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Public Expenditure and Growth in Developing Countries: Education is the Key

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ABSTRACT

This paper examines the growth effects of government expenditure for a panel of thirty developing countries over the decades of the 1970s and 1980s, with a particular focus on sectoral expenditures. Our methodology improves on previous research on this topic by explicitly recognising the role of the government budget constraint and the possible biases arising from omitted variables. Our primary results are twofold. Firstly, the share of government capital expenditure in GDP is positively and significantly correlated with economic growth, but current expenditure is insignificant. Secondly, at the sectoral level, government investment and total expenditures in education are the only outlays that are significantly associated with growth once the budget constraint and omitted variables are taken into consideration. Therefore, we conclude that education is the key to growth for developing countries.

Keywords: Public Expenditure, Economic Growth, Education, Omission Bias, Public Financing, and Budget Constraint.

JEL Classification: O4; E62; H6

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1. Introduction

The recent revival of interest in growth theory has also revived interest among researchers in verifying and understanding the linkages between the fiscal policies and economic growth. Over the past decade and a half, a substantial volume of empirical research has been directed towards identifying the elements of public expenditure (at its aggregate and disaggregate levels) that bear significant association with economic growth. This empirical literature varies in terms of data sets, econometric techniques, and often produces conflicting results[1]. Explanations offered to account for these varied and conflicting results can broadly be divided into two categories. According to the first, it is the differences in the set of conditioning variables and initial conditions across studies that are responsible for the lack of consensus in the results (Levine and Renelt 1992). In contrast, the second category consists of a handful of studies (Helms 1985; Mofidi and Stone 1990; Kneller *et al*. 1999) that suggest this variation in the results, in part at least, reflects the wide spread tendency among researchers to ignore the implications of the government budget constraint for their regressions. In particular, the latter view emphasizes the need to consider both the sources and the uses of funds simultaneously for a meaningful evaluation of the effects of taxes or expenditures on economic growth.

In addition to producing conflicting views, the existing literature displays a disturbing trend. Most of the conclusions drawn in the recent literature on the growth effects of public spending are based either on the experiences of a set of developed countries or on the basis of large samples consisting of a mixture of developed and developing countries. Accordingly, there remains little by way of understanding the process by which public expenditure policies shape the prospect of economic growth for developing countries. This trend has continued despite the long standing view among development experts that there exists not only a significant difference in the composition of public expenditure between the developed and developing countries, but the difference is also profound in the way in which public expenditures shape the outcome in these two

[1] Consider, for example, the association between government size (as measured either by the level of total public expenditure or by the level of public consumption expenditure) and economic growth. According to some studies, such association is significant and positive (Ram, 1986; Romer, 1989, 1990, 1991). The same association has been found to be significant and negative in other studies (e.g. Landau 1983, 1985, 1986; Grier and Tullock 1989; Alexander 1990; Barro 1990, 1991). Yet other studies have found this association to be insignificant or fragile (e.g. Kormendi and Meguire 1985; Levine and Renelt 1992). A similar variation in results can also be observed among studies which look for the growth effects of public expenditures at disaggregated levels.

set of countries[2]. The only exceptions to the above trend that we know of are the contributions by Landau (1986), Devarajan *et al.* (1996), and Miller and Russek (1997). Despite their commendable objective, these studies, however, share one of the aforementioned weaknesses that is pervasive in the existing literature. In particular, none of these studies include the government budget constraint in full in their analysis. Accordingly, the parameter estimates in these studies are prone to systematic biases.[3]

The primary objective of this paper is to examine the growth effects of public expenditure by sector for a panel of thirty developing countries, paying attention to the "sensitivity" issue arising from initial conditions and conditioning variables while also avoiding the omission bias that may result from ignoring the full implications of the government budget constraint. On one hand, by focussing attention exclusively to developing countries and, on the other, by recognising the existence of the government budget constraint, the present paper fills an important gap that currently exists in the literature.

In particular, our aim in this paper is to pin down which specific components of government expenditure significantly impact on economic growth. Here, we are not interested in the financing of this expenditure per se, but we include the important financing variables (government budget surplus/deficit and tax revenue) to avoid the coefficient biases that would result from their omission (Kneller *et al*., 1999). Further, where government expenditure components are found to be individually significant, we include them jointly to investigate whether their apparent individual roles are genuine, or spurious in the sense of being attributable to other components with which they are correlated. In other words, from an econometric perspective we again control for possible omitted variable bias that will result should any component of government expenditure that is important for growth be excluded from the model.

Our disaggregated analysis is also valuable from the policy perspective. Our results for the growth effects of public expenditures by individual sectors of the economy gives rise to information that is particularly useful for developing countries, which are

[2] Please refer to the World Bank Report, 1988, for details.

[3] The possibility of omission bias arises in Landau (1986) and Devarajan *et al*. (1996) due to the fact that these studies only focus on the expenditure side of the budget constraint and ignore the revenue side. In contrast, the source of omission bias in Miller and Russek (1997) lies in its own purpose – that is, to demonstrate that the growth effect of public expenditure is dependent on the mode of financing. According to their argument, this objective is best achieved by running regressions based on the specifications that exclude budget surplus/deficits – a variable that has been established in previous studies (e.g., Fischer 1993) to have a significant and robust association with economic growth.

resource constrained and where the allocation of limited public resources between the sectors is an issue of paramount importance. In this regard, our main contribution is the finding that education is the key sector to which public expenditure should be directed in order to promote economic growth. This result is novel and overturns previous findings of negative or insignificant positive effects of education expenditure on growth for developing countries (Landau 1986; Devarajan *et al*. 1996; Miller and Russek 1997). However, as argued above, our analysis is more satisfactory from an econometric perspective than these earlier studies.

Our two principal empirical findings can be summarized as:

(1) The share of government capital expenditure in GDP is positively and significantly correlated with economic growth, while the growth effect of current expenditure is insignificant for our group of countries.

(2) At the sectoral level, government investment and total expenditures in education are the only outlays that remain significantly associated with growth throughout the analysis.

Other findings of our analysis are:

(3) Although public investments and expenditures in other sectors (transport and communication, defence) initially have significant associations with growth, these do not survive when we incorporate the government budget constraint and other sectoral expenditures into the analysis.

(4) The private investment share of GDP is associated with economic growth in a significant and positive manner.

