EDY2(-e) +$$
$$+ d_{26} * \sum_{e=0}^{f} HY2(-e) + d_{27} * \sum_{e=0}^{f} HSY2(-e) + d_{28} * \sum_{e=0}^{f} POY2(-e) + d_{29} * \sum_{e=0}^{f} ENY2(-e) +$$
$$+ d_{30} * \sum_{e=0}^{f} TCY2(-e) + d_{31} * \sum_{e=0}^{f} DTY2(-e) + d_{32} * YG(-1) + u_{2it}$$

(3)

In (3), *YG* is the growth of GDP per capita and the fiscal policy variables are defined as follows:

SSY: Social spending/GDP

OTY: Other revenues/GDP

OGY: Other expenditure/GDP

BY: Budget surplus/GDP

DTY: Distortionary taxation/GDP

EDY: *Expenditure on education/GDP*

HY: Expenditure on health/GDP

HSY: *Expenditure on housing-community amenities/GDP*

POY: Expenditure on public order-safety/GDP

ENY: Expenditure on fuel-energy/GDP

TCY: Expenditure on transportation-communication/GDP

4.2.1.3 Simultaneous-equations models

In addition to the single-equation models analyzed above, we estimate a system of simultaneous equations, where the first equation is (3) and in the second equation we endogenize the social spending variable SSY (see Bellettini-Ceroni, 2000). We proceed in this way for three reasons.

First, our analysis corresponds to the two stages we typically follow when we study growth models with policy. In the first stage, we solve the agents' problem who maximize their utility choosing the variables of interest and take economic policy as given. This is the decentralized competitive equilibrium. This stage corresponds to the estimation of equation (3) with the single-equation methods outlined above. In the second stage, policy makers optimize with respect to the policy instruments (social spending in our case) taking into account the decentralized competitive equilibrium. This stage is implemented by endogenizing social spending using simultaneous-equations methods. The second reason for undertaking the estimation of a simultaneous-equations model is to increase the efficiency of our estimates relative to the single-equation models and the third reason is to check the robustness of the results obtained by single-equation methods.

Regarding the specification of the social spending equation, according to Atkinson (1999) the level of social spending is affected by the replacement rate (average benefit/average wage), the wage share (average wage/GDP per worker) and the dependency ratio (recipients/workers). As a consequence, social spending can be high due to either high generosity of the welfare state system (replacement rate) and/or a high wage rate relative to GDP per worker and/or a large number of people who receive welfare benefits (dependency ratio). Thus, it is not necessary that a high level of social spending coincides with a generous welfare state system, i.e. a high replacement rate.[3] In this framework of analysis, we use the replacement rate, the wage share and the dependency ratio as determinants of the social spending (see also Razin et al. 2001, 2002).

Furthermore, Rodrik (1998) pointed out that there exists a positive correlation between the exposure of an economy to international trade and the size of its government, as given by various measures of public spending as share of GDP. The explanation he

---

[3] This point is also relevant if the benefit generosity is believed to have an adverse impact on economic behaviour.

gave for this empirical regularity is that government spending provides social insurance against external risk. An associated hypothesis is that the risk-reducing role of government spending is most prominent in the context of social spending, especially in the advanced countries, which have greater administrative capability to maintain welfare systems than the developing countries. He also confirmed these hypotheses empirically for a large sample of low and high-income countries. Following this rationale, we incorporate an index of the openness of the economy, *OPEN*, in the equation of the determinants of social spending. This is included in summation form and reflects our belief that the impact of openness on growth has a long-run character.

In addition, we include the initial GDP per capita in the social spending equation to test whether initial conditions play a role in the determination of social spending. Finally, we incorporate one variable capturing business cycle effects, *BC* (it is the same as the one used before in the estimation of equation (3)), and another variable measuring trend growth, *TR*. This way we isolate the influence of business fluctuations and growth on social expenditure.

Furthermore, since previous empirical evidence suggests that there are lagged effects of fiscal policy, in order to distinguish the effects of policy during transition from those on the steady state, we use sums of contemporaneous and lagged values of the relevant variables in our models. Following the same rationale, we allow most non-fiscal variables to have lagged effects on growth.

With those mentioned above in mind, we will estimate in Section 4.3.3 the following system of equations:

$$YG = d_0 + d_1 * \sum_{e=0}^{f} SSY(-e) + d_2 * \sum_{e=0}^{f} LFP(-e) + d_3 * \sum_{e=0}^{f} OTY(-e) + d_4 * \sum_{e=0}^{f} OGY(-e) +$$

$$+ d_5 * \sum_{e=0}^{f} BY(-e) + d_6 * \sum_{e=0}^{f} DTY(-e) + d_7 * \sum_{e=0}^{f} EDY(-e) + d_8 * \sum_{e=0}^{f} HY(-e) + d_9 * \sum_{e=0}^{f} HSY(-e)$$

$$+ d_{10} * \sum_{e=0}^{f} POY(-e) + d_{11} * \sum_{e=0}^{f} ENY(-e) + d_{12} * \sum_{e=0}^{f} TCY(-e) + d_{13} * Y0 + d_{14} * Y02 + d_{15} * Y03 +$$

$$+ d_{16} * Y04 + d_{17} * \sum_{e=0}^{f} IY(-e) + d_{18} * \sum_{e=0}^{f} EMG(-e) + d_{19} * \sum_{e=0}^{f} ULC(-e) + d_{20} * \sum_{e=0}^{f} SY(-e) +$$

$$+d_{21}*BC+d_{22}*\sum_{e=0}^{f}EY(-e)+d_{23}*\sum_{e=0}^{f}HEY(-e)+d_{24}*\sum_{e=0}^{f}SSY2(-e)+d_{25}*\sum_{e=0}^{f}EDY2(-e)+$$

$$+d_{26}*\sum_{e=0}^{f}HY2(-e)+d_{27}*\sum_{e=0}^{f}HSY2(-e)+d_{28}*\sum_{e=0}^{f}POY2(-e)+d_{29}*\sum_{e=0}^{f}ENY2(-e)+$$

$$+d_{30}*\sum_{e=0}^{f}TCY2(-e)+d_{31}*\sum_{e=0}^{f}DTY2(-e)+d_{32}*YG(-1)+u_{2it} \quad (3)$$

$$SSY=g_0+g_1*RR+g_2*WS+g_3*DR+g_4*\sum_{h=0}^{i}OPEN(-h)+g_5*BC+g_6*TR+ \quad (4)$$
$$+g_7*Y0+u_{3it}$$

4.2.2 Estimation

In order to estimate equations (2)-(3), we first apply standard static panel econometric techniques.[4] We use these methods in an effort to overcome estimation problems that arise in cross-section growth empirics and may bias the coefficient estimates, i.e. omitted variables, endogeneity and measurement errors. Also, panel data contain a larger amount of information relative to time-series or cross-section data, thereby increasing the efficiency of the estimates obtained.

Specifically, in the presence of persistent heterogeneity across countries, arising from differences in initial technology level or country-specific historical and cultural factors, which are unobservable and, therefore, omitted from the specifications to be estimated, the estimates will be biased if the explanatory variables are correlated with these factors. The problem may be represented by $E(u_{it}/X_{it})=E(a_i/X_{it})\neq 0$, where $u_{it}=a_i+v_{it}$ (5) is the error term in equation (1) (see Section 2), $i=1,...,N$ countries, $t=1,...,T$ time periods. Panel data estimation deals with this problem in various ways, which differ in the treatment of a_i. We first use the "fixed effects estimator", which considers a_i as a time invariant unknown parameter that differs across countries. This constant term captures differences among countries and is estimated for each one of them. Afterwards, the "random effects" estimator is utilized, which assumes that country-specific constant terms are drawn from a distribution of constant terms across countries.

[4] We do not conduct explicit econometric testing of the cross-equation overidentifying restrictions implied by any particular model. Also, we do not work in the RBC tradition in order to reproduce the main moments of the data.

Specifically, $a_i = a + \eta_i$, $a_i \sim N(0, \sigma_a^2)$, where a is the group intercept and η_i is the error term related to country i. The error term of equation (1) given in (5) becomes now $u_{it} = v_{it} + \eta_i$ and it is assumed that $E(a_i / v_{it}) = E(a_i / X_{it}) = 0$.

