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A new framework for testing the effect of government spending on growth and productivity*

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Abstract. Does government spending have a positive or negative effect on economic growth? The results of earlier empirical studies give mixed results. In this study we suggest a new method for testing the effect of different kinds of government expenditure on productivity growth in the private sector. The focus on productivity in the private sector and the use of disaggregated data makes it possible to avoid or mitigate a number of methodological problems.

The major conclusions, which are quite robust, are that government transfers, consumption and total outlays have consistently negative effects, while educational expenditure has a positive effect, and government investment has no effect on private productivity growth.

The impact is also found to work solely through total factor productivity and not via the marginal productivity of labor and capital.

1. Introduction

Does government spending have a positive or negative effect on economic growth? *A priori*, we do not know. One can easily advance plausible arguments indicating that the effect ought to be positive, but one can just as easily find arguments indicating the reverse. A large number of empirical tests have also been carried out, but the results are ambiguous.

The studies differ in so many dimensions that comparability is impaired. Most tests are at the most aggregate level, i.e., studying the effect of government spending on the growth rate of GDP. A major problem with this approach is that a large part of government spending is also part of measured GDP, which implies that GDP may in fact grow just because government spending grows. Furthermore, different types of spending should be expected to have different effects. This aspect is rarely pursued in depth in the aggregated studies.

In order to avoid or substantially mitigate the above-mentioned issues and a number of additional problems marring other studies it is more appropriate to focus on the effect of government spending on the nongovernment sector.

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Specifically, one should test what effects different types of government spending have on productivity growth in the nongovernment sector. That is the purpose of the present paper.

We use a production function approach on disaggregated data, where account is taken of a potential catching-up effect (Abramovitz, 1986).[1] This approach has a number of advantages such as a sharp increase in the number of degrees of freedom, and it allows us to test whether total factor productivity (TFP) or the productivity of the factors of production are influenced. Our empirical study covers 14 industries in 14 OECD countries during the period 1970–87. The results indicate that the level of government consumption, transfers and total spending as a share of GDP has a strongly negative effect on the growth of TFP in the nongovernment sector. Educational spending has a positive effect and the level of government investment has no effect.

The paper is organized as follows. In section 2 we briefly review the various arguments that have been put forward to explain why and how government spending is expected to influence growth and productivity. In section 3 we identify and critically review earlier studies of the effect of government spending on economic growth. In the following section some pertinent methodological problems are highlighted. In section 5 we present our theoretical model. This is followed by a description of the data used, and in section 7 we present the results from our regression analyses. Section 8 serves as a conclusion.

2. Why should government spending affect growth and productivity?

In this section we will briefly review the arguments indicating positive and negative effects of government spending (and taxation) on growth and productivity, respectively.

2.1 Arguments pointing towards a positive effect

Market failures

To the extent that the well-known effects of the existence of collective goods, externalities and natural monopolies are important impediments to growth, the types of government expenditure that rectify these problems can be expected to have growth-enhancing effects. Following Barro (1990) we may label this "productive" government spending.

The valuation of government expenditure

In the different accounts, government goods and services are valued at their cost of production. This procedure gives rise to a number of difficulties which

bias the researcher to find that increased government spending results in increased economic growth. This is due to the implicit assumption that government output is produced with a constant returns to scale technology, that all government production can be classified as final output rather than intermediate inputs lowering private sector production costs, and that the market value of government output is equal to the cost of production (Carr, 1989; Koskela and Virén, 1992).

Government expenditure is part of GDP
Since both government consumption and investment are part of GDP when measured from the expenditure side, explaining GDP growth by changes in government spending involves explaining something partly by itself. In particular during periods when the government spending share has been increasing, this problem lends an upward bias to the estimated effect.

Verdoorn's law
Kaldor (1966) claimed that a high rate of utilization has a beneficial effect on long-run productivity growth. In so far as an expansion of the public sector results in a higher utilization rate, there ought to be a positive effect on economic growth through the workings of Verdoorn's Law.

Cost of social inequality
Myrdal (1960) stressed that a greater government involvement in the economy can foster growth because the greater involvement can be used partly to reduce social inequality, which is seen as detrimental to growth for at least two reasons: it leads to a waste of human capital as a consequence of poverty, and it restricts the opportunities for low-income individuals to exploit their talent.

Income effect of higher taxes
Although increased taxes have a negative substitution effect on work effort and labor supply, this may be offset by a positive income effect. A further argument often advocated by sociologists (Easterlin, 1974; Korpi, 1985) is that the distortionary effects of higher taxes may be mitigated by the possibility that relative ranking of individuals in terms of income is more important for incentives than absolute differences in after-tax income. Thus, as long as government spending and taxation does not change the rank order of people in the income distribution, the disincentive effects may be limited.

2.2 Arguments pointing towards a negative effect

Effect of taxation
In recent endogenous growth models such as Barro (1990) and King and Rebelo (1990), taxes create a wedge between the gross and net returns on saving, which leads to a lower rate of capital accumulation and hence a lower rate of economic growth. Lindbeck (1983), among others, has instead stressed the disincentive effects of large tax wedges on labor income in high-tax societies. Hansson (1984) assesses that the cost of increasing public revenue at the margin may be extremely high in a country like Sweden with a large public sector.

Crowding out of private investment
As emphasized by Plosser (1992) capital formation is likely to be quantitatively more important for long-run growth rates than the original Solow (1956) model suggested. Hence, if government spending and taxation crowd out private investment in human and physical capital, this could have a sizeable effect on the rate of economic growth. Landau (1983), Smith (1975) and Cameron (1982) find such crowding out for physical capital formation.