(5) There is strong evidence that a government budget deficit gives rise to adverse growth effects.

The remainder of the paper is organised as follows. Section 2 discusses our data and its sources. In Section 3, presents a baseline analysis of the impact of government expenditure categories on growth, which is extended in Section 4 to examine the implications of omitted variable bias and the government budget constraint. Section 5 concludes.

2. Data and Variables

Our data set on public expenditures include series for both current and capital expenditures[4] (at aggregate and sectoral levels) of the Central Government Consolidated accounts for thirty developing countries[5] for the period of 1970-1990. Despite some of its known drawbacks, the *Government Financial Statistics (GFS)* – an annual publication of the International Monetary Fund – has established itself as a primary source for data on government expenditures. In our case, however, the usefulness of this data source is limited. In addition to the aggregate capital and current expenditures, we wish to study the effects of capital and current expenditures by sector (e.g., defence, education, health, agriculture, transport and communication, and manufacturing). For developing countries, information on the latter variables are not available in the *GFS* data series. To overcome this problem, we have constructed a data set after consulting a large collection of World Bank Country Economic Reports and Public Expenditure Reviews[6]. From these, information about the central government's total, current and capital expenditures by sector was available over 1979-1990 for thirty developing countries, and hence these countries constitute our sample.

Data for other variables has been drawn from two different data sources. Initial GDP per capita, population, initial human capital, life expectancy, political instability, private investment, initial trade ratio, black market premium and the terms of trade have been extracted from the Barro and Lee (1994) data set. Growth of GDP per capita, agriculture's share in GDP, and broad money (M2) have been extracted from the World Bank CDROM. Availability of fiscal information and some other variables makes it impractical to conduct an analysis at the annual frequency. Thus, unless we state otherwise, a data point for a variable corresponds to the decade average value (1970-1979, 1980-1989) of that variable. The details of the variables and their data sources are included in the appendix.

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[4] We have followed the Government Finance Statistics Yearbook (published by IMF) guidelines for classifying expenditures into current and capital expenditures.

[5] The countries are listed in the appendix.

[6] In an earlier exercise, Easterly and Rebelo (1993) collected data on public investment by sectors. We differ from this existing data set on two grounds. First, our data set includes information on both public investment expenditures and current expenditures by sector. Second, the measure of public investment used by Easterly and Rebelo also includes investment by public enterprises. In contrast, we strictly follow the *GFS* guidelines and exclude pubic enterprise investments. We acknowledge that this narrower definition may give rise to some bias in the results. At the same time (as acknowledged by the authors themselves) the measure used by Easterly and Rebelo (1993) creates a tendency to overstate public investment by including investments by public firms that have activities and goals similar to those of the private sector. Our data set and further details about the data sources are available on request from the authors.

3. Baseline Results

To start with, we classify the variables into three distinct sets: **I, M** and **Z**. The set **I** consists of variables that commonly appear as conditioning variables in growth regressions. The set **Z** includes variables that often have been included in previous studies as indicators for monetary policies, trade policies, and market distortion.

Finally, the set **M** consists of variables that are of particular interest for the present study, namely Central Government expenditures and their major components at aggregate and sectoral levels. These variables are expressed as percentages of GDP. In total, we consider twenty such variables, as detailed in the appendix. To make our tables digestible, however, we do not report results for variables with no significant association with growth at the most elementary stage of our analysis, that is, in the base regression of (1) below.

Operationally, we use a panel set-up in which the dependent variable (growth rate in real GDP per capita, GR_{it}) is observed twice (as decade averages) for each country for 1970-79 and 1980-89. The system includes a separate constant term, β_{0t}, for each decade. The other coefficients are constrained to be the same for both time periods. Panel estimation is carried out by the seemingly unrelated regression (SURE) method, with two equations for each country (one equation for each decade). Thus, the disturbance term, u_{it}, for country i at time t, is allowed to be correlated with term $u_{it'}$ for the same country at the different date, t'. The variance of u_{it} varies with t but not with i. In practice, the estimated correlations of the error terms across the time periods turn out to be small and insignificant (see the tables below).

3.1 Base Regressions

Initially, we examine whether the variables of interest (i.e., the elements of the set **M**) are significantly correlated with growth after controlling for the **I** variables. For this, we run a series of base regressions each of which includes all conditioning (**I)** variables and one government expenditure (**M)** variable:

$$GR_{it} = \beta_{0t} + \sum_{j=1}^{6} \beta_j^I I_{j,it} + \beta^M M_{it} + u_{it} \qquad (1)$$

Following Levine and Renelt (1992) and Barro (1991, 1995, 1999), we include log of initial GDP per capita, initial school enrolment ratio[7], investment share of GDP, log of life expectancy and an index of political stability in the set **I**[8]. It has been emphasised by a number of studies (e.g. Cashin, 1995; Kocherlakota and Yi, 1997) that while the provision of public goods is growth-enhancing, the distortionary taxes that need to be raised to fund the provision of the same public goods may have growth-diminishing effects. Accordingly, it is necessary to control for tax revenue in order to make a proper assessment about the growth effects of public spending. Keeping this view and the primary objective of this paper in mind, we have also included tax revenue as a percentage of GDP in the set **I**.

Therefore, the set **I** of the base regression (1) embodies a central idea of the new growth literature, namely that human capital and institutional factors are important determinants of economic growth. In addition, through inclusion of the initial GDP, the above model also controls for possible effects of convergence on output growth.

Table 1 summarizes the results from the base regression (1). Out of the twenty categories of public expenditure examined, we report the results only for the six categories (total investment, investment in education, investment in transport and communication, total expenditure on education, total expenditure on transport and communication and total expenditure on defence) that we find to display a significant association with growth, using a 10 percent significance level.

We open the discussion with our results for the **I** variables. Among this set, only private investment demonstrates a significant association with growth. This is in congruence with the basic prediction of the neoclassical growth theory, and is supported by a number of previous empirical studies (e.g. Levine and Renelt 1992, Mankiw, Romer and Weil 1992, DeLong and Summers 1991). Some other results, however, are less in tune with the theoretical predictions. For example, our analysis shows no sign of convergence among this group of countries. We suspect this may be due to the fact that our sample includes a number of poor countries (such as Sub-Saharan countries), which

[7] We also considered average schooling years as a proxy for human capital stock. However, we dropped this variable from our analysis as data are missing for a quarter of the countries in our sample.