We estimate our models initially by OLS with White-corrected standard errors and select the appropriate model specification using the R^2-adjusted, Akaike Information Criterion and Schwartz Bayesian Information Criterion as selection criteria[5] taking into account the efficiency of the parameter estimates of the various models. We choose the model(s) with the highest R^2-adjusted and the lowest absolute value for the two information criteria (see Greene, 1993) which are also superior in terms of efficiency of the parameter estimates. Then, we estimate the chosen models using fixed effects (LSDV) and random effects (GLS) estimators, and conduct F-tests for equal intercepts between countries and Hausman specification tests for the selection of the proper specification of the constant term (fixed effects vs. random effects).

In addition to these estimation methods, we employ GMM to our panel data set.[6] We estimate two versions of GMM for each of our models. In the simple one, we assume that the errors are serially independent and conditionally homoscedastic (henceforth GMM1). This coincides with 2SLS in the case of single-equation models and 3SLS when we estimate simultaneous-equations models. In the more complicated version, we allow for conditional heteroscedasticity and autocorrelated disturbances of second order, which we call GMM2 from now on. After estimating our equations with both versions of GMM, we perform a specification test of our models testing the validity of the overidentifying restrictions.[7] Only models that pass this specification test will be presented.[8]

---

[5] It is hard to derive adequate selection criteria for the conditioning variables, see e.g. Bellettini et al, 2000.

[6] GMM is a semiparametric estimation procedure, i.e. it does not require a complete knowledge of the probability distribution of the data. Specifically, in order to increase the amount of information in the form of moment conditions that our estimator exploits, we increase the number of moment conditions so that it is larger than the number of parameters to be estimated. Afterwards, we minimize the properly normalized distance between the theoretical moments and their empirical counterparts. So, our estimator depends on the distance matrix and the instrumental variables we use to construct the empirical moment conditions. The GMM estimator (GMME) is strongly consistent and asymptotically normal. The asymptotic variance of the GMME depends on the distance matrix and the optimal distance matrix is the variance matrix of the orthogonality conditions. So, we estimate the parameters of the model using the identity matrix and then compute the variance matrix of the orthogonality conditions. We then estimate the parameters again using the estimated variance matrix and compute new values for the parameters until a convergence criterion is fulfilled.

[7] This test was introduced by Sargan (1958) and extended by Hansen (1982) (see Baltagi, 2001).

Since we introduce the possibility of lagged effects of the independent variables on growth, we allow the data to determine the appropriate number of lags. However, static panel estimation methods may generate biased and/or inefficient coefficient estimates when applied to panels with predetermined right-hand-side and/or lagged dependent variables due to the potential endogeneity of the conditioning variables. To overcome such problems, we employ instrumental variables. We use predetermined values of the explanatory variables and lagged growth as instruments, thus exploiting the time-series dimension of our panel data set (see Judson-Owen 1999, Bun-Kiviet 2001 for a discussion of dynamic panel data estimation).

Finally, we estimate jointly the system (3)-(4) by GMM1, GMM2, i.e. the same versions of GMM with the single-equation case. We employ simultaneous equation methods, since the joint estimation of a system of equations gives in general more efficient estimates compared to the estimation of each equation separately.

4.3 Empirical results

4.3.1 Benchmark equation

Following the methodology described in Section 4.2 and based on the findings of Jones (1995), Kocherlakota-Yi (1997) and KBG (2001) (see KBG, 2001 for a review of the empirical literature) we estimate (2) with a maximum of 7, 8, 9 periods allowed for the full impact of *EDY, GY, IY* and *ULC* on growth. This implies a reduction in the number of countries in our sample from sixteen to thirteen (see Table 3 for the countries included). The model selection criteria imply that the version of (2) with 8 lags best captures the long-run behaviour of the fiscal variables.[9] Regarding the panel data estimates, an F- test of the null hypothesis of common constant terms rejects this hypothesis and the Hausman test rejects the random effects (RE) specification in favour of fixed effects (FE). This is expected given the heterogeneity of the countries in our sample. We apply the fixed effects method and then GMM using predetermined values of the independent variables as instruments. The fixed effects estimates and the GMM

---

[8] We also iterate the variance matrix of the orthogonality conditions using starting values from 2SLS or 3SLS. By allowing for heteroscedasticity and serial correlation of the errors and by iterating the variance matrix of the orthogonality conditions, we aim at increasing the efficiency of our estimates.

[9] This is in accordance with the findings of the above authors.

estimates which pass the overidentifying restrictions test (see Section 4.2.2) are presented in Table 3.

From Table 3, we see that public education spending affects growth positively, as one would expect, since it increases the human capital stock of the countries; this is in accordance with the results in BS. The statistically significant negative coefficient of *Y0EDY* demonstrates that the growth impact of government spending on education weakens the higher the initial per capita income of a country, i.e. the growth benefit of education is higher in initially poorer countries. This is intuitively appealing since education is likely to be most beneficial in countries, where the educational level of the population is low. It is also consistent with empirical evidence that the returns to education are higher in poorer countries (see Psacharopoulos, 1985).

Table 3. Benchmark equation estimates

Model 1		
Dependent variable: YG	FE	GMM2
Independent variables	Estimated coefficient (t-statistic)	Estimated coefficient (t-statistic)
Y0	0.350161E-04** (2.29079)	-0.109272E-04*** (-2.69002)
Y0EDY	-0.832595E-04** (-2.47571)	0.184703E-04** (2.00176)
EDY	1.65102*** (3.03015)	-0.285776 (-1.63780)
IY	-0.072933*** (-2.85527)	-0.010745 (-1.12357)
GY	-0.024177 (-1.10233)	0.298960E-02 (0.660256)
ULC	-0.256741E-04** (-2.06168)	0.108144E-04 (1.26332)
COUNTRY INTERCEPTS		CONSTANT

Germany	-0.41265	0.183871*** (2.56714)
France	-0.43584	
Italy	-0.40999	
UK	-0.44826	
Denmark	-0.41779	
Spain	-0.38794	
Portugal	-0.51022	
S. Korea	-0.14825	
Australia	-0.42125	
Norway	-0.36148	
Iceland	-0.44944	
US	-0.44513	
Sweden	-0.42625	
	d.f=80	d.f=3
F-test of a_0 vs. a_{0i}	P-value=0.0083	**Overidentifying restrictions test**
Hausman test of RE vs. FE	P-value=0.0027	P-value=0.187

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

Besides these, total government spending has a statistically insignificant effect on growth. This might reflect the fact that a large portion of government spending is unproductive or even if it is productive it is financed mainly by distortionary taxes (see Table 2) which cancels out its growth-enhancing effects.

Furthermore, investment seems to be negatively related to growth, when the relation is statistically significant. Although this is puzzling from a theoretical point of view, BS found a positive but statistically insignificant relation between growth and investment and concluded that the causation runs from growth to investment, i.e. investment is endogenous (see also KBG, 1999 for a similar result).

The competitiveness index has a negative impact on growth, when it is statistically significant. This is expected, given that a higher value of the index implies higher relative unit labour cost in manufacturing and deterioration in the export market position of a country. This is consistent with the positive effect of growth in the terms of trade on per capita growth found by BS.

Finally, it seems that fixed effects and GMM imply a statistically significant coefficient of opposite sign for *Y0*. Theory and previous empirical findings (see e.g. BS, Cashin 1995, KBG 1999, Brons et al. 2000) suggest that the GMM result is more reasonable. However, the data is not definitive with respect to conditional convergence as predicted by the neoclassical growth models.

As a conclusion, we could say that the results we get from (2) are broadly consistent with those of BS, with the exception of the effect of initial income per capita on growth.

4.3.2 Single-equation models

We estimate two versions of the single-equation model in (3), the second one including the lagged GDP growth term in addition to the terms of the first version. Initially, we test the hypothesis that unproductive government spending and non-distortionary taxation are characterized by statistically insignificant coefficients and can not reject this hypothesis, therefore they share a common coefficient. So, we impose a zero coefficient on both variables and omit them from the models presented below (see Section 4.2.1.2 and Section 2 for details).