Crowding out of private production
Increased government demand for labor will put an upward pressure on real wages and hence crowd out private sector employment (Koskela and Virén, 1992).

Institutional sclerosis and rent-seeking
Olson (1982) has suggested that organized interest groups tend to evolve, and they strive to obtain advantages for their own group in the form of legislation or transfers that have the growth-retarding side effect of worsening the functioning of the market economy. The scope for interest group action of this kind may be greater in countries with larger public sectors. Similarly, in the case of a large public sector the potential profits from rent-seeking activities are larger, which may lead to a greater diversion of resources into unproductive use (Buchanan, 1980).

This brief review of the arguments that have been proposed regarding the expected effect of government spending on growth leads us to conclude that there is no basis for having strong priors regarding the effect of government spending in general. We should also expect that different types of expenditure have divergent effects.

3. Other approaches and results

The majority of empirical studies use a general regression approach (or a simple correlational approach). The studies are so diverse that it is difficult to make a complete survey and to draw generally valid conclusions. With this caveat in mind, we will briefly review the most important studies that we find relevant in the present context.[2]

Barro (1989), Grier and Tullock (1989) and Engen and Skinner (1992) have used the Summers-Heston data base. Barro finds that the level of government consumption excluding education and defense as a share of GDP has a negative effect on the growth of GDP per capita. On the other hand, he finds no effect of government investment, whereas educational expenditure is found to have a positive effect.[3] Grier and Tullock use the change in the consumption spending share as the regressor in a pooled time-series cross-section regression. With that specification, a significant negative effect on economic growth is detected only for the OECD countries. Engen and Skinner use an explicit production function approach where they try to identify separate effects of spending and taxation. The main finding is that an increase in the tax ratio by 10 percentage points reduces GDP growth by as much as 3.2 percent p.a.

Landau (1983, 1986) and Kormendi and Meguire (1985) are other studies that use a country sample including developing countries. Landau finds a highly significant negative effect of government consumption as a share of GDP on the growth rate of GDP per capita, although it is worth noting that this negative effect disappears if the sample is restricted to the poorest half of the countries. In Landau (1986) the separate effect of transfers, educational expenditure and government investment is also assessed. All three are found to be insignificant. Kormendi and Meguire find no effect of the change in the government consumption spending ratio on the average GDP growth rate in 47 countries during the period 1950–77.

A fair number of studies find that the level of government as a share of national income has a significantly negative effect on GDP growth for OECD countries. Smith (1975) finds a strongly negative effect for consumption and investment spending combined, while the effect of transfers is negligible. Saunders (1985) detects a highly negative effect of total expenditures as a share of GDP on GDP growth for 21 countries between 1960 and 1981. Cameron (1982) studies 19 countries and finds that an increase of the share of total government expenditure by 1 percentage point decreases the growth rate by 0.05 percent p.a.

Gould (1983) uncovers a negative relationship between economic growth and the change in the total spending ratio in 13 OECD countries during the period 1960–73. Katz *et al.* (1983) study whether different tax measures as a share of GDP affect the growth rate for 22 OECD countries during the 1970s. No effect

is found. Korpi (1985) studies the effect of different kinds of spending ratios on growth in 18 OECD countries during the period 1950–79. If Japan is not excluded from the sample, it appears that the level of all types of government spending relative to GDP has either a negative or no effect on growth. Excluding Japan, a positive effect is found for transfers and social security spending.

Finally, there is the study by Ram (1986) which has received a great deal of attention. Using a two-sector production function framework, Ram finds a strong positive effect of increased government consumption on growth using the Summers-Heston data for 115 countries. Ram's study has been disputed by Carr (1989) and Rao (1989). They assert that his results are dependent on crucial assumptions regarding relative factor productivities across sectors/countries and over time, and that there are measurement problems involved biasing the researcher towards finding a positive effect. Rao (1989) shows that the overall effect does not apply to the 21 industrial market economies taken separately. We will return to the measurement issue below.

In sum, the level of government consumption appears to have a fairly robust negative effect on economic growth, in particular in the richer countries. The effect of the change in the consumption spending ratio is less clear-cut. For other types of expenditure the results are much less consistent, although it is fair to say that spending for investment and educational purposes has at least no negative effect on growth. The measured effect also seems to differ between developed and developing countries.

4. Some methodological problems

Almost all studies that try to explain GDP growth by government spending shares suffer to differing degrees from a number of methodological problems. First, the change in GDP is definitionally related to the change in the part of government expenditure that is included in GDP (investment and consumption). In particular, this is likely to bias the researcher towards finding a positive effect of a change in the spending ratio on growth (Bairam, 1989; Gould, 1983). Second, there may exist a bias in the opposite direction as an artefact of a spurious correlation between output growth and changes in the government spending share. This would occur if an unusually high growth rate depresses the rate of change in the spending share (Engen and Skinner, 1992). Third, it is quite possible that countries that grow rapidly tend to increase government spending as a result of the increased income, i.e., government spending may be endogenous (Rao, 1989; Conte and Darrat, 1988).

A further problem is a likely measurement error in government output. This valuation problem has already been treated in section 2.1. Since it is likely to be greater for countries at a low level of development,[4] it is all the more ques-

tionable to include countries at very different levels of economic development in the same regression. In growth equations including both industrialised and developing countries it also appears to be essential to include human capital and probably a number of other control variables (Levine and Renelt, 1992). Failing this, which is the case in most studies, the regression results may be biased.