[8] Levine and Renelt (1992) also include average annual population growth rate in the set **I**, but we dropped it from the analysis since it was always insignificant, perhaps due to the lack of variability in its values. We did, however, verify that all our results remain unaltered when this variable is included in the analysis.

Table 1: Growth Regressions with Central Government Expenditures

	Capital Expenditure	Education Investment	Transport and Communication Investment	Education Expenditure	Transport and Communication Expenditure	Defence Expenditure
Government expenditure	0.171*** (0.056)	1.516*** (0.431)	0.389* (0.206)	0.681*** (0.239)	0.394** (0.191)	0.257* (0.135)
I variables						
Tax revenue	-0.030 (0.055)	0.041 (0.052)	-0.020 (0.062)	-0.096 (0.068)	-0.044 (0.067)	-0.003 (0.064)
Private Investment	0.265*** (0.053)	0.242*** (0.053)	0.246*** (0.059)	0.283*** (0.055)	0.249*** (0.058)	0.294*** (0.058)
Initial GDP per capita	0.005 (0.003)	0.004 (0.003)	0.003 (0.003)	0.005 (0.003)	0.003 (0.003)	0.004 (0.003)
Initial human capital	-0.012* (0.007)	-0.011* (0.006)	-0.014** (0.007)	-0.009 (0.007)	-0.016** (0.007)	-0.013* (0.007)
Initial Life expectancy	0.076 (0.070)	0.050 (0.068)	0.116 (0.078)	0.015 (0.075)	0.136 (0.079)	0.093 (0.070)
Political instability	-0.007 (0.020)	-0.006 (0.020)	-0.014 (0.020)	-0.004 (0.020)	-0.016 (0.020)	-0.025 (0.019)
R^2	0.50 (0.52)	0.51 (0.57)	0.44 (0.53)	0.51 (0.56)	0.46 (0.55)	0.56 (0.64)
Observations	30 (30)	29 (29)	29 (29)	28 (28)	28 (28)	25 (25)
Regression test (p-value)	61.602 (0.000)	67.891 (0.000)	46.465 (0.000)	56.926 (0.000)	46.465 (0.000)	65.499 (0.000)
AR(1) coefficient (p-value)	0.018 (0.922)	0.002 (0.993)	0.176 (0.342)	0.139 (0.462)	0.162 (0.392)	0.164 (0.413)

Notes: The column heading shows the specific government expenditure category (M_{it}) used in the regression. Estimation is by the SURE (seemingly-unrelated regression) technique, which allows the error term to be correlated across the two decades and to have a different variance in each period. The dependent variable is growth rate in real GDP per capita. Standard errors of coefficients are shown in parentheses. The first R^2 is for 70s and the R^2 reported within parentheses is for 80s. Similarly the first number of observations is for 70s and the number of observations reported within parentheses is for the 80s. The number of observations differs across models due to the lack of availability of some explanatory variables for specific countries. The serial correlation coefficient is the AR(1) value in a regression of residuals for 1970s and those for 1980s, with the p-value being that for the Breusch-Pagan test, which refer to the hypothesis that the residuals of the equations for two decades are uncorrelated. The regression test is a Wald χ^2 test. For the coefficients, * indicates significant at 10 percent, ** indicates significant at 5 percent and *** indicates significant at 1 percent.

experienced dismal growth performances (often negative growth rates) over a prolonged period of time[9]. Surprisingly, initial human capital is found to have a negative effect on growth, with this sometimes being significant. In terms of direction, the relationships between growth and the remaining two conditioning variables accord well with theoretical predictions, but neither of these associations is significant for this group of countries.

As already noted, our preliminary analysis indicates that the GDP shares of only six out of twenty categories of public spending display an association with economic growth. However, Table 1 shows the levels of significance across of these to be varied. The most significant associations are obtained for total capital expenditure, total expenditure in the education sector, and for investment expenditure in the education sector. The significant association between the share of central government capital expenditure in GDP and economic growth is not entirely surprising in the light of the conclusions drawn by previous studies (e.g., Easterly and Rebelo 1993; Cashin 1995; Fuente 1997) that are based on either developed countries or a large pool of developed and developing countries. However, to our knowledge, Landau (1986) is the only panel study that included total capital expenditure in the regression for developing countries, but found its association with growth to be insignificant. Thus, our result here contains new information.

Our result on total education expenditure differs from conclusions drawn by previous studies, irrespective of whether these are based on data for a large pool of countries (e.g. Barro 1995, 1999) or developing countries (e.g. Landau 1986; Devarajan 1996). These earlier results indicate that the association of this variable with growth is either insignificant or non-robust. Our result regarding the association between investment expenditure in the education sector and economic growth also merits some comment. Due to the lack of readily available data, the analysis of the impact of this variable on growth is almost non-existent in the literature. To our knowledge, the only exception is Easterly and Rebelo (1993), who study a large pool of developed and developing countries. We find investment in education to be not only highly significant, but the magnitude of the effect of this variable on growth is considerable: a one percentage point increase in central government investment in education in relation to

[9] In the growth literature (e.g. Azariadis and Drazen 1986) often these countries have been referred to as the countries in 'development trap'.

GDP is associated with an increase in the average growth rate of real GDP per capita by 1.5 percentage points. Although not significant in their case, Easterly and Rebelo (1993) find similarly large effects for investment in education. The explanation for this effect may lie in the strong externalities of investment in education in raising the productivity of both human and physical capital. Theoretical justification of this view is readily available in the new growth literature.

Results for the other three expenditure variables draw mixed support from the existing literature. For example, the positive and significant association between the total expenditure in the transport and communication sector and growth finds support in the study by Aschauer (1989). Support for the positive association between the investment expenditure in the transport and communication sector and growth can be obtained in the study by Easterly and Rebelo (1993). We, however, find this association significant only at the ten percent level. Finally, our preliminary analysis suggests a positive and significant (at ten percent level) association between defence spending and growth. In the existing literature, this association has sometimes been reported as positive and significant (Benoit 1978; Frederiksen and Looney 1982). At the same time, other studies have found it to be negative (Deger and Smith 1983; Knight *et al*. 1996), while in yet other studies the growth effect of defence expenditure has been found to be neutral (Biswas and Ram 1986).