We follow the methodology described in Section 4.2 and estimate the cumulative effects of most explanatory variables over 7, 8 and 9 periods. The preferred models according to the information criteria and R^2-adjusted are those involving nine lags, which is not much different from what previous authors have found (see KBG, 2001). In other words, it takes nine years for fiscal policy variables to have their long-run effect on growth. Afterwards, we estimate (3) with panel data and GMM methods. The relatively large number of right hand-side variables and lags implies that the number of countries involved in the estimations declines significantly, from thirteen to eight, in comparison with the benchmark regressions, since we use an unbalanced data set.[10] The countries with more data are usually the richer countries, therefore the sample is more homogeneous than before. So, unlike the results of the previous section, F-tests can not reject the hypothesis of equal constant terms in the panel regressions. The random effects is the preferred estimation method, since both our intuition and Hausman tests imply that the constant term is not correlated with the explanatory variables. We report the random effects and GMM estimates for the preferred static and dynamic panel models in Tables 4-5.[11] The coefficients reported are those of the summation operators of the variables, whenever this is implied by (3).

Table 4. Static panel estimates

Model 2			
Dependent variable: YG	**RE**	**GMM1(2SLS)**	**GMM2**
Independent variables	**Estimated coefficient (t-statistic)**	**Estimated coefficient (t-statistic)**	**Estimated coefficient (t-statistic)**
CONSTANT	-109.059* (-1.84248)	-182.721*** (-13.5826)	-51.1810*** (-26.5624)
SSY	1.17403* (1.69533)	3.84924* (1.93776)	2.70670*** (7.47910)
LFP	-0.339624** (-2.53200)	-0.794106*** (-2.78818)	-0.501739*** (-7.17472)
OTY	-0.041320 (-0.234497)	-0.600327 (-0.772903)	-0.133482** (-2.35480)
OGY	0.181914 (1.09255)	1.32317 (1.60522)	0.958573*** (12.0090)
BY	0.263677** (2.50463)	0.871381** (2.02301)	0.695206*** (7.59833)

[10] So, our sample now includes Germany, Italy, U.K, Denmark, Spain, Australia, Norway and U.S.A.
[11] A complete set of results is available from the author upon request.

DTY	-3.43085**	-8.42994**	-9.41692***
	(-2.45194)	(-2.40046)	(-148.708)
EDY	11.2487***	39.0250**	33.6726***
	(2.72291)	(2.53839)	(23.4244)
HY	25.8068***	87.1028***	82.2193***
	(2.71791)	(3.02257)	(18.2909)
HSY	-8.49987***	-25.0611**	-21.1951***
	(-2.76221)	(-2.44056)	(-8.41007)
POY	-13.7127	-48.8180	-30.3692***
	(-0.988236)	(-1.01873)	(-44.1948)
ENY	4.32605	51.7524	47.9703***
	(0.560948)	(1.04785)	(9.13416)
TCY	-7.95243***	-19.1597***	-18.2442***
	(-3.40950)	(-2.98540)	(-52.5638)
Y0	0.028831*	0.045812***	0.011484***
	(1.80299)	(17.9307)	(32.0603)
Y02	-0.287360E-05*	-0.465805E-05***	-0.133246E-05***
	(-1.85030)	(-28.9546)	(-53.6062)
Y03	0.124180E-09*	0.204401E-09***	0.655785E-10***
	(1.90147)	(60.4665)	(119.823)
Y04	-0.196299E-14*	-0.327578E-14	-0.115666E-14
	(-1.95062)	(0)	(0)
IY	0.099589	0.425046	-0.083519
	(0.473819)	(0.907830)	(-0.512593)
EMG	0.071836	0.405687***	0.283419***
	(1.26524)	(2.60545)	(7.72315)
ULC	0.175914E-04	0.166980E-03	0.388027E-03***
	(0.213089)	(0.655591)	(5.30759)
SY	-0.198970E-04	-0.368759E-04	-0.752892E-04***
	(-0.767526)	(-0.533772)	(-4.19078)
BC	0.010711***	0.026604***	0.030733***

	(3.23878)	(2.69809)	(26.6131)
EY	-0.115828E-03** (-2.02701)	-0.172511E-03 (-1.33706)	0.224777E-04 (0.520062)
HEY	0.606711E-04 (0.742125)	-0.239719E-04 (-0.135962)	-0.213706E-03 (0)
SSY2	-0.721634 (-0.264301)	-6.75943 (-0.870080)	-1.39033 (0)
EDY2	-77.7583*** (-2.56298)	-274.416*** (-2.74624)	-297.571 (0)
HY2	-198.463** (-2.52362)	-614.566*** (-2.65426)	-533.997*** (-14.8132)
HSY2	237.063*** (3.03259)	586.279*** (3.01309)	512.915*** (7.81968)
POY2	312.476 (0.832917)	1029.41 (0.862078)	407.304 (0)
ENY2	-14.7179 (-0.023900)	-2485.07 (-0.720078)	-2415.17*** (-5.73912)
TCY2	115.842*** (3.14886)	214.303*** (2.58809)	191.063 (0)
DTY2	7.28783** (2.30691)	16.8791** (2.10567)	18.7844 (0)
	d.f=27	d.f=3	d.f=13
F-test of d_0 vs. d_{0i}	P-value=0.4362	**Overidentifying restrictions test**	**Overidentifying restrictions test**
Hausman test of RE vs. FE	P-value=0.4014	P-value=0.620	P-value=0.992

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

Table 5. Dynamic panel estimates

Model 3			
Dependent variable: YG	**RE**	**GMM1(2SLS)**	**GMM2**
Independent variables	**Estimated coefficient (t-statistic)**	**Estimated coefficient (t-statistic)**	**Estimated coefficient (t-statistic)**
CONSTANT	-131.445*** (-4.34565)	167.315*** (28.9378)	-60.9345*** (-111.173)
SSY	0.816212** (2.28865)	-3.80597*** (-5.50060)	-2.21828*** (-10.6493)
LFP	-0.345213*** (-5.08473)	0.503608*** (3.03606)	-0.247376*** (-6.00652)
OTY	0.011608 (0.129395)	0.460726*** (3.27139)	0.174749*** (5.19754)
OGY	0.028805 (0.323858)	-0.921180*** (-5.32043)	-0.969581*** (-44.2878)
BY	0.207562*** (3.82356)	-0.283646** (-2.31041)	0.036937 (1.17915)
DTY	-2.73283*** (-3.79674)	1.19820** (2.01440)	1.79145*** (15.6168)
EDY	12.3163*** (5.86537)	0.862962 (0.209768)	4.11013* (1.64330)
HY	18.8931*** (3.79963)	4.85879 (0.513879)	-19.3096*** (-11.5409)
HSY	-7.08152*** (-4.48401)	-8.84146* (-1.89031)	4.66181*** (40.3067)
POY	-13.3554* (-1.90191)	63.0106*** (5.67691)	23.2488*** (20.9077)
ENY	-0.028591 (-0.717537E-02)	-23.2169** (-2.39599)	-32.0870*** (-50.6078)

TCY	-7.72441***	-6.18630	9.19520***
	(-6.53886)	(-1.03354)	(28.2961)
Y0	0.035114***	-0.046316***	0.016755***
	(4.29389)	(-41.8320)	(76.5751)
Y02	-0.348181E-05***	0.448918E-05***	-0.163368E-05***
	(-4.38420)	(62.9184)	(-59.3461)
Y03	0.149634E-09***	-0.188475E-09***	0.695042E-10***
	(4.48099)	(-126.976)	(40.9678)
Y04	-0.235219E-14***	0.290316E-14	-0.108494E-14***
	(-4.57187)	(0)	(-30.3458)
IY	0.043035	0.384072*	-0.104888
	(0.402571)	(1.93870)	(-1.23797)
EMG	0.101186***	0.133978	-0.062980**
	(3.45975)	(1.35482)	(-2.36104)
ULC	-0.359939E-04	-0.802178E-04	-0.150260E-03***
	(-0.838350)	(-1.12365)	(-4.47974)
SY	-0.260222E-04**	-0.433438E-04	-0.518651E-04***
	(-1.97631)	(-1.61519)	(-5.09092)
BC	0.010259***	0.011314	-0.748804E-02***
	(6.12170)	(1.59462)	(-4.52163)
EY	-0.153333E-03***	-0.966492E-04**	-0.518999E-04
	(-5.15607)	(-1.97162)	(0)
HEY	0.139149E-03***	0.130759E-03	0.408335E-03***
	(3.17414)	(1.39984)	(8.71247)
SSY2	1.26941	17.4010***	9.20247
	(0.887754)	(3.74299)	(0)
EDY2	-81.2600***	1.77160	-45.6383**
	(-5.28798)	(0.056998)	(-1.95660)
HY2	-163.555***	-85.4885	41.1470
	(-4.05636)	(-1.29920)	(0)
HSY2	205.399***	311.833***	46.3684