Considering all these pitfalls, we advocate a different approach. In our view, it would be more appropriate to study the effect of government spending on productivity in the private sector, preferably at a disaggregated level. By doing so many of the problems of endogeneity, spurious correlation and the definitional effect can be circumvented. By concentrating on developed countries at similar levels of income the measurement problem and the problem of finding a comprehensive set of control variables can be alleviated to a large degree. Moreover, since we use a production function approach we do not run the risk of biasing the estimated effect of government spending on growth due to its potential indirect effect via the crowding out of private investment.

5. The model

Our model takes its point of departure in a production function:

$$Y_{ikt} = A_{ikt}\, \mathrm{f}(K_{ikt}, L_{ikt}) \tag{1}$$

Output Y_{ikt} in a given industry i and country k at time t is a function of capital K_{ikt} and labor L_{ikt}. A_{ikt} measures the level of total factor productivity (TFP).

Differentiation with respect to time and some rewriting gives us an expression of the relative growth of output in industry i:

$$\left[\frac{\dot{Y}}{Y}\right]_{ik} = \left[\frac{\dot{A}}{A}\right]_{ik} + \mathrm{f}_K \left[\frac{\dot{K}}{K}\frac{K}{Y}\right]_{ik} + \mathrm{f}_L \left[\frac{\dot{L}}{L}\frac{L}{Y}\right]_{ik} \tag{2}$$

$\left[\frac{\dot{A}}{A}\right]_{ik}$, $\left[\frac{\dot{K}}{K}\right]_{ik}$ and $\left[\frac{\dot{L}}{L}\right]_{ik}$ denote, respectively, the relative growth rate in TFP, capital and labor in industry i. f_K and f_L are the marginal productivity of capital and labor, which are assumed to be equal across industries and across countries. A justification for this specification is that free mobility of factors within a country will equalise the marginal products across industries. Even in the absence of international factor mobility, free trade will, under certain conditions, equalise the marginal products in the tradables sector across countries, and indirectly also in the nontradables sector. Moreover, we do not assume anything about the functional form of the production function.

In specifying how government spending affects the nongovernment sector we will initially assume that it exclusively affects the rate of growth of TFP. In modelling TFP we hypothesize that the relative rate of growth in TFP, $(\dot{A}/A)_{ik}$ in (2), is determined by a catching-up factor and by the relevant government spending measure, g_k.[5] Following the practice of many others, catching-up potential is measured by the initial technological gap in terms of TFP levels between a country k and the leading country in that industry.[6] The relative rate of growth in TFP in industry i in country k is then given by:

$$\left[\frac{\dot{A}}{A}\right]_{ik} = \lambda + \kappa \log\left[\frac{\tau_{ik}}{\tau_{il}}\right] + \psi g_k \tag{3}$$

τ_{ik}/τ_{il} is the catching-up factor. τ_{il} is the TFP level in the country with the highest productivity in industry i in 1970 and τ_{ik} is the TFP level in industry i in country k. ψ measures the effect of government spending on $(\dot{A}/A)_{ik}$. Catching up is defined in terms of TFP levels in different industries. TFP_{ik} is a measure of the technological level in industry i in country k. The indices of TFP levels are implicitly based on a Cobb-Douglas function:

$$\log\tau_{ik} = \log Y_{ik} - \alpha_i \log L_{ik} - (1-\alpha_i)\log K_{ik} \tag{4}$$

Y_{ik} is value added and K_{ik} is the capital stock in industry i in country k. To be able to compare TFP levels across countries, the local currencies have been converted to a common standard by using the OECD purchasing power parity estimates with 1980 as the base year (Ward, 1985).[7] L_{ik} is total employment in industry i in country k.

Under the assumption that labor and capital elasticities are the same in each industry across countries, factor shares should be equal across countries. Thus, we can use the international average factor shares in different industries as measures of α_i. The share of labor in value added in sector i in country k is calculated as

$$\alpha_{ik} = \frac{W_{ik}\dfrac{L_{ik}}{E_{ik}}}{Y^*_{ik}} \tag{5}$$

where W_{ik} denotes compensation to employees; Y^*_{ik}, value added in current prices; L_{ik}, total employment including self-employed; and E_{ik}, total number of employees. The self-employed are included in the weighting scheme by assuming that they receive the same average rate of compensation, and total compensation is rescaled in accordance.

By combining (2) and (3) we get our basic model:

$$\left[\frac{\dot{Y}}{Y}\right]_{ik} = \beta_0 + \beta_1\left[\frac{\dot{K}}{K}\frac{K}{Y}\right]_{ik} + \beta_2\left[\frac{\dot{L}}{L}\frac{L}{Y}\right]_{ik} + \beta_3 \log\left[\frac{\tau_{ik}}{\tau_{il}}\right] + \beta_4 g_k + \varepsilon_{ik} \quad (6)$$

ε_{ik} denotes a zero-mean, normally distributed error term. The average annual relative growth rate of a variable X during the period 1970–87 is given by:[8]

$$\left[\frac{\dot{X}}{X}\right]_{ik} = \frac{1}{17}\left(\log X_{ik}^{87} - \log X_{ik}^{70}\right) \quad (7)$$

A more sophisticated hypothesis is that government spending may have an effect on the marginal productivity of capital and labor, in addition to its effect on TFP. This can be tested by assuming that the marginal productivities in country k, f_{Kk} and f_{Lk}, are linearly correlated with g_k:

$$f_{Kk} = \bar{f}_K + \mu_1 g_k \quad (8a)$$

$$f_{Lk} = \bar{f}_L + \mu_2 g_k \quad (8b)$$

By combining (8a) and (8b) with (2) and (3), output growth in sector i in country k can be expressed as follows:[9]

$$\left[\frac{\dot{Y}}{Y}\right]_{ik} = b_0 + b_1\left[\frac{\dot{K}}{K}\frac{K}{Y}\right]_{ik} + b_2\left[\frac{\dot{L}}{L}\frac{L}{Y}\right]_{ik} + b_3 \log\left[\frac{\tau_{ik}}{\tau_{il}}\right] + b_4 g_k\left[\frac{\dot{K}}{K}\frac{K}{Y}\right]_{ik} + b_5 g_k\left[\frac{\dot{L}}{L}\frac{L}{Y}\right]_{ik} + b_6 g_k + \eta_{ik} \quad (9)$$

η_{ik} is assumed to be a zero-mean, normally distributed error term. Before we proceed to the estimation of (6) and (9), the data should be presented more in depth.