3.2 Robustness Checks

The robustness of the results from the base regression (1) are now examined, focusing only on the **M** variables that are associated with growth in a significant manner and included in Table 1. This analysis is conducted in two stages. First, following Easterly and Rebelo (1993), we expand the set of regressors to include the ratio of broad money (*M2*) to GDP in 1970 and the trade share of GDP in 1970 (*TR*):

$$GR_{it} = \beta_{0t} + \sum_{j=1}^{6} \beta_j^I I_{j,it} + \beta^M M_{it} + \beta_1^Z M2_{it} + \beta_2^Z TR_{it} + u_{it} \qquad (2)$$

The purpose of including these variables is to control for the effects of monetary policy and the degree of openness which, according to previous studies (e.g., Levine and Renelt 1992; King and Levine 1993), are significant correlates of economic growth. Next, we expand the set of regressors to include other variables:

$$GR_{it} = \beta_{0t} + \sum_{j=1}^{6} \beta_j^I I_{j,it} + \beta^M M_{it} + \beta_1^Z M2_{it} + \beta_2^Z TR_{it} + \beta_3^Z BMP_{it} + \beta_4^Z TT_{it} + u_{it} \qquad (3)$$

More specifically, we include the black market premium (*BMP*) and the growth rate of the terms of trade (*TT*) in (3). These control for market distortions and capture the adverse effect of trade shocks that a number of countries in our sample experienced during the period of our analysis. These two variables have also appeared as significant correlates of growth in previous studies (e.g., Fischer 1993, Deverajan *et al*. 1996 and Barro 1999). The results are reported in Table 2.

In the spirit of Levine and Renelt (1992), we certify that the variable under consideration has a robust association with economic growth if the coefficient of the **M** variable remains significant and of the same sign as in Table 1. As our results indicate, none of the six expenditure variables fails the robustness test. In fact, in most cases, we observe an improvement in the level of significance. In contrast, for the countries in our sample, of the four Z variables only the growth of the terms of trade has any significant association with economic growth.

Therefore, the results of the base regression in Table 1 have not been unduly distorted by omission of variables capturing monetary policies, trade policies or market distortions.

4. Omitted Variables and the Government Budget Constraint

4.1 The Government Budget Constraint

We noted in the Introduction that almost all previous studies of the association between government expenditure and growth are subject to potential biases because they omit variables that enter the government's budget constraint. This is the case also for the regressions (1) to (3) above, whose results have been summarised in Tables 1 and 2.

Kneller *et al.* (1999) discuss the importance of the government budget constraint in the context of the growth effects of fiscal policy for developed countries, and our discussion largely derives from their analysis[10]. Generalising the notation of Section 3 above, let $M_{j,it}$ be a fiscal variable relating to country i at time t. If there are m distinct government expenditure or revenue elements, then the government budget constraint

[10] Miller and Russek (1997) make arguments similar to those of Kneller *et al.* (1999), but they do not consider omission bias in their econometric analysis (see footnote 3).

Table 2: Robustness Checks for Effects of Government Expenditure

	Total Investment		Education Investment		Transport and Communication Investment		Education Expenditure		Transport and Communication Expenditure		Defence Expenditure	
Government expenditure	0.201***	0.201***	1.803***	1.997***	0.431**	0.471**	0.679***	0.675***	0.471**	0.515**	0.324**	0.372**
	(0.057)	(0.060)	(0.446)	(0.446)	(0.213)	(0.220)	(0.245)	(0.248)	(0.198)	(0.205)	(0.149)	(0.149)
I variables												
Tax revenue	-0.036	-0.068	0.014	-0.033	-0.011	-0.041	-0.072	-0.096	-0.057	-0.088	-0.017	-0.040
	(0.069)	(0.072)	(0.064)	(0.067)	(0.074)	(0.077)	(0.081)	(0.083)	(0.079)	(0.082)	(0.062)	(0.086)
Private Investment	0.270***	0.276***	0.229***	0.220***	0.255***	0.252***	0.296***	0.289***	0.255***	0.254***	0.332***	0.350***
	(0.053)	(0.055)	(0.053)	(0.053)	(0.062)	(0.063)	(0.058)	(0.060)	(0.060)	(0.061)	(0.062)	(0.064)
Initial GDP per capita	0.007**	0.006*	0.007**	0.006*	0.005	0.004	0.006	0.004	0.006	0.005	0.004	0.004
	(0.003)	(0.003)	(0.003)	(0.003)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.003)	(0.003)
Initial human capital	-0.014	-0.017**	-0.015**	-0.019**	-0.014	-0.019**	-0.006	-0.009	-0.018**	-0.022**	-0.017**	-0.020**
	(0.008)	(0.008)	(0.007)	(0.007)	(0.009)	(0.009)	(0.008)	(0.008)	(0.009)	(0.009)	(0.008)	(0.008)
Initial Life expectancy	0.038	0.069	0.009	0.060	0.084	0.126	-0.026	0.002	0.112	0.151**	0.145*	0.180**
	(0.081)	(0.084)	(0.079)	(0.080)	(0.095)	(0.097)	(0.089)	(0.092)	(0.094)	(0.096)	(0.087)	(0.088)
Political instability	0.003	-0.008	0.021	0.011	-0.009	-0.017	-0.000	-0.005	-0.008	-0.018	-0.032	-0.045**
	(0.020)	(0.021)	(0.020)	(0.021)	(0.021)	(0.023)	(0.021)	(0.022)	(0.021)	(0.023)	(0.020)	(0.021)
Z variables												
Initial M2	0.024	0.017	0.026	0.018	0.019	0.013	0.018	0.014	0.019	0.014	-0.030	-0.039
	(0.026)	(0.026)	(0.025)	(0.025)	(0.028)	(0.028)	(0.029)	(0.029)	(0.027)	(0.028)	(0.030)	(0.030)
Initial trade ratio	0.002	0.004	0.014	0.020	-0.004	0.000	-0.009	-0.005	0.002	0.004	-0.002	0.002
	(0.026)	(0.014)	(0.014)	(0.014)	(0.016)	(0.017)	(0.014)	(0.015)	(0.016)	(0.017)	(0.014)	(0.014)
Black market premium	-	0.001	-	0.001	-	0.002	-	0.001	-	0.002	-	0.003
		(0.002)		(0.002)		(0.003)		(0.002)		(0.003)		(0.002)
Growth rate of terms of trade	-	0.028	-	0.089*	-	0.064	-	0.085*	-	0.044	-	-0.010
		(0.052)		(0.048)		(0.055)		(0.051)		(0.056)		(0.061)
R^2	0.56	0.56	0.56	0.62	0.47	0.49	0.52	0.53	0.51	0.53	0.58	0.54
	(0.49)	(0.51)	(0.55)	(0.54)	(0.53)	(0.54)	(0.57)	(0.59)	(0.54)	(0.55)	(0.66)	(0.72)
Observations	29 (29)	28 (28)	28 (28)	27 (27)	28 (28)	27 (27)	27 (27)	26 (26)	27 (27)	26 (26)	24 (24)	23 (23)
Regression test	72.009	72.220	84.546	91.711	49.005	50.304	57.553	51.182	55.232	56.7317	73.073	75.940
(p-value)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
AR(1)	-0.086	-0.076	-0.155	-0.154	0.115	0.138	0.132	0.177	0.064	0.064	0.088	0.088
(p-value)	(0.643)	(0.688)	(0.412)	(0.423)	(0.544)	(0.472)	(0.494)	(0.366)	(0.741)	(0.745)	(0.667)	(0.672)