	(5.13605)	(3.38777)	(0)
POY2	321.798* (1.69496)	-1623.31*** (-6.41232)	-433.556 (0)
ENY2	160.772 (0.513139)	877.095 (1.43249)	1499.05 (0)
TCY2	123.896*** (6.63271)	96.0235 (1.14715)	-99.8805 (0)
DTY2	5.93518*** (3.66760)	-1.94764** (-2.25628)	-1.95943*** (-6.78722)
YG(-1)	-0.423667*** (-5.41351)	-1.08670*** (-5.26278)	-0.615891*** (-12.9870)
	d.f=26	d.f=8	d.f=19
F-test of d_0 vs. d_{0i}	P-value=0.5708	**Overidentifying restrictions test**	**Overidentifying restrictions test**
Hausman test of RE vs. FE	P-value=1.000	P-value=0.427	P-value=0.911

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

It is to be noted that in both versions of our model, with and without lagged GDP growth, the second method of GMM estimation (GMM2) gives more efficient estimates than the first method (GMM1). This is explained by the richer structure of disturbances and the optimal weighting matrix used by the former estimation method in contrast with the latter (see Section 4.2.2 for details). However, in the specification that incorporates lagged growth, the RE method gives more efficient estimates than GMM2. This apparently unexpected result can be justified by the relatively homogenous sample of countries included in the estimations, which makes unnecessary in this model the rich structure of disturbances and the optimal weighting matrix used by GMM2 compared with the RE method. Since GMM2 involves the estimation of many additional parameters in relation to RE, it consumes more degrees of freedom resulting in less efficient estimates.

Before we comment on the results of Tables 4-5, we should note that when the evidence on a government spending variable implies that there might exist a inverse U-shaped relationship between this variable and growth, there is an optimal (growth-maximizing) level of this type of expenditures. In other words, when spending is lower than this level, the relevant good/service is underprovided, while when spending is higher we have overprovision (see e.g. Barro 1990, Karras 1996, Brons et al 2000). So, when a spending category is found to have in some studies e.g. a negative growth effect, this might simply mean that it is provided in a scale larger than the optimal and not that it is generally bad for growth. In the cases where the results are not in favour of a non-linear relation, this might simply reflect the fact that the data points are clustered around the upward-sloping or downward-sloping part of the functional relationship.

Public expenditures on human capital

We begin the discussion about policies, which affect human capital accumulation, i.e. the quantity and quality of human capital, by noting that the conclusions are clear in most estimations which yield statistically significant results.

The most conclusive evidence exists with respect to government education expenditures. Education spending exhibits a statistically significant positive relationship with growth up to point and at higher levels of expenditures it seems, the evidence is quite robust, that it has a negative impact on growth. The growth-maximizing share of expenditure on education in GDP is between 6.6% and 7.6% for all but one estimate. So, the median value of this variable on our data (5.3%) is below the optimal level and this is confirmed by the positive effect of median education spending on growth, which means that a 1% increase of this type of expenditure as a share of GDP implies an increase in GDP growth between 3% and 9.8%. These effects are stronger the poorer a country is (see Tables 4-5 for the results).

Regarding public spending on health, we find an inverse U-shaped relationship with growth in most cases. The share of government expenditure on health, which maximizes growth, is estimated between 5.8% and 7.7%, which is higher than the median value of 5.5% actually observed. This causes an increase of 1% as a share of GDP to lead to a 1%-22% increase in GDP growth. Moreover, the effect of health expenditures seems to be stronger the richer a country is, although the relevant variable, *HEY*, is not statistically significant most of the time. This sort of impact suggests the possibility of positive externalities of better nutrition, housing and social infrastructure in wealthier countries on health spending.

Third, strong evidence exists for public expenditure on housing and community amenities, for which the relation with growth is of the U-shaped type, when it is statistically significant. So, this type of spending lowers growth initially up to a minimum and then it is growth-enhancing. This is an indication of economies of scale in the provision of social infrastructure. The level of housing spending, which minimizes growth is estimated at 1.4% to 2.1%. The lower median expenditure on housing (1.2%) explains the negative impact of this type of spending on growth at its median value estimated between 1.1% and 11.8% decline in growth for every 1% increase in housing spending as share of GDP.

These findings are partially consistent with the positive effects of government education expenditures reported in the review paper of Poot (2000), and similar effects of productive public spending (which includes expenditures on education, health and housing-community amenities) in KBG (1999, 2001). In addition, Trish (1997) found positive growth impact for education, health and housing spending. At the same time, our evidence implies non-linear effects of these types of spending on growth, which is sensible both theoretically (see e.g. BS, Brons et al., 2000) and empirically (Karras 1996, Kalaitzidakis et al, 2001). Also, the above results are somewhat consistent with the difficulty of Devarajan-Swaroop-Zou (1996, DSZ from now on) to get statistically significant estimates for health and education spending. However, Hanushek-Kimko (2000) found that although labour-force quality is important for growth and quality differences are related to schooling, these differences are not due to the resources devoted to schooling (see also Bils-Klenow, 2000), contrary to our results for a positive influence of public education expenditure on growth up to a level of spending.

Social Spending

The single-equation results regarding social spending are not very conclusive. In all six equations estimated the linear term is statistically significant and in four of them it is positive. The respective quadratic term is positive the only time when it is statistically significant, implying a U-shaped relationship of social spending and growth. This confirms the non-linearity hypothesis for the impact of government spending on growth put forward by BS among others (see relevant discussion for human capital). The growth-minimizing level of social spending is 10.9% of GDP. The fact that median social spending is higher (14%) explains why it has a positive growth impact, i.e. a 1% increase in its GDP share implies a 1.1% increase in GDP growth.

The above results for low levels of social spending are in line with the prediction of many growth models that redistributive policies have a depressing effect on physical capital accumulation and growth. For high levels of social expenditures, however, the findings are consistent with theoretical models implying that social security spending may e.g. positively influence savings, the level and productivity of physical and human capital investment, employment, international competitiveness and growth (see e.g. Bellettini-Ceroni, 2000, BC from now on, Lau et al., 2001 and Van Der Ploeg, 2003). On the empirical front, for high levels of spending our results confirm the findings of BC and Cashin (1995) who find a positive association of spending on social security and growth. But for low levels of social expenditures our evidence is in line with the theoretical predictions of Feldstein (1974). Atkinson (1999) in a survey of the literature concluded that the evidence on the relationship between the size of the welfare state and growth is mixed. But, our evidence might imply that a critical level of social spending must be reached before its beneficial impact outweighs its negative effects.

Moreover, the interaction term *SY* is negative and statistically significant in three out of six estimations implying that the influence of social spending on growth might weaken the higher the level of development of a country. This is consistent with the finding of BC that social security expenditure is most beneficial for growth in poor countries with an underdeveloped welfare state, e.g. low social spending.

Public expenditures on infrastructure/energy

As far as the public expenditures on transportation-communication are concerned, the estimation results imply an impact on growth of the U-shaped type, i.e. the effect on growth is negative for low levels of spending and turns positive afterwards. This is somewhat in line with growth models, which consider transportation and communication as very important ingredients of a country's infrastructure, which imply positive externalities to private producers, raise their productivity, therefore enhance economic growth. Our results are also partially consistent with evidence from both ER, who found a positive correlation of this kind of expenditure with growth, and DFZ, Trish (1997) who identified a negative growth impact. Our evidence might simply be explained by economies of scale in investments in the transportation-communication sectors. These imply that large scale spending is necessary before its productivity starts increasing leading to higher efficiency and growth in the whole economy. But before the economy reaches this stage, we might well have a growth depressing impact of expenditures on transportation-communication, due to the high initial cost of this type of infrastructure. The critical point where the growth effect of this type of spending turns from negative to positive is estimated between 3.1% to 4.5% of GDP. The median share of GDP devoted to transportation-communication expenditures is lower (2.6%) which is consistent with its negative impact on growth equal to 1.3%-9.1% for each percentage point increase in this type of spending as a share of GDP.