6. Data description

All data except for government spending comes from the June 1991 version of the International Sectoral Data Bank (ISDB) compiled by the OECD. It contains 14 countries and fully covers the period 1970–87. The countries and industries contained in the ISDB as well as some descriptive statistics of the data are presented in the *Appendix*.

In Table 1 we summarize the government spending variables that we consider to be of interest. All variables are related to GDP and the level is calculated as the average during the period under study. Averages and changes have been calculated for both 1965–82 and for 1970–87.[10] Values for the former period

Table 1. GDP-share of various government spending categories, average 1965–82 and 1970–87 for the 14 countries.

Category		*Mean*	*Std dev.*	*Min.*	*Max.*
Consumption, *GC*	1965–82	17.23	3.75	8.84	24.20
	1970–87	18.28	3.99	9.43	26.16
Education, *GE*	1965–82	4.78	0.93	3.45	6.06
	1970–87	4.98	0.92	3.53	6.45
Investment, *GI*	1965–82	4.54	1.26	1.80	7.10
	1970–87	4.11	1.14	1.51	6.52
Transfers, *GTR*	1965–82	18.29	5.40	9.67	29.18
	1970–87	21.43	6.09	13.02	33.67
Social security, *GSOC*	1965–82	12.80	4.64	6.69	22.58
	1970–87	14.19	4.76	8.32	24.23
Total outlays, *GTOT*	1965–82	40.05	7.44	25.57	51.08
	1970–87	43.82	8.22	28.97	56.41

Source: Consumption and GDP in current prices are from *OECD Economic Outlook*, December 1992; Data on defense and educational spending are from *OECD National Accounts*, Vol. 2, 1992, except for Canada where they are drawn from Liesner (1989); data for all other spending variables are from *OECD Historical Statistics* 1960–1989.

are used alternatively in order to allow for the possibility that government spending might influence productivity with a lag. As we can see, there are large variations in both the level and change of all spending categories.

The effect of the three components of government spending – investment, transfers and consumption – as well as their sum, total outlays, are obvious choices for the empirical analysis. In addition, we have chosen to look for a separate effect of educational expenditure, which is a subset of *GC*, but should rather be considered as investment in human capital (Barro, 1990), and for the effect of social security payments, which is a subset of *GTR*. We hypothesize that *GSOC* has a more positive (or less negative) effect on productivity thanks to a likely element of deferred wages, and hence smaller expected dead-weight costs than for *GTR*. Furthermore, in addition to expenditure for social security, *GTR* consists mainly of subsidies to firms and interest payments on the public debt. On the other hand, we do not include any measure of government revenue. Unless we are interested in assessing the effect of particular types of taxes on productivity, the tax ratio would, in practice, measure the same thing as *GTOT*. In the long run public revenue has to follow expenditure closely.[11] There is therefore little reason to believe that revenue decisions are made independently of expenditure decisions.

Table 2. The basic model without any government spending variables.

Variable	(i)	(ii)
$\left[\begin{matrix}\dot{K} & K \\ \overline{K} & \overline{Y}\end{matrix}\right]_{ik}$	0.032 [2.75]	0.025 [2.22]
$\left[\begin{matrix}\dot{L} & L \\ \overline{L} & \overline{Y}\end{matrix}\right]_{ik}$	7386 [7.97]	7032 [8.42]
$\log(\tau_{ik}/\tau_{il})$	−0.004 [−1.03]	−0.010 [−2.58]
Country dummies	No	Yes
Constant	0.018 [7.50]	0.009 [2.46]
$\bar{R}^2$	0.447	0.534
n	153	153

Note: Brackets [ ] in Tables 2–6 give White's (1980) heteroscedasticity consistent t-statistics.

7. Empirical results

In Table 2 the regression results from our basic model (6) without government spending variables are presented. The marginal productivities of capital and labor are both significant in this and all subsequent specifications. In specification (ii) country dummies are included, and both the large increase in $\bar{R}^2$ and a standard F-test[12] indicate that there are large variations in TFP-growth across countries, i.e., there are strong country-specific effects calling for an explanation. It may also be worth noting that without the country dummies the expected catching-up effect is insignificant. This is a further indication that specification (i) suffers from an omitted variables bias.

In Table 3 we present results for the effect of *GTOT*, *GC* and *GI* on TFP-growth. Both total government expenditure and consumption expenditure as a share of GDP have a highly significant negative effect on TFP-growth. Whether the government variables are lagged or contemporaneous makes little difference. The point estimate for the 1965–82 measure, which we think is preferable on *a priori* grounds, indicates that an increase in *GTOT* by 10 percentage points would decrease the growth rate of TFP by 0.92 percent p.a. A commensurate increase of *GC* would lower the TFP growth rate by 1.4 percent p.a.