Notes: See Table 1.

implies the identity

$$\sum_{j=1}^{m} M_{j,it} = 0 .$$

Allowing each element to have an impact on growth leads to a generalisation of the growth regression (1) as:

$$GR_{it} = \beta_{0t} + \sum_{j=1}^{5} \beta_j^I I_{j,it} + \sum_{j=1}^{m} \beta_j^M M_{j,it} + u_{it} . \qquad (4)$$

In comparing (4) with equations (1) – (3), it should be noted that tax revenue appeared as a conditioning, or **I**, variable in the earlier equations. However, as this is an element of the budget constraint, we include it in (4) as a variable in the set **M**. Consequently, there are now five rather than six elements of **I.**

Equation (4) cannot be estimated due to the perfect collinearity between the m elements $M_{j,it}$ of the budget constraint. Consequently, (at least) one element $M_{j,it}$ must be omitted. If, for simplicity, we assume $M_{m,it}$ is the single omitted element, then the model to be estimated becomes

$$GR_{it} = \beta_{0t} + \sum_{j=1}^{5} \beta_j^I I_{j,it} + \sum_{j=1}^{m-1} \gamma_j^M M_{j,it} + u_{it} \qquad (5)$$

where, in relation to (4), $\gamma_j = \beta_j^M - \beta_m^M$. From standard results of linear regression analysis, overall measures relating to the estimated regression (including R^2, residuals, etc) and the coefficients β_j^I are invariant to which element of the government budget constraint is excluded. However, the magnitude and significance of $\gamma_j = \beta_j^M - \beta_m^M$ depends on both β_j^M and β_m^M, and therefore depends on which element is excluded. If, however, the excluded $M_{j,it}$ has coefficient $\beta_m^M = 0$, then $\gamma_j = \beta_j^M$ and the coefficient of each included fiscal variable in (5) retains the same interpretation as in (4).

Our models estimated in Section 3 each include one government expenditure category, together with tax revenue. Therefore, in attaching an estimated coefficient to a specific expenditure component, we implicitly assumed all excluded $\beta_j^M = 0$. We now wish to acknowledge the possibility that the significant association between growth and each of the six components of public expenditure obtained in Section 3 could be affected by omitted variable bias. Indeed, by considering these one by one, an association of growth with one category could be spurious in the sense of being attributable to other

components of public expenditure with which it is correlated. To eliminate this possibility, we should ideally include all the elements of the government budget constraint, except for one category whose coefficient we anticipate to be zero. Given our sample size, the scope of conducting such an exercise, however, is severely limited.

As a practical alternative, we consider the six components of public expenditure found to have significant impacts on growth in our earlier analysis into three sub-groups (total expenditure, total sectoral expenditures and sectoral investment expenditures), and include the elements of each sub-group jointly in the model along with the budget constraint. Specifically, the models are as follows:

$$GR_{it} = \beta_{0t} + \sum_{j=1}^{5} \beta_j^I I_{j,it} + \beta_1^M CUR_{it} + \beta_2^M CAP_{it} + \beta_3^M OTHEXP_{it} + \beta_4^M TX_{it} + \beta_5^M GD_{it} + u_{it} \tag{6.1}$$

$$GR_{it} = \beta_{0t} + \sum_{j=1}^{5} \beta_j^I I_{j,it} + \chi_1^M IED_{it} + \gamma_2^M ITC_{it} + \gamma_3^M OTHEXP_{it} + \gamma_4^M TX_{it} + \gamma_5^M GD_{it} + u_{it} \tag{6.2}$$

$$GR_{it} = \beta_{0t} + \sum_{j=1}^{5} \beta_j^I I_{j,it} + \delta_1^M EDU_{it} + \delta_2^M TC_{it} + \delta_3^M DF_{it} + +\delta_4^M OTHEXP_{it} + \delta_5^M TX_{it} + \delta_6^M GD_{it} + u_{it} \tag{6.3}$$

In model (6.1), the variables *CUR*, *CAP*, and *GD* denote total public current expenditure, total public capital expenditure and the budget surplus/deficit, respectively. All these three variables are expressed as percentages of GDP. The variables *IED* and *ITC* in (6.2) denote investment expenditure (as a share of GDP) in the education and in the transport and communication sectors, respectively. Finally, *EDU*, *TC* and *DF* in model (6.3) denote total expenditures (as shares of GDP) in education, transport and communication, and defence sectors, respectively.

Equations (6.1)-(6.3) explicitly include the relevant expenditures in a sub-group found to be significant in Table 1. Therefore, we avoid possibly spurious statistical significance arising due to correlation between included and excluded elements. In addition, for the purpose of bringing the budget constraint in full into the analysis, we include the variable *OTHEXP* to represent all other government expenditures as a percentage of GDP. The definition of this variable differs across the models. In the case of model (6.1), it measures total expenditure net of the outlays on total current and capital expenditure (in other words, expenditure not classified as current or capital). For (6.2), the same variable represents total expenditure minus the outlays on investment

expenditures in the education and transport and communication sectors. Finally, in model (6.3) it captures total public expenditure net of the outlay in the education, transport and communication and defence sectors.