Finally, there is some evidence of a hump-shaped relationship of public spending on fuel-energy and economic growth, but the respective quadratic term is not statistically significant in most estimations and its sign is not stable throughout the estimations. The only time when the quadratic term is significant, the growth-maximizing share of expenditure on fuel-energy is about 1% of GDP, while the median share is 0.3%, so growth would increase if governments increased somewhat spending on fuel-energy.

Spending on public order-safety

We include expenditure on public order-safety in our estimated equations as an attempt to test the view expressed in some growth models that this type of spending contributes to the protection of property rights increasing the probability that the citizens retain these rights to their goods and services (see e.g. BS). Therefore, such models argue, the higher spending on public order-safety is, the stronger the incentive agents have to accumulate human/physical capital and this enhances growth.

However, our empirical results are not equally encouraging, since we are able to detect a statistically significant non-linear effect of spending on public order-safety on growth in only two out of six estimations. In one of these cases the estimates imply an inverse U-shaped relationship and in the other case a hump-shaped relationship between spending on public order-safety and growth. The growth-maximizing GDP share of this type of expenditure is 1.9%, i.e. higher than the median level observed in the data (1.6%).

This explains the positive growth effect of spending on public order-safety, i.e. it is compatible with the 11.5% increase in growth for a 1% increase in this type of expenditure at its median value, although the size of the impact is implausibly large. The growth-minimizing level of spending on public order-safety is 2.1%, so the corresponding growth impact is negative, equal to 3.1% for each percentage point increase in growth. Poot (2000) and DFZ reported insignificant or negative influence of defense spending on growth (this type of government expenditure could be considered to contribute towards protection of property rights of a country's citizens as a whole).[12]

Government revenues

Looking at the revenue side of the budget, we see that distortionary taxes have a non-linear statistically significant impact on growth in most cases. However, the type of non-linearity is not clear from the estimation results, since in two cases there seems to be a hump-shaped relationship and in three we find a U-shaped relationship between distortionary taxes and growth. These conflicting results might be due to the omission of net borrowing, which causes biases in the estimates. Generally, the impact of taxes on growth is expected to be statistically significant and negative by most growth models. But in models with productive government spending financed by distortionary taxes, the inverse U-shaped relation of spending and growth implies the same relation between growth and taxes assuming a balanced budget. In this context, the growth-maximizing GDP share of distortionary taxation is between 30.8% and 45.7%.

A related item is budget surplus, which is estimated to exert a statistically significant positive impact on growth in most cases. The positive growth effect is consistent with the theory of public finance, which argues that since a current surplus will finance future deficits through cuts in distortionary taxation or increases in productive spending, it causes an increase in the expected returns to current investment, therefore growth (KBG, 1999).

As far as the remaining types of public spending and revenues are concerned, "other expenditures" and "other revenues", when they affect growth statistically significantly, they have a negative and a positive impact respectively.

---

[12] Previous empirical evidence justifies the classification of defense expenditures as unproductive government spending in this paper. However, it is the most closely related category to public order-safety

The statistically insignificant findings or coefficients with theoretically implausible sign shown in the analysis of the growth effects of fiscal policy might be due to an inappropriate classification of some expenditure types as productive/unproductive, a question over which there is some debate (KBG, 1999). This point will be examined later in more detail (see Section 4.4). Also, such results might reflect the omission of the net borrowing variable due to lack of data. In other words, some findings may appear due to the incomplete specification of the budget constraint because of data limitations (see discussion in Section 2).

Non-policy variables

The relationship between per capita growth and initial GDP per capita is statistically significant in most estimations and captured by a fourth-order polynomial implying a non-linear convergence effect. This is consistent with recent empirical studies on convergence (see Kalaitzidakis et. al, 2001).

Moreover, investment is estimated to have a positive, mostly statistically insignificant, effect on growth. However, similarly inconclusive results are not uncommon in growth empirics, where it is sometimes argued that the causation runs from growth to investment and not the other way around, i.e. that investment is endogenous (see e.g. KBG, BS).

As far as the labour market variables are concerned, we are not always able to disentangle the impact of labour force participation from that of employment growth on per capita growth. So, the former has a negative impact on growth and the latter a positive growth effect when these effects are statistically significant in all but two cases.

Furthermore, competitiveness, measured by the *ULC* variable, affects growth negatively in one case and positively in another case, but is mostly insignificant. This in not theoretically plausible, since a higher value of the index, i.e. rising relative unit labour cost in manufacturing, should lower exports and growth. However, it is more likely that there are other factors except cost competitiveness which affect exports, therefore growth.

---

expenditure and this is why empirical results for defense spending are mentioned here.

In this context, it should be mentioned that competitiveness indicators are composed of many factors.[13]

Also, the business cycle variable enters the equations with a statistically significant positive sign in most cases. This simply indicates that when the economy is booming, growth rate is higher than otherwise and is therefore expected. Regarding lagged GDP growth, it has a negative impact on current growth in accordance with previous evidence (KBG, 2001).

4.3.3 Simultaneous-equations models

Following the methodology analyzed in Section 4.2, we estimate jointly by GMM1, GMM2 the system of equations (3)-(4). Based on the single-equation estimation results, we use the version of (3) involving nine lags of the fiscal policy variables and estimate two versions of (3), the second including lagged GDP growth (Model 5) in addition to the right-hand side variables of the first version (Model 4). For both versions of the system (3)-(4), we present the results of the GMM2 estimation method, which are reported in Table 6.

Table 6. Simultaneous-equations estimates

Model 4		**Model 5**	
Dependent variable: YG	**GMM2**	**Dependent variable: YG**	**GMM2**
Independent variables	**Estimated coefficient (t-statistic)**	**Independent variables**	**Estimated coefficient (t-statistic)**
CONSTANT	-74.1903*** (-4.57989)	**CONSTANT**	-128.544*** (-39.9387)
SSY	2.91742** (2.01124)	**SSY**	0.649104 (1.29399)

[13] These have to do with the macroeconomic performance of a country, the extent to which government policies are conducive to competitiveness, firms perform in an innovative, profitable and responsible manner and the extent to which basic, technological, scientific and human resources satisfy the needs of businesses (see e.g. De Grawe-Polan, 2003).

LFP	-0.501817** (-2.32048)	**LFP**	-0.375089*** (-10.3866)
OTY	-0.474886 (-0.939882)	**OTY**	0.044891 (0.949702)
OGY	1.15732* (1.81468)	**OGY**	0.038251 (0.788117)
BY	0.811992** (2.29080)	**BY**	0.218215*** (6.30897)
DTY	-9.12483** (-2.49557)	**DTY**	-2.95506*** (-55.6962)
EDY	38.1774*** (2.78774)	**EDY**	12.3735*** (26.0796)
HY	81.3815*** (2.76869)	**HY**	20.8281*** (24.9990)
HSY	-27.5192*** (-2.56899)	**HSY**	-7.56575*** (-24.3884)
POY	-40.7359 (-1.25043)	**POY**	-12.0995*** (-22.8657)
ENY	63.5951* (1.71276)	**ENY**	-1.41728 (-0.992499)
TCY	-21.4899*** (-2.77989)	**TCY**	-8.37021*** (-5.48396)
Y0	0.017815*** (5.32021)	**Y0**	0.034356*** (54.9818)
Y02	-0.197544E-05*** (-9.04115)	**Y02**	-0.340824E-05*** (-81.5108)
Y03	0.933104E-10*** (20.3535)	**Y03**	0.146567E-09*** (164.814)
Y04	-0.159127E-14 (0)	**Y04**	-0.230521E-14 (0)
IY	0.233617	**IY**	0.016969