As is clear from the results for *GI*, we cannot find any effect of increased government investment on TFP-growth – the estimates are not significantly different from zero. The absence of a positive effect may at first seem surpris-

Table 3. Government consumption, investment and total outlays.

Variable	(iii)	(iv)	(v)	(vi)	(vii)	(viii)
$\left[\frac{\dot{K}}{\overline{K}}\,\frac{K}{\overline{Y}}\right]_{ik}$	0.025 [2.16]	0.026 [2.25]	0.025 [2.18]	0.025 [2.13]	0.032 [2.72]	0.032 [2.74]
$\left[\frac{\dot{L}}{\overline{L}}\,\frac{L}{\overline{Y}}\right]_{ik}$	6847 [8.99]	6954 [8.67]	7475 [9.00]	7441 [8.91]	7330 [7.76]	7376 [7.86]
$\log(\tau_{ik}/\tau_{il})$	−0.011 [−2.64]	−0.010 [−2.46]	−0.008 [−2.09]	−0.009 [−2.25]	−0.005 [−1.06]	−0.004 [−1.02]
GTOT *1965–82*	−0.092 [−4.20]					
GTOT *1970–87*		−0.072 [−3.75]				
GC *1965–82*			−0.139 [−3.52]			
GC *1970–87*				−0.132 [−3.51]		
GI *1965–82*					−0.056 [−0.45]	
GI *1970–87*						−0.015 [−0.11]
Constant	0.053 [5.72]	0.047 [5.42]	0.041 [5.56]	0.041 [5.58]	0.020 [4.10]	0.019 [3.66]
$\overline{R}^2$	0.518	0.500	0.507	0.507	0.444	0.443
n	153	153	153	153	153	153

ing; public investment is generally considered as an input to private production, and hence one would expect it to enhance private sector productivity. One conceivable explanation for this result is that inefficiencies in public-sector decision making on average result in government investment with a low social rate of return.[13] Another possible, although less plausible, explanation for this result is the suggestion made by Barro (1990) that if governments are optimising, then the reason different countries exhibit different investment spending ratios is that the relative productivity of public and private capital differs across countries. Therefore, in a cross-country regression one should not expect *GI* to be correlated with productivity growth.

As we can see in Table 4, transfer payments also appear to exercise a significantly negative effect on TFP-growth. According to the 1965–82 estimate, an increase of transfers as a share of GDP by 10 percentage points would, *ceteris*

Table 4. Government transfers and social security.

Variable	(ix)	(x)	(xi)	(xii)
$\left[\frac{\dot{K}}{\overline{K}}\ \frac{K}{\overline{Y}}\right]_{ik}$	0.030 [2.61]	0.030 [2.61]	0.031 [2.64]	0.031 [2.64]
$\left[\frac{\dot{L}}{\overline{L}}\ \frac{L}{\overline{Y}}\right]_{ik}$	6953 [8.03]	7041 [7.96]	7128 [7.89]	7156 [7.80]
$\log(\tau_{ik}/\tau_{il})$	−0.007 [−1.72]	−0.007 [−1.66]	−0.006 [−1.39]	−0.006 [−1.35]
GTR *1965–82*	−0.079 [−2.47]			
GTR *1970–87*		−0.060 [−2.11]		
GSOC *1965–82*			−0.063 [−1.73]	
GSOC *1970–87*				−0.050 [−1.43]
Constant	0.031 [4.84]	0.030 [4.49]	0.025 [4.64]	0.025 [4.30]
$\bar{R}^2$	0.469	0.461	0.455	0.451
n	153	153	153	153

paribus, decrease the growth rate of TFP by 0.8 percent per year. The effect of social security is smaller and of lower statistical significance; at least it is insignificant at the 5% level.

As regards *GC* it is worth noting that it partly constitutes educational expenditures, *GE*, which is really a type of investment. In specifications (xiii) and (xiv) in Table 5 we therefore distinguish between these two types of spending. Compared to the results for *GC* in Table 3, the negative effect of *GC*−*GE* is larger, whereas *GE* has a positive, although not quite significant, effect on TFP-growth.

To further check the validity of the results when we have included one government expenditure variable at a time, we have also made regressions when all components of total spending are included and the different components sum to total outlays, see specifications (xv) and (xvi). Here we see that *GE* is now significant at the 5% level and the estimates of all other variables are almost identical to what was found above. Taken literally there are potentially very large beneficial effects from increasing educational expenditure – an increase of *GE* by one percentage point would increase the rate of TFP

Table 5. Education and all variables.

Variable	(xiii) (1965–82)	(xiv) (1970–87)	(xv) (1965–82)	(xvi) (1970–87)
$\left[\begin{matrix}\dot{K} & K \\ \overline{K} & \overline{Y}\end{matrix}\right]_{ik}$	0.025	0.025	0.023	0.024
	[2.35]	[2.26]	[2.26]	[2.22]
$\left[\begin{matrix}\dot{L} & L \\ \overline{L} & \overline{Y}\end{matrix}\right]_{ik}$	7431	7421	6905	7002
	[9.32]	[9.14]	[9.34]	[9.20]
$\log(\tau_{ik}/\tau_{il})$	−0.007	−0.008	−0.00 10	−0.00 10
	[−1.98]	[−2.20]	[−2.69]	[−2.65]
GC − *GE*	−0.174	−0.163	−0.168	−0.153
	[−4.22]	[−4.18]	[−4.24]	[−4.10]
GE	0.174	0.182	0.278	0.381
	[1.31]	[1.28]	[2.01]	[2.33]
GI			−0.050	−0.030
			[−0.45]	[−0.22]
GTR			−0.083	−0.072
			[−2.76]	[−2.30]
Constant	0.032	0.030	0.042	0.033
	[3.65]	[3.40]	[4.52]	[3.43]
$\overline{R}^2$	0.523	0.522	0.543	0.535
n	153	153	153	153

growth by 0.28 percent p.a. This finding is consistent with other recent studies emphasising the crucial role of human capital formation for economic growth (Baumol, Blackman and Wolff, 1989; Barro, 1991).