A few additional comments are necessary before we turn our attention to the results. When considering models (6.1)-(6.3), we have seen that perfect collinearity must be avoided by excluding an element of the budget constraint. Ideally, one should omit a component, which, according to the theory, has neutral effect on growth. By including *OTHEXP*, we include the expenditure side of the budget constraint, and we also explicitly include tax revenue (*TX*) and the budget surplus/deficit (*GD*), both as percentages of GDP. Therefore, the element we choose to exclude from the models is non-tax revenue. This omission is based on the theoretical prediction (e.g., Barro 1990) that variation in non-distortionary revenue items is likely to generate minimal growth effects. Finally, our previous analysis indicates that inclusion of the **Z** variables does not have any substantial impact on the government expenditure coefficients. Consequently, we do not include these variables in models (6.1)-(6.3) on the ground of parsimony. Table 3 summarizes our results.

The effects of including the budget constraint, and also jointly considering significant expenditure components, are strikingly evident from the above table in comparison with Tables 1 and 2. In particular, of the six expenditure variables, which were previously found to bear significant associations with growth, only three survive in the present analysis. These are total capital expenditure, total outlay in the education sector, and investment expenditures in the education sector. In contrast, none of the variables related to defence and the transport and communication sectors now show any significant association with growth. In the total expenditures model (6.1), we include current expenditure to check whether this plays any role when considered in conjunction with capital expenditures, but it does not. It should also be noted that in both the total sectoral expenditures and sectoral investment expenditures models (the final two columns of Table 3), other expenditure has a significant and positive impact on growth (at a 5 percent level of significance). Therefore, while education is the key, in aggregate other components of expenditure also contribute positively to growth. However, given the set-up of our models, where we cannot separately include all sectors for practical reasons, then we cannot identify those sectors that make this contribution.

Table 3: Growth Regressions with Budget Constraint

	Total Expenditure Regression	Sectoral Expenditures Regression	Sectoral Investments Regression
M variables			
Capital Expenditure	0.151**	-	-
	(0.059)		
Current Expenditure	0.093	-	-
	(0.057)		
Education Expenditure	-	1.582***	0.658***
		(0.554)	(0.223)
Transport and Communication Expenditure	-	-0.001	0.049
		(0.237)	(0.191)
Defence Expenditure	-	-	0.021
			(0.111)
Other Expenditures	-0.059	0.087**	0.121**
	(0.719)	(0.040)	(0.054)
Tax revenue	-0.006	-0.009	-0.209***
	(0.054)	(0.059)	(0.070)
Government Surplus (/Deficit)	0.146**	0.153**	0.156***
	(0.062)	(0.063)	(0.057)
I variables			
Private Investment	0.214***	0.209***	0.312***
	(0.055)	(0.052)	(0.056)
Initial GDP per capita	0.004	0.006**	0.010***
	(0.003)	(0.003)	(0.003)
Initial human capital	-0.013**	-0.011*	-0.016***
	(0.006)	(0.006)	(0.005)
Initial Life expectancy	0.089	0.034	0.055
	(0.067)	(0.070)	(0.063)
Political instability	-0.016	0.000	-0.012
	(0.019)	(0.020)	(0.016)
R^2	0.59	0.70	0.64
	(0.55)	(0.50)	(0.89)
Observations	30 (30)	28 (28)	21 (21)
Regression test	80.8	105.1	177.3
(p-value)	(0.000)	(0.000)	(0.000)
AR(1)	-0.019	-0.129	-0.092
(p-value)	(0.918)	(0.495)	(0.673)

Notes: See Table 1.

The results on the growth effect of outlay on the transport and communication merit some additional comments. There is a general consensus among empirical studies

that the association between public investment expenditure in the transport and communication sector and growth is particularly strong and significant. For example, Aschauer (1989) finds that public investment in the transport sector is highly correlated with private sector productivity in the United States for the period 1949-85. Likewise, Easterly and Rebelo (1993) find that public investment in this sector is consistently and positively correlated with growth. In Table 3, however, such evidence is absent.

We account for this on the basis of the two following observations. First, this difference may be due to the fact that, unlike previous studies, our analysis considers only developing countries. Second, and perhaps more substantively, this difference may reflect the presence of omission biases in the previous studies due to their failure to consider the budget constraint and to consider more than one sector simultaneously.

In addition, our analysis brings out into the open the adverse growth effects of government budget deficits.[11] We find that these adverse effects for these countries is significant and of considerable magnitude: a one percentage point increase in the government surplus (as a percentage of GDP) is associated with an increase in growth rate of real GDP per capita by an average of 0.15 percentage points. An increase in the budget deficit, of course, has the corresponding negative effect.

4.2 Endogeneity Tests

In measuring the extent to which government expenditures affect economic growth, one has to recognize that fiscal and other economic variables evolve jointly: not only do government expenditures affect economic performance, but the reverse causality is also a possibility. Therefore, we now turn to a verification of whether our results in Table 3 may be a manifestation of reverse causation or not. For this, we estimate the growth regression using three–stage least squares (3SLS).

In choosing the instruments for 3SLS, we follow the footsteps of Barro and Sala-i-Martin, (1995, 1999). In particular, our set of instruments comprises of some of the original variables and lags of the other variables.[12] In the absence of data for the government expenditure variables prior to 1970, we have chosen to run the regressions for the periods 1971 – 79 and 1981 – 89, instead of 1970s 1980s, so that we obtain at least one set of observations for the government expenditure variables that are

[11] A similar view has been expressed by Fischer (1993).
[12] For comparison purposes, we also considered agriculture's share in GDP and population as instruments (e.g., Easterly and Rebelo 1993). The results that we obtain are essentially very similar to those reported.

predetermined for each equation of the system. Accordingly, the instruments for government expenditure variables are their own observations for 1970 and 1980 respectively. These lag values are reasonable candidates for instruments since the correlation between the residuals in the growth regressions for two decades is small and insignificant (Tables 1 – 3). Given that the initial variables (GDP per capita, human capital, and life expectancy) are exogenous to the sample, these variables enter as their own instruments. Finally, the instruments for private investment and political instability are their averages for five years prior to the specific decade. The results are reported in Table 4[13].