	(0.403810)		(0.247462)
EMG	0.352853** (2.23206)	**EMG**	0.120691* (1.84794)
ULC	0.216560E-03 (0.967270)	**ULC**	-0.478204E-04 (0)
SY	-0.646365E-04 (-1.05762)	**SY**	-0.204481E-04** (-2.34966)
BC	0.033251** (2.47778)	**BC**	0.011351*** (9.74434)
EY	-0.139623E-03 (-1.23417)	**EY**	-0.156882E-03 (0)
HEY	-0.101926E-03 (-0.605745)	**HEY**	0.113380E-03*** (4.23906)
SSY2	-1.42006 (-0.241517)	**SSY2**	1.37345 (0.777291)
EDY2	-287.292*** (-2.60438)	**EDY2**	-81.5121 (0)
HY2	-541.405** (-2.54126)	**HY2**	-173.680 (0)
HSY2	632.415*** (2.80859)	**HSY2**	215.838 (0)
POY2	726.061 (0.940056)	**POY2**	285.022 (0)
ENY2	-3435.27 (-1.39159)	**ENY2**	320.771 (0)
TCY2	239.363** (2.50794)	**TCY2**	134.214*** (5.31139)
DTY2	18.0804** (2.27985)	**DTY2**	6.45403 (0)
		YG(-1)	-0.445331*** (-5.28995)

Dependent variable: SSY		**Dependent variable: SSY**	
Independent variables		**Independent variables**	
CONSTANT	-0.202036*** (-16.7873)	**CONSTANT**	-0.203816*** (-17.3870)
RR	0.531873*** (47.7361)	**RR**	0.532193*** (48.5052)
WS	0.185893*** (13.3657)	**WS**	0.188827*** (13.6665)
DR	0.121845*** (20.6623)	**DR**	0.121903*** (20.8469)
OPEN	-0.118272E-02** (-2.36638)	**OPEN**	-0.122116E-02** (-2.38920)
BC	-0.401272E-03*** (-3.36375)	**BC**	-0.389574E-03*** (-3.33434)
TR	-0.164098E-05*** (-3.78395)	**TR**	-0.161903E-05*** (-3.53066)
Y0	0.112405E-05*** (2.84606)	**Y0**	0.109398E-05*** (2.63016)
	d.f=37		d.f=78
	Overidentifying restrictions test P-value=0.146		**Overidentifying restrictions test** P-value=0.136

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

Looking at Table 6, we do not confirm the statement made in Section 4.2.2 on the increased efficiency of the system estimates of equation (3) in Table 6 relative to their single-equation counterparts in Tables 4-5. The efficiency loss in system estimation underlines the need for a more extensive search for appropriate instruments.

However, the findings confirm the results of the single-equation estimations with a few exceptions. The first is that social spending appears not to have a statistically significant impact on growth in one of the two models presented in Table 6, in contrast with the findings in Table 4, where the linear social spending term is always significant, although this is not the case with the quadratic term. This difference confirms that the relationship of social expenditure and growth is still an open question in the literature, both theoretically and empirically (Belletini-Cerroni, 2000). The second difference is that the linear coefficient of expenditure on public order-safety is statistically significant and negative in Model 5, while it is positive in two of the four cases, where it is significant in Models 2-3. The respective quadratic term is insignificant in Models 4-5 and statistically significant with unstable sign in two of the six cases in Models 2-3. The third main difference is that only the linear term of spending on fuel-energy is significant and positive in Model 4, while in Model 2 it has the opposite sign, when it is significant. The non-linear term is significant and negative in Model 2, while it is not significant in Model 4. Finally, the linear term of expenditure on fuel-energy is significant and negative in Model 3 and insignificant in Model 5.

Regarding equation (5), the results for the replacement ratio, wage share and dependency ratio are in accord with the predictions of Atkinson (1999), i.e. all these factors exert a positive influence on social spending. However, the openness indicator affects social spending negatively, which contrasts the findings of Rodrik (1998). A sensitivity analysis should be done in this case using alternative measures of exposure to external risk to check the impact of openness on welfare spending. Also, initial income per capita is strongly positively correlated with subsequent social spending, since initially rich countries have a greater administrative capacity to manage the welfare state in the future. Finally, a higher long-run growth rate (TR) and a booming economy (BC) imply lower social spending. These results could be explained by low natural unemployment and low cyclical unemployment, associated with high employment growth, arising from strong long-run growth and economic recovery. All these factors tend to reduce social expenditures, due e.g. to the decline in unemployment benefits.

4.4 Specification testing

The lack of robustness of the estimated effects of fiscal variables on economic growth in previous studies is obvious from the wide range of estimates (see Section 3 for examples). In this section, we examine the robustness of our earlier results to the classification of government expenditures into the productive and unproductive categories. Specifically, expenditures on general public services and defense are considered productive and social security expenditures unproductive in some previous work (see e.g. KBG 1999, 2001). We try this classification in the Models 2-3 including public spending on general public services (*GPSY, GPSY2= GPSY*GPSY)* and government defense expenditures *(DEFY, DEFY2= DEFY*DEFY*) in the productive public spending variables and excluding the variables related to social spending (*SSY, SSY2* and *SY*) from growth-enhancing public spending. The random effects estimation method is selected after the relevant F-tests and Hausman tests are conducted. Our estimation results imply that all four new elements of productive government expenditures do not have a statistically significant impact on growth suggesting that these types of expenditures should not be included in the productive components of public spending. As for the other fiscal variables, although estimates change somewhat, they are mostly robust compared with the results presented in Tables 4-5.

5. CONCLUSIONS

The composition of both sides of the government budget, spending and revenues, matters for balanced growth. This paper takes into account explicitly both sides of the government budget, since the policy variables in the growth regressions include both public revenues and expenditures. We also extend the work of KBG by disaggregating government spending in a more detailed way and endogenizing social spending, the most important, quantitatively, component of government expenditures. We find that some types of public spending and taxation affect growth, i.e. government spending on education and health displays a hump-shaped relation with per capita growth. However, the impact of education spending on growth is stronger the poorer a country is, while the opposite holds for expenditures on health. Also, public expenditures on housing-community amenities and social security-social assistance exhibit a U-shaped relation with growth and the effect of social spending on growth is stronger, the poorer a country is. Moreover, expenditures on fuel-energy display a hump-shaped relationship with growth and government spending on transport-communication is characterized by a U-shaped relation with growth. Furthermore, budget surplus contributes positively to growth, while a non-linear relationship between distortionary taxation and growth is detected, but its form is not robust to changes in model specification and estimation method.

Regarding social spending, it is positively affected by the replacement ratio, wage share, dependency ratio and initial income and negatively by openness. Finally, an economy in a recovery period and when characterized by rapid long-run growth contributes to a lower social spending.

We close with future extensions. We could update our data set including more recent data and more countries. We could also apply additional GMM estimation methods for dynamic panel data and seemingly unrelated regressions for the system of equations to check the robustness of our results. Finally, we might include additional variables in the social spending equation, like welfare benefit coverage and duration, as well as income distribution measures so as to test the predictions of various political economy theories.

APPENDIX

Definition of variables/Data sources

Y: GDP per head, $US in 1990 prices and exchange rates, OECD Statistical Compendium 1999/2.

YG: growth rate of real GDP per capita equal to $[Y - Y(-1)]/Y(-1)$.

Y0: initial GDP per head, $US in 1990 prices and exchange rates, OECD Statistical Compendium 1999/2.

EDY: *Expenditure on education/GDP* (local currency-current prices), OECD Statistical Compendium 1999/2, IMF Government Finance Statistics Yearbook 2000 and earlier issues.

HY: *Expenditure on health/GDP* (local currency-current prices), OECD Statistical Compendium 1999/2, IMF Government Finance Statistics Yearbook 2000 and earlier issues.

HSY: *Expenditure on housing-community amenities/GDP* (local currency-current prices), OECD Statistical Compendium 1999/2, IMF Government Finance Statistics Yearbook 2000 and earlier issues.

Social security benefits**:** payments made to individuals under social security schemes, usually out of a special fund (Glossary of Main Terms, OECD 1999).

Social assistance grants: cash grants to individuals and households, by public authorities, private non-profit institutions, and corporate and quasi-corporate enterprises, except social security benefits and unfunded employee welfare benefits (Glossary of Main Terms, OECD 1999).

SSY: (*Social security benefits+Social assistance grants)/GDP* (local currency-current prices), OECD Statistical Compendium 1999/2 and earlier issues.