So far we have only tested for a potential level effect of different kinds of government spending on TFP-growth. But it is not unlikely that, after having controlled for the level effect, there may be an independent effect of changes in the spending ratio. Such tests are carried out for *GTOT*, *GC*, *GTR*, and *GC* and *GTR* combined in Table 6. The negative level effect is still present and of the same order of magnitude as before, while a change in transfer payments and total outlays is associated with an improved TFP-growth. For ΔGC we do not find any effect of a change in the ratio. The positive effect of an increase in transfers (and hence in total outlays) may very well be the outcome of reverse causation; those countries that have had a high TFP-growth during the period under study have been able to meet a high demand for transfer payments.[14]

Table 6. Changes in government spending.

Variable	(xvii)	(xviii)	(xix)	(xx)
$\left[\frac{\dot{K}}{\overline{K}}\ \frac{K}{\overline{Y}}\right]_{ik}$	0.025 [2.17]	0.025 [2.16]	0.030 [2.66]	0.024 [2.10]
$\left[\frac{\dot{L}}{\overline{L}}\ \frac{L}{\overline{Y}}\right]_{ik}$	6827 [9.38]	7458 [8.87]	6965 [8.07]	7197 [9.20]
$\log(\tau_{ik}/\tau_{il})$	−0.009 [−2.36]	−0.009 [−2.05]	−0.006 [−1.55]	−0.009 [−2.32]
GTOT *(1965–82)*	−0.112 [−4.53]			
$\Delta GTOT$	0.059 [2.79]			
GC *(1965–82)*		−0.137 [−3.43]		−0.141 [−3.45]
ΔGC		−0.014 [−0.29]		−0.021 [−0.39]
GTR *(1965–82)*			−0.088 [−2.64]	−0.066 [−2.08]
ΔGTR			0.038 [1.46]	0.068 [2.44]
Constant	0.054 [5.82]	0.041 [5.55]	0.029 [4.58]	0.046 [5.10]
$\overline{R}^2$	0.537	0.504	0.472	0.528
n	153	153	153	153

Note: The changes in the government expenditure measures have been calculated by regressing the respective measures on a time trend in order to obtain observations unaffected by temporary business cycle effects. These observations are then used in the calculation of changes in the different types of expenditure.

Finally, we tested equation (9), i.e., the more sophisticated hypothesis that government spending in addition to its effect on TFP may have an independent effect on the marginal productivity of capital and labor. The interactive terms were always insignificant, whereas the effects of the government spending variables were similar to what we obtained for the different variants of equation (6). Therefore, these results are of limited interest and are not presented here.[15] It thus appears that the effect of government spending works entirely through its influence on TFP, rather than via the marginal productivities of capital and labor.

8. Conclusions

Theoretical reasoning is not sufficient to determine whether government expenditure should be expected to have a positive or negative effect on growth and productivity. This issue has to be solved by empirical testing. A large number of studies with this purpose have been conducted. While the results are mixed, it is fair to say that the majority of them find a negative effect of government spending on economic growth. This is the case for government consumption in particular.

In this paper we have argued that for a number of reasons – notably measurement problems, the fact that government consumption and investment are part of GDP and a likely endogeneity of government spending – it is more appropriate to focus on the effect of various types of government spending on the rate of productivity growth in the nongovernment sector, preferably using disaggregated data. For this purpose we use a production function approach where a potential catching-up effect is allowed for. The developed model is applied to disaggregated data for 14 OECD countries and 14 industries during the period 1970–87.

Our results are quite distinct and consistent. The level of total outlays, consumption and transfers invariably have a negative impact on the rate of growth of total factor productivity. Government investment is not found to have any effect on TFP-growth. On the other hand, educational expenditure exerts a positive influence on TFP-growth. In a regression combining transfers, consumption excluding education, educational expenditure and investment, all previous findings for the different spending categories taken separately reappear. In that regression, which we consider to be the most convincing, the positive effect of educational expenditure is reinforced. In addition to the level effect there is also an independent positive effect of changes in the spending ratio of transfer payments. This is likely to be caused by reverse causation.

Finally, it should be noted that the influence of government spending on private sector productivity is wholly reflected through its impact on total factor productivity. We cannot find any significant relationship between the level of different government spending categories and the marginal productivity of capital and labor.

Notes

1. The hypothesis says that when the productivity level is higher in one or more countries compared to a number of other countries, the latter have the opportunity to embark on a catching-up process by borrowing superior production techniques from the more advanced economies. Hence, we should expect technologically less advanced countries to grow faster than the technologically leading country(ies). Now technological leadership in different industries is likely

to be spread among different countries. To account for this possibility it is necessary to use disaggregated data.