Table 4: Endogeneity Test (3SLS)

	Total Expenditure Regression	Sectoral Expenditures Regression	Sectoral Investments Regression
Capital Expenditure	0.159**	-	-
	(0.063)		
Investment in Education	-	2.245***	1.093***
		(0.541)	(0.297)
Investment in Transport and	-	-0.258	0.013
Communication		(0.227)	(0.206)
Defence Expenditure	-	-	-0.144
			(0.224)

For the sake of brevity, we have chosen only to report the results for the six government expenditure variables that we considered previously. A straightforward comparison of the results with those reported in Table 3 indicates that the sign of the coefficients and the levels of significance of the three expenditure variables (i.e., total capital expenditure, investment in the education sector and the total outlay in the education sector) remain unaltered. Accordingly, the significant growth effects of these three expenditure variables that we obtained in the previous section should not be attributed to endogeneity.

4. Conclusion

[13] The size of our sample has constrained our ability to include all components of total expenditures in model (6.3). In particular, we had to exclude the variable 'other expenditures' from the model.

The objective of our study has been to evaluate the growth effects of public expenditures at its aggregate and disaggregate levels for 30 developing countries. The primary contributions of this study are two fold. First, in considering the implications of the government budget constraint (including, where feasible, separate expenditure components), we believe that our study marks a substantial methodological improvement compared to almost all of the previous literature. Second, our exclusive focus on developing countries is important, because the role of government expenditure for growth may profoundly differ across developed and developing countries.

Our analysis strongly supports the prevalent view in the modern growth theory that education is an important key to economic prosperity. This is true whether we consider total expenditure in education (in a regression that considers total sectoral expenditures) or investment in education (in a model that focuses on sectoral investment expenditures). Such strong evidence is absent in the existing empirical literature. Accordingly, from the policy perspective, our analysis prioritizes the allocation of scarce government resources towards the education sector. Further, our analysis also suggests that aggregate current expenditure has no effect on growth, whereas aggregate capital expenditure has a positive effect. This implies that, for developing countries, decisions on current versus capital expenditure should (at least in the aggregate) favour the latter in order to enhance growth.

Our results should not, however, be interpreted as implying that expenditure on education or on capital projects should be increased irrespective of how these are financed. Indeed, our analysis is careful in considering the role of the government budget constraint. Since tax revenue has a negative impact (although not always significant) on growth, while increasing the government deficit has a highly significant negative effect, the raising of additional finance will moderate the positive effects of education or capital expenditure. Perhaps the importance of our results can be considered most clearly in the context of a transfer of, say, one percentage point of government expenditure in relation to GDP from another sector towards education, or from current to capital expenditure, where our results imply that such a transfer will be growth enhancing.

APPENDIX

The Data

A.1 Countries Included

Countries included in the sample are:

Bahamas, Bangladesh, Botswana, Burundi, Congo, Ethiopia, Ghana, Guatemala, India, Indonesia, Jamaica, Kenya, Madagascar, Malawi, Malaysia, Mauritius, Morocco, Nepal, Nigeria, Pakistan, Rwanda, Sierra Leone, Sri Lanka, Sudan, Syria, Tanzania, Thailand, Tunisia, Zaire, Zambia,

A.2 Definitions and Sources

Definitions for all variables and data sources are presented in Table A.1.

Table A.1 Definition of Variables and Data Sources

	Variable	Data Sources
GDP data		
gr	Average growth rate in GDP per capita	World Bank CDROM
lgc	Log of GDP per capita	World Bank CDROM
Government expenditure categories		
cur	Government current expenditure (% of GDP)	World Bank Reports and IMF
cap	Government capital expenditure (% of GDP)	World Bank Reports and IMF
cdf	Government consumption in defense (% of GDP)	World Bank Reports and IMF
ced	Government consumption education (% of GDP)	World Bank Reports and IMF
chl	Government consumption in health (% of GDP)	World Bank Reports and IMF
cag	Government consumption in agriculture (% of GDP)	World Bank Reports and IMF
cmf	Government consumption in manufacturing (% of GDP)	World Bank Reports and IMF
ctc	Government consumption in transport and communication (% of GDP)	World Bank Reports and IMF
idf	Government investment in defense (% of GDP)	World Bank Reports and IMF
ied	Government investment in education (% of GDP)	World Bank Reports and IMF
ihl	Government investment in health (% of GDP)	World Bank Reports and IMF
iag	Government investment in agriculture (% of GDP)	World Bank Reports and IMF
imf	Government investment in manufacturing (% of GDP)	World Bank Reports and IMF
itc	Government investment in transport and communication (% of GDP)	World Bank Reports and IMF
df	Government expenditure in defense (% of GDP)	World Bank Reports and IMF
edu	Government expenditure education (% of GDP)	World Bank Reports and IMF
hl	Government expenditure in health (% of GDP)	World Bank Reports and IMF
ag	Government expenditure in agriculture (% of GDP)	World Bank Reports and IMF
mf	Government expenditure in manufacturing (% of GDP)	World Bank Reports and IMF
tc	Government expenditure in transport and communication (% of GDP)	World Bank Reports and IMF
Other variables		
P	Primary school enrolment ratio	Barro-Lee (1994)
S	Secondary school enrolment ratio	Barro-Lee (1994)
H	Higher education enrolment ratio	Barro-Lee (1994)
psh	A linear combination of p, s and h (see below)	Barro-Lee (1994)
Life	Log of life expectancy	Barro-Lee (1994)
As	No. of assassinations per million population per year	Barro-Lee (1994)
Rev	No. of revolutions per year	Barro-Lee (1994)
coup	No. of coups per year	Barro-Lee (1994)
pinst	A linear combination of as, rev, and coup (see below)	Barro-Lee (1994)
bmp	Black market premium	Barro-Lee (1994)
m2	Broad money (M2) (% of GDP)	World Bank CDROM
Tr	Trade ratio (export plus import as % of GDP)	Barro-Lee (1994)

Tt	Growth rate of terms of trade	Barro-Lee (1994)
Tx	Tax revenue (% of GDP)	Government Finance Statistics (GFS), IMF
gsd	Government surplus / deficit (% of GDP)	World Bank CDROM
pviw	Private investment (% of GDP)	Barro-Lee (1994)
Agr	Agriculture's valued added (% of GDP)	World Bank CDROM
pop	Log of population	Barro-Lee (1994)

Human Capital (PSH):
Following Landau (1983), we construct the initial human capital (PSH) variable as the weighted sum of the initial enrolment ratios (%) in primary and secondary schools and in higher education. The weights are 1 for primary school enrolment ratio, 2 for secondary school and 3 for enrolment in higher education. The weights are approximations to the relative values of three types of education. The PSH variable is necessary because of the high milticollinearity between the separate enrolment rates. The data for average schooling years are missing for one-fourth of the countries in the sample; thus the enrolment rates are probably better available measures of investment in education. The other rationale for taking enrolment rates is that these are more frequently used in literature [see Easterly and Rebelo (1993), Barro and Sala-i-Martin (1995, 1999) among others].