TCY: *Expenditure on transportation-communication/GDP* (local currency-current prices), OECD Statistical Compendium 1999/2, IMF Government Finance Statistics Yearbook 2000 and earlier issues.

ENY: *Expenditure on fuel-energy/GDP* (local currency-current prices), OECD Statistical Compendium 1999/2, IMF Government Finance Statistics Yearbook 2000 and earlier issues.

GPSY: *Expenditure on general public services/GDP* (local currency-current prices), OECD Statistical Compendium 1999/2, IMF Government Finance Statistics Yearbook 2000 and earlier issues.

POY: *Expenditure on public order-safety/GDP* (local currency-current prices), OECD Statistical Compendium 1999/2, IMF Government Finance Statistics Yearbook 2000 and earlier issues.

DEFY: *Expenditure on defense/GDP* (local currency-current prices), OECD Statistical Compendium 1999/2, IMF Government Finance Statistics Yearbook 2000 and earlier issues.

NPRGY**:** Non-productive expenditure/GDP *(Expenditure on general public services + Expenditure on defense + Expenditure on recreational-cultural-religious affairs + Expenditure on agriculture-forestry-fishing-hunting+ Expenditure on mining-manufacturing-construction, except fuel-energy+ Expenditure on other economic services+ Expenditure on other functions)/GDP* (local currency-current prices), (local currency-current prices), OECD Statistical Compendium 1999/2, IMF Government Finance Statistics Yearbook 2000 and earlier issues.

OGY: *Expenditure on other functions /GDP* (local currency-current prices), OECD Statistical Compendium 1999/2, IMF Government Finance Statistics Yearbook 2000 and earlier issues.

GY: *Total government expenditures/GDP* (local currency-current prices), OECD Statistical Compendium 1999/2, IMF Government Finance Statistics Yearbook 2000 and earlier issues.

DTY: Distortionary taxation as share of GDP *(Taxes on income and profits+ Social security contributions+ Taxes on payroll and workforce+ Taxes on property)/*GDP (local currency-current prices), SourceOECD electronic database 2001, IMF Government Finance Statistics Yearbook 2000 and earlier issues.

NDTY**:** Non-distortionary taxation as share of GDP *(Taxes on domestic goods and services)/GDP* (local currency-current prices), OECD Statistical Compendium 1999/2, IMF Government Finance Statistics Yearbook 2000 and earlier issues.

OTY: Other revenues as share of GDP equal to *(Customs and import duties+ Taxes on exports+ Other taxes on international trade and transactions+ Other taxes+ Non-tax* *revenues+ Grants)/GDP* (local currency-current prices), SourceOECD electronic database 2001, IMF Government Finance Statistics Yearbook 2000 and earlier issues.

BY: Budget surplus as a share of GDP *(Tax revenues+ Non-tax revenues+ Grants- Total government expenditures)/GDP* (local currency-current prices), SourceOECD electronic database 2001, IMF Government Finance Statistics Yearbook 2000 and earlier issues.

LFP: Labour force participation equal to *Total labour force/Population 15-64*, OECD Statistical Compendium 1999/2.

EM: Total employment (number of employed), OECD Statistical Compendium 1999/2.

EMG: Employment growth equal to $\left[EM - EM(-1)\right]/EM(-1)$, OECD Statistical Compendium 1999/2.

IY: *Total fixed investment excluding stockbuilding/GDP* (local currency-current prices), OECD Statistical Compendium 1999/2.

OPEN: *(Exports+Imports)/GDP* (local currency-current prices), (index of openness) OECD Statistical Compendium 1999/2.

ULC: Relative unit labour cost in manufacturing (index of competitiveness), SourceOECD electronic database 2001.

RR: Replacement ratio equal to *Average Benefit/Average wage=((Social security benefits+social assistance grants)/(Unemployment+population under 15+population over 64))/Compensation per employee in private sector*, OECD Statistical Compendium 1999/2.

WS: *Wage share equal to Average wage/Average GDP per worker= Compensation per employee in private sector/(GDP/Total employment)*, OECD Statistical Compendium 1999/2.

DR: Dependency ratio, i.e. *welfare recipients /number of workers= (Unemployment+population under 15+population over 64)/ Total employment*, OECD Statistical Compendium 1999/2.

List of countries

The sample was determined by data availability and the number of countries included in each estimation depends on the availability of the relevant variables for each country. The countries included in our sample are the following:

Germany, France, Italy, U.K, Belgium, Denmark, Spain, Portugal, S. Korea, Australia, Norway, Iceland, Greece, US, Japan, Sweden.

REFERENCES

Agell J., Lindth, T. and H. Ohlsson (1997)."Growth and the Public Sector: A Critical Review Essay", *European Journal of Political Economy*, 13, 33-52.

Agell, J. (2000). «On the Determinants of Labour Market Institutions: Rent-Sharing vs. Social Insurance», *AUEB seminar paper*.

Agiomirgianakis, G., Asteriou, D., and V. Monastiriotis (2001). "New Evidence on the Role of Human Capital on Economic Growth from a Panel Data Study", 1-23.

Alesina, A. and D. Rodrik (1994). "Distributive Politics and Economic Growth", *Quarterly Journal of Economics*, 465-490.

Angel de la Fuente (1997). "Fiscal Policy and Growth in the OECD", *CEPR Discussion Paper* 1755, December.

Angel de la Fuente (1997). "The Empirics of Growth and Convergence: A Selective Review", *Journal of Economic Dynamics and Control,* 21, 23-73.

Arvanitis, S. (2001)."Simulation Based Econometric Estimators", *AUEB lecture notes*.

Atkinson A.B. (1995). "The Welfare State and Economic Performance", *National Tax Journal* 48, 171-198.

Atkinson, A.B. (1995). "The Scope for a European Growth Initiative. Is the Welfare State Necessarily an Obstacle to Economic Growth?", *European Economic Review*, 39, 723-730.

Atkinson A.B. (1999). "The Economic Consequences of Rolling Back the Welfare State", Munich Lectures in Economics, MIT Press.

Baltagi, B.H (2001). *"A Companion to Theoretical Econometrics",* Blackwell Publishers.

Barro, R.J. (1990). "Government Spending in a Simple Model of Endogenous Growth", *Journal of Political Economy,* 98, 5, s103-s125.

Barro, R.J. (1991). "Economic Growth in a Cross Section of Countries", *The Quarterly Journal of Economics*, CVI, 2, May, 407-443.

Barro, R.J. and Xavier Sala-i-Martin (1995). *"Economic Growth"*, McGraw-Hill.

Bellettini, G. and C.B Ceroni (2000). "Social Security Expenditure and Economic Growth: An Empirical Assessment", *Research in Economics*, 54, 249-275.

Benabou, R. (1999). "Tax and Education Policy in a Heterogeneous Agent Economy: What levels of redistribution maximize Growth and Efficiency*?", NBER Working Paper 7132*, May.

Bils, M. and P.J. Klenow (2000). "Does Schooling Cause Growth?", *American Economic Review*, 90, 5, 1160-1183.

Bloom, D.E, Canning, D. and J. Sevilla (2001). "The Effect of Health on Economic Growth: Theory and Evidence", *NBER Working Paper 8587*.

Bond, S.R., Hoeffler, A. and J. Temple (2001). "GMM Estimation of Empirical Growth Models", *CEPR Discussion Paper 3048*.

Brons, M.R.E., De Groot, H.L.F. and P. Nijkamp (2000). "Growth Effects of Governmental Policies: A Comparative Analysis in a Multi-Country Context", *Growth and Change*, 31, 547-572.

Bun, M.J.G. and J.F. Kiviet (2001). "The Accuracy of Inference in Small Samples of Dynamic Panel Data Models: Simulation Evidence and Empirical Results», *Timbergen Institute Discussion Paper, TI 2001-006/4*.

Card, D. and A.B. Krueger (1992). "Does School Quality Matter? Returns to Education and the Characteristics of Public Schools in the United States", *Journal of Political Economy*, 100, 1-40.

Cashin, P. (1995). "Government Spending, Taxes and Economic growth", *IMF Staff Papers*, 42(2), June, 237-269.

Chang R. (1998). "Political Party Negotiations, Income Distribution and Endogenous Growth", *Journal of Monetary Economics*, 41, 227-255.