2. For this reason, we do not deal with the Granger-Causality studies such as Holmes and Hutton (1990) and Conte and Darrat (1988).
3. Levine and Renelt (1992) have recently questioned the robustness of these results.
4. First, the wage level in the public sector is more likely to be above the competitive level in developing countries (Lindauer and Sabot, 1983; Psacharopoulos and Tzannatos, 1992). Second, since the informal economy constitutes a greater portion of economic activity in developing countries (ILO, 1986), a larger part of private sector activity is not recorded in the national accounts.
5. Barro (1989), Landau (1983) and several other studies also include a variable that controls for initial income or initial level of productivity. In most cases initial GDP per capita is used. With few exceptions, if any, this variable comes out with a negative sign in the regressions.
6. E.g., Dowrick and Gemmell (1991). However, due to lack of data on capital stocks, they proxied TFP-levels by labor productivity.
7. Current exchange rates are inappropriate for the conversion because of the strong volatility of exchange rates after the demise of the Bretton Woods system. The use of PPP exchange rates follows the standard used by other researchers, e.g., Dowrick and Nguyen (1989) and Dowrick and Gemmel (1991).
8. To economize on computation, K/Y and L/Y are calculated by taking the average of the initial and final years.
9. The variable Y_{ik} is truncated since it cannot be negative. Hence the lowest value $(\dot{Y}/Y)_{ik}$ can assume is -1. An alternative independent variable is $\ln(Y_{t+1}/Y_t)_{ik} = \ln(1+\dot{Y}/Y)_{ik}$. This variable is not truncated and thus more compatible with the assumption that $\varepsilon_{ik} \sim N(0,\sigma^2)$. The difference between $\ln(Y_{t+1}/Y_t)_{ik}$ and $(\dot{Y}/Y)_{ik}$ is negligible when the changes in Y_{ik} are small. In Tables 2 to 6, we present results with $\ln(Y_{t+1}/Y_t)_{ik}$ as the dependent variable; the estimates with $(\dot{Y}/Y)_{ik}$ as the dependent variable are virtually the same, and the intepretations remain completele unchanged.
10. In the Appendix we show some descriptive statistics for changes in the spending measures.
11. Trehan and Walsh (1988) show that almost any short-run budget deficit path is consistent with a budget that is balanced in present value terms. In a test on U.S. data for the period 1890–1986 they find that the government's budget is consistent with intertemporal budget balance despite the existence of substantial short-run deviations from budget balance.
12. $F(13, 136) = 3.62$ in specification (ii), which strongly rejects the hypothesis of country dummies equal to zero.
13. See, e.g., Mueller (1989, chap. 14).
14. Barro (1989) finds reverse causation for transfer payments for an extended sample of countries using the Summers-Heston data base.
15. Likewise, Engen and Skinner (1992) failed to find any direct effect on the marginal productivities of capital and labor.

References

Abramovitz, M. (1986). Catching up, forging ahead, and falling behind. *Journal of Economic History* 66 (2): 385–406.

Bairam, E. (1989). Government expenditure and economic growth: reflections on professor Ram's approach, a new framework and some evidence from New Zealand Time-Series Data. *Keio Economic Studies* 25 (1): 59–66.

Barro, R.J. (1989). A cross-country study of growth, saving, and government. NBER working paper no. 2855.

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. *Quarterly Journal of Economics* 106 (2): 407–443.

Baumol, W.J., Blackman, S.A.B. and Wolff, E.N. (1989). *Productivity and American leadership.* Cambridge, MA: MIT Press.

Buchanan, J.M. (1980). Rent seeking and profit seeking. In J.M. Buchanan, G. Tullock and R. Tollison (Eds.), *Toward a theory of a rent seeking society*. Texas A. and M. University Press.

Cameron, D. (1982). On the limits of the public economy. *Annals of the Academy of Political and Social Science* 459 (January): 46–62.

Carr, J.L. (1989). Government size and economic growth: a new framework and some evidence from cross-section and time-series data: comment. *American Economic Review* 79 (1): 267–280.

Conte, A. and Darrat, A.F. (1988). Economic growth and the expanding public sector: a reexamination. *Review of Economics and Statistics* 70 (2): 322–330.

Dowrick, S. and Gemmell, N. (1991). Industrialisation, catching up and economic growth: a comparative study across the world's capitalist economies. *Economic Journal* 101 (405): 263–275.

Dowrick, S. and Nguyen, D.-T. (1989). OECD comparative economic growth 1950–85: catching up and convergence. *American Economic Review* 79 (5): 1010–1030.

Easterlin, R.A. (1974). Does economic growth improve the human lot? Some empirical evidence. In P.A. David and M.W. Reder (Eds.), *Nations and households in economic growth*. New York: Academic Press.

Engen, E.M. and Skinner, J. (1992). Fiscal policy and economic growth. NBER working paper no. 4223.

Gould, F. (1983). The development of public expenditures in western industrialized countries: a comparative analysis. *Public Finance* 38 (1): 38–69.

Grier, K.B. and Tullock, G. (1989). An empirical analysis of cross-national economic growth, 1951–80. *Journal of Monetary Economics* 24 (2): 259–276.

Hansson, I. (1984). Marginal cost of public funds for different tax instruments and government expenditures. *Scandinavian Journal of Economics* 86 (2): 115–130.

Holmes, J.M. and Hutton, P.A. (1990). On the causal relationship between government expenditures and national income. *Review of Economics and Statistics* 72 (1): 87–95.

ILO (1986). *The challenge of employment and basic needs in Africa.* Nairobi: Oxford University Press.

Kaldor, N. (1966). *Causes of the slow rate of economic growth of the United Kingdom: an inaugural lecture.* Cambridge: Cambridge University Press.

Katz, C.J., Mahler, V.A. and Franz, M.G. (1983). The impact of taxes on growth and distribution in developed capitalist countries: a cross-national study. *American Political Science Review* 77 (4): 871–886.

King, R.G. and Rebelo, S. (1990). Public policy and economic growth: developing neoclassical implications. *Journal of Political Economy* 98 (5): S126–S150.

