GOVERNMENT CONSUMPTION: ITS EFFECTS ON PRODUCTIVITY AND INVESTMENT
A Study using panel data for 24 OECD countries

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Introduction

This paper is concerned with the empirical relationship between the size of government and the processes of economic growth and development. I present new evidence that those authors who claim to have found evidence of a systematic relationship between government consumption expenditures and productivity growth have misread the data, or have misinterpreted the direction of causality. I find that productivity growth induces growth in the size of government rather than the reverse. If government size has any systematic effect on economic growth, it is not through productivity but through investment.

These findings are important inasmuch as they refute the simplistic arguments of both the proponents and the detractors of 'big government' who have variously claimed that public expenditures are in themselves either panacea or poison with respect to the goal of productivity growth. In contrast to such simplistic conclusions, I suggest that aggregate government size does not appear to be detrimental with respect to productivity; rather the effects of government size must be judged in relation to its effect on investment. This is not to deny, however, that a more detailed breakdown of government expenditure may well reveal systematic microeconometric effects.

1. Modelling the impact of government growth

Before we can attempt to estimate the impact of government expenditures on economic growth we need clear hypotheses about the possible nature and direction of the relationship. Is it the size of the government sector in absolute terms that affects
the private sector? or is it government size relative to the private sector? or is it the rate of growth of government? Does government impact primarily on productivity levels, or on productivity growth or on resource allocation within the private sector? If we can establish empirical regularities in the relationship between government and private sector output, may this be the result of the private sector affecting government rather than vice versa?

factor productivity differentials

There are a variety of hypotheses which need to be explored. One of the simplest is the proposition that measured productivity levels may differ systematically between government and private sectors. This difference might reflect a real productivity gap arising from the lack of market incentives and signals in the public sector. Alternatively, measured productivity in the public sector might lag that in the public sector simply because of the difficulties involved in measuring the true value of public sector output. When services such as public education and health and defence are not marketed, there is no easy measure of the value of their output. Is the output of a typical school teacher in the UK in 1991 higher than that of their counterpart in 1951, or higher than the output of a contemporary in India? If so, by how many percentage points? It is the difficulty of answering such questions that leads most systems of national accounting to bypass the question of public sector productivity. It is a common practice to simply equate the value of the output with the value of the inputs, or in particular with the level of employment. On the one hand this procedure denies the possibility of measuring true productivity growth within the public sector, so understating public sector output. On the other hand, it is

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1 Indeed, the reason that many of these services are provided in the public sector is that market provision is likely to be inefficient precisely because it is difficult to measure the social value of these outputs and difficult to apportion the costs to those who benefit.

2 See ABS (1989, section 4) for a description of Australian