Political Instability (PINST):
Following Barro and Sala-i-Martin (1995, 1999), we take the average of each decade of revolutions and coups per year and political assassinations per million inhabitants per year.

A.3 Summary Statistics

Table A.2 presents summary statistics for the variables used in the results reported in the paper. Data are used primarily as decade averages, relating to the 1970s and 1980s. However, for 3SLS, we take the averages for 1971 – 80 and 1981 – 90 instead of 1970 – 80 and 1980 – 90 respectively. A suffix of two numbers after a variable name indicates a specific year (for example, P70 is the primary school enrolment ratio in 1970), while a single number refers to the period for a specific average; for example, gr1 is the average growth rate of GDP per capita for 1970 – 80, gr2 is for 1980 – 90, gr3 is for 1971 – 80 and gr4 is for 1981 – 90.

Summary Statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
gr1	30	0.0242	0.028085	-0.0221	0.111
gr2	30	0.011507	0.022997	-0.0229	0.0708
lgc70	30	3.378233	0.816354	2.087	5.295
lgc80	30	3.490367	0.818446	2.222	5.518
psh70	30	1.0823	0.598587	0.246	2.821
psh80	30	1.500733	0.649766	0.368	3.248
life70	30	1.694333	0.068113	1.535	1.827
life80	30	1.728833	0.067238	1.581	1.853
pinst1	30	0.097233	0.115842	0	0.4449
pinst2	30	0.097417	0.154524	0	0.7297
bmp1	29	0.421517	0.473344	0	2.024
bmp2	30	0.837366	1.423522	0	7.185

m270	30	0.238933	0.106714	0.085	0.435
m280	30	0.320267	0.141969	0.079	0.775
tr70	29	0.444793	0.241678	0.077	0.925
tr80	30	0.6003	0.332593	0.157	1.333
tt1	28	0.014	0.069645	-0.085	0.176
tt2	28	-0.02132	0.027295	-0.106	0.011
tx1	30	0.144267	0.049878	0.045	0.257
tx2	30	0.150433	0.062003	0.056	0.284
gd1	30	-0.05213	0.033452	-0.139	0.002
gd2	30	-0.0565	0.044555	-0.132	0.114
pvi1	30	0.118913	0.058493	0.026	0.316
pvi2	30	0.109433	0.049225	0.034	0.217
cur1	30	0.140097	0.059672	0.0121	0.2512
cur2	30	0.159017	0.068689	0.0109	0.3037
cdf1	29	0.024945	0.025821	0.0005	0.1359
cdf2	28	0.028586	0.030493	0.0019	0.1417
ced1	30	0.024793	0.014776	0.0022	0.056
ced2	29	0.025845	0.015858	0.0019	0.0614
chl1	30	0.00967	0.006789	0.0011	0.0257
chl2	29	0.009976	0.007613	0.0008	0.0321
cag1	30	0.007533	0.005962	0.0009	0.0292
cag2	30	0.00699	0.004863	0.0006	0.021
cmf1	23	0.002209	0.001884	0	0.0076
cmf2	23	0.003083	0.006639	0	0.0328
ctc1	28	0.006582	0.005015	0.0006	0.022
ctc2	28	0.004132	0.003045	0	0.0109
cap1	30	0.072057	0.037766	0.0043	0.1602
cap2	30	0.085897	0.048786	0.0061	0.1722
idf1	28	0.002846	0.005497	0	0.0177
idf2	25	0.002536	0.004708	0	0.018
ied1	30	0.006207	0.005097	0.0004	0.0194
ied2	29	0.0067	0.005781	0.0005	0.0215
ihl1	30	0.00236	0.001774	0.0001	0.0086
ihl2	29	0.003831	0.005107	0.0002	0.0274
iag1	30	0.011177	0.006995	0.0008	0.0283
iag2	30	0.0144	0.011995	0.0007	0.0503
imf1	28	0.007736	0.012527	0.0001	0.0663
imf2	28	0.010061	0.011694	0	0.0469
itc1	29	0.016438	0.011852	0.0009	0.0459
itc2	29	0.017052	0.01424	0.0009	0.0659
te1	30	0.212127	0.086696	0.0166	0.3899
te2	30	0.246013	0.102958	0.0186	0.4427
df1	28	0.027129	0.023882	0.0003	0.1159
df2	25	0.02654	0.022557	0.0019	0.0999
edu1	30	0.031827	0.015562	0.0036	0.0583
edu2	28	0.033482	0.015824	0.0036	0.0669
hl1	30	0.0121	0.006722	0.0012	0.027
hl2	28	0.014136	0.008227	0.0012	0.0353
ag1	30	0.01871	0.010777	0.0022	0.0493
ag2	30	0.02139	0.014023	0.0022	0.0594

mf1	23	0.0104	0.013645	0.0001	0.0669
mf2	23	0.013848	0.014103	0	0.0496
tc1	28	0.023489	0.014706	0.0019	0.069
tc2	28	0.021875	0.01577	0.0016	0.0738
agr70	29	0.330828	0.163018	0.066	0.669
agr80	29	0.292103	0.143508	0.082	0.579
pop70	29	4.005483	0.655401	2.794	5.744
pop80	29	4.118931	0.656377	2.955	5.838
popgr70	30	2.572233	0.586422	1.315	3.609
popgr80	30	2.5749	0.658353	0.976	3.577

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