Kormendi, R.C. and Meguire, P.G. (1985). Macroeconomic determinants of growth: cross-country evidence. *Journal of Monetary Economics* 16 (2): 141–164.

Korpi, W. (1985). Economic growth and the welfare system: leaky bucket or irrigation system? *European Sociological Review* 1 (2): 97–118.

Koskela, E. and Virén, M. (1992). Is there a Laffer curve between government size and private output: some evidence from a market price approach. Research report no. 20, Department of Economics, University of Turku.

Landau, D. (1983). Government expenditure and economic growth: a cross-country study. *Southern Economic Journal* 49 (4): 783–792.

Landau, D. (1986). Government and economic growth in the less developed countries: an empirical study for 1960–1980. *Economic Development and Cultural Change* 35 (October): 35–75.

Levine, R. and Renelt, D. (1992). A sensitivity analysis of cross-country growth regressions. *American Economic Review* 82 (4): 942–961.

Liesner, T. (1989). *One hundred years of economic statistics.* London: The Economist Publications.

Lindauer, D.L. and Sabot, R. (1983). The public/private wage differential in a poor urban economy. *Journal of Development Economics* 12 (2): 137–152.

Lindbeck, A. (1983). Budget expansion and cost inflation. *American Economic Review* 73 (2): 285–296.

Meyer-zu-Schlochtern, F.J.M. (1988). An international sectoral data base for thirteen OECD countries. Working paper no. 57, OECD Econometric Unit, Paris.

Mueller, D.C. (1989). *Public choice II.* Cambridge: Cambridge University Press.

Myrdal, G. (1960). *Beyond the welfare state.* New Haven, CN: Yale University Press.

Olson, M. (1982). *The rise and decline of nations.* New Haven, CN: Yale University Press.

Plosser, C.I. (1992). The search for growth. In *Policies for long-run grown.* Kansas: The Federal Reserve Bank of Kansas City.

Psacharopoulos, G. and Tzannatos, Z. (1992). Latin American women's earnings and participation in the labor force. The World Bank, WPS 856.

Ram, R. (1986). Government size and economic growth: a new framework and some evidence from cross-section and time-series data. *American Economic Review* 76 (1): 191–203.

Rao, V.V.B. (1989). Government size and economic growth: a new framework and some evidence from cross-section and time-series data: comment. *American Economic Review* 79 (1): 272–280.

Saunders, P. (1985). Public expenditure and economic performance in OECD countries. *Journal of Public Policy* 5 (1): 1–21.

Smith, D. (1975). Public consumption and economic performance. *National Westminster Bank Review*, November, 17–30.

Solow, R.M. (1956). A contribution to the theory of economic growth. *Quarterly Journal of Economics* 70 (1): 65–94.

Trehan, B. and Walsh, C.E. (1988). Common trends, the government's budget constraint, and revenue smoothing, *Journal of Economic Dynamics and Control* 12 (2–3): 425–444.

Ward, M. (1985). *Purchasing power parities and real expenditure in the OECD.* Paris: OECD.

White, H. (1980). A heteroscedasticity-consistent covariance matrix estimator and a direct test for heteroscedasticity. *Econometrica* 48 (4): 817–838.

Appendix

Table A1. Countries and industries in ISDB.

Industries	
Food, beverages, tobacco	Machinery, equipment
Textiles	Construction
Wood, wood products	Wholesale, retail trade, restaurants,
Paper, printing, publishing	hotels
Other manufactured products	Transport, storage, communication
Chemicals	Finance, insurance, real estate
Nonmetallic mineral products	Electricity, gas, water
Basic metal products	

Countries		
Australia	France	Sweden
Belgium	Italy	U.K.
Canada	Japan	U.S.A.
Denmark	The Netherlands	West Germany
Finland	Norway	

Note: Agriculture, Mining, and The public sector (Community, social, personal services and Producers of government services) have been excluded. Due to lack of data on the more disaggregated levels, we were forced to aggregate Wholesale, retail trade, restaurants, hotels as well as Finance, insurance, real estate. See Meyer-zu-Schlochtern (1988) for further details.

Table A2. Means and standard deviations of nongovernment variables in the model (percentage change).

Variable	*Mean, all industries*	*Std dev.*
$(\dot{Y}/Y)_{ik}$	2.32	2.10
$(\dot{K}/K)_{ik}$	3.49	2.16
$(\dot{L}/L)_{ik}$	−0.20	2.07
(τ_{ik}/τ_{il}) (1970)	0.614	0.220
(τ_{ik}/τ_{il}) (1987)	0.608	0.202

Table A3. Change in GDP-share of various government spending categories, 1965–82 and 1970–87 for the 14 countries.

Category		*Mean*	*Std dev.*	*Min.*	*Max.*
Consumption, ΔGC	1965–82	4.30	2.89	−0.44	9.09
	1970–87	3.32	2.12	−0.60	6.10
Education, ΔGE	1965–82	1.18	0.68	0.12	2.53
	1970–87	0.51	0.75	−0.71	1.99

Table A3. Continued.

Investment, ΔGI	1965–82	−1.26	1.27	−4.45	0.90
	1970–87	−1.45	1.79	−5.40	0.80
Transfers, ΔGTR	1965–82	11.63	5.18	3.96	19.84
	1970–87	9.88	4.03	5.00	15.80
Social security, ΔGSOC	1965–82	5.68	2.33	2.77	9.27
	1970–87	5.16	1.86	3.00	9.10
Total outlays, ΔGTOT	1965–82	14.74	6.69	6.11	26.80
	1970–87	11.74	4.20	3.80	17.10

Source: See Table 1.