Chortareas, G.E. and R.L Driver (2000). «PPP and the Real Exchange Rate-Real Interest Rate Differential Puzzle Revisited: Evidence form Non-Stationary Panel Data», December.

Devarajan, S., Swaroop, V. and Heng-fu Zou (1996). "The Composition of Public Expenditure and Economic growth", *Journal of Monetary Economics*, 37, 313-344.

Diamond P.A. (1997). "Macroeconomic Aspects of Social Security Reform", *Brookings Papers on Economic Activity*, 1-87.

Easterly, W. and S. Rebelo (1993). "Fiscal Policy and Economic Growth: An Empirical Investigation", *Journal of Monetary Economics*, 32, 417-458.

Enders, W. (1995). *«Applied Econonetric Time Series»*, John Wiley and Sons.

**Everitt, B.S. (1998*).* *"The Cambridge Dictionary of Statistics",* Cambridge University Press.

Feldstein, M. (1974). "Social Security, Induced Retirement and Aggregate Capital Accumulation", *Journal of Political Economy*, 82, 905-926.

Feldstein, M. (1995)."Fiscal Policies, Capital Formation and Capitalism", *European Economic Review*, 39, 399-420.

Fernadez, R. and R. Rogerson (1998). "Public Education and Income Distribution: A Dynamic Quantitative Evaluation of Education-Finance Reform", *American Economic Review*, September, 88, 4, 813-833.

Gilles, S-P. and T. Verdier (1993). "Education, Democracy and Growth", *Journal of Development Economics*, 42, 399-407.

Glomm, G. and B. Ravikumar (1997). "Productive Government Expenditures and Long-Run Growth", *Journal of Economic Dynamics and Control*, 21 (1997), 183-204.

Gradstein, M. (2000). "An Economic Rationale for Public Education: The Value of Commitment", *Journal of Monetary Economics*, 45, 463-474.

Greene, W.H. (1993). "Econometric Analysis", Prentice Hall.

Hamilton, J.D (1994). *"Time Series Analysis"*, Princeton University Press.

Hanushek, E.A. and D.D. Kimko (2000). "Schooling, Labour Force Quality and the Growth of Nations", *American Economic Review*, 90, 5, 1184-1208.

Hanushek, E.A. and J.A. Somers (1999). "Schooling, Inequality and the Impact of Government", NBER *Working Paper* 7450, December.

Hoxby, C.M. (2000). "Does Competition Among Public Schools Benefit Students and Taxpayers?", *American Economic Review*, 90, 5, 1209-1238.

Inman R.P (1987). "Markets, Governments and The "New" Political Economy", *Handbook of Public Economics*, II, 647-777.

Judd, K. (1985). "On the performance of patents", *Econometrica* 53, 3, 567-585.

Judson, R.A. and A.L. Owen (1999). "Estimating Dynamic Panel Data Models: A Guide for Macroeconomists", *Economics Letters*, 65, 9-15.

Kaganovich, M. and I. Zilcha (1999). "Education, Social Security and Growth", *Journal of Public Economics*, 71, 289-309.

Kalaitzidakis, P., Mamuneas, T.P., Savvidis, A. and T. Stengos (2001). "Measures of Human Capital and Nonlinearities in Economic Growth", *Journal of Economic Growth*, 6, 229-254.

Karras, G. (1996). "The Optimal Government Size: Further International Evidence on the Productivity of Government Services", *Economic Inquiry*, XXXIV, 193-203.

Kneller, R., Bleaney, M.F. and N. Gemmel (1999). "Fiscal Policy and Growth: Evidence From OECD Countries", *Journal of Public Economics* 74, 171-190.

Kneller, R., Bleaney, M.F. and N. Gemmel (2001). "Testing the Endogenous Growth Model: Public Expenditure, Taxation, and Growth Over the Long Run", *Canadian Journal of Economics* 34, 1, 36-57.

Lau, M.I. and P. Poutvaara (2001). "Social Security Incentives and Human Capital Investment", *CESIfo Working Paper, 438.*

Levine, R. and D. Renelt (1992). "A Sensitivity Analysis of Cross-Country Growth Regressions", *American Economic Review*, 82, 4, 942-963.

Malley, J. and A. Philippopoulos (2001). "Economic Growth and Endogenous Fiscal Policy: In Search of a Data Consistent General Equilibrium Model", *AUEB*.

Mankiw, N.G., Romer, D. and D.N. Weil (1992). "A Contribution to the Empirics of Economic Growth", *The Quarterly Journal of Economics*, May, 407-437.

Moschovakis, Y.N. (1994). *"Notes on Set Theory"*, Undegraduate texts in Mathematics, Springer-Verlag.

Mundle, S. (1998). «Financing Human Development: Some Lessons from Advanced Asian Countries», *World Development*, 26, 659-672.

Murhpy, K.M and F. Welch (1998)."Perspectives on the Social Security Crisis and Proposed Solutions", *AEA Papers and Proceedings*, 88, 2, May, 142-150.

Ortigueira S. (1998). "Fiscal Policy in an Endogenous Growth Model with Human Capital Accumulation", *Journal of Monetary Economics*, 42, 323-355.

Park, H. and A. Philippopoulos (1999). "On the Dynamics of Growth and Fiscal Policy with Redistributive Transfers", AUEB, May.

Perroti, R. (1993). "Political Equilibrium, Income Distribution and Growth", *Review of Economic Studies*, 60, 755-776.

Persson T. and G. Tabellini (1994). "Is Inequality Harmful for Growth?", *American Economic Review*, 84, 3, June, 600-621.

Poot, J. (2000). "A Synthesis of Empirical Research on the Impact of Government on Long-Run Growth", *Growth and Change*, 31, 516-546.

Psacharopoulos, G. (1985). "Returns to Education: A Further International Update", *Journal of Human Resources*, XXIV, 583-612.

Ranis, G., Stewart, F. and A. Ramirez (2000). «Economic Growth and Human Development», *World Development*, 28, 2.

Razin, A., Sadka, E. and P. Swagel. **(2001)** "The Aging Population and the Size of the Welfare State, *NBER Working Paper 8405*.

Rodrik D. (1998). "Where Did All the Growth Go? External Shocks, Social Conflict and Growth Collapses", *CEPR Discussion Paper* 1789, January.

Rodrik, D. (1997). «The paradoxes of the successful state», Alfred Marshall Lecture, *European Economic Review*, 41, 411-442.

Rodrik, D. (1998). "Why Do More Open Economies Have Bigger Governments?", *Journal of Political Economy*, 106, 5, 997-1032.

Romer, P.M. (1986). "Increasing Returns and Long-Run Growth", *Journal of Political Economy*, 94, 5, 1002-1037.

Roussas, G. (1997). *"A Course in Mathematical Statistics",* Academic Press.

Sandmo, A. (1995). "Introduction: The Welfare Economics of the Welfare state", *Scandinavian Journal of Economics*, 97, 4, iii, 469-476.

Sinn, H-W. (1995). «A Theory of the Welfare State», *Scandinavian Journal of Economics*, 97(4), 495-526.

Solow, R.M. (1956). "A Contribution to the Theory of Economic Growth", *Quarterly Journal of Economics*, 70, 65-94.

Tamura, R. (1991). "Income Convergence in an Endogenous Growth Model", *Journal of Political Economy, 99,* 522-540.

Tanzi, V. and Howell H. Zee (1997). "Fiscal Policy and Long-Run Growth", *IMF Staff Papers*, 44, 2, June, 179-209.

Temple, J. (1999). «A Positive Effect of Human Capital on Growth», *Economics Letters*, 65, 131-134.

Temple, J. (2001). "Growth Effects of Education and Social Capital in the OECD Countries", *CEPR Discussion paper 2875*.

Trish, Kelly (1997). "Public Expenditures and Growth", *The Journal Of Development Studies*, 34, 1, October, 60-84.

Wigger, B.U. (2001). "Higher Education Financing and Income Redistribution", *CESIfo Working Paper*, 527.

Wolff, E.N. (2000). "Human Capital Investment and Economic Growth: Exploring the Cross-Country Evidence", *Structural Change and Economic Dynamics*, 11, 433-472.

Zhang J. (1996)."Optimal Public Investments in Education and Endogenous Growth", *Scandinavian Journal of Economics*, 98, 3, 387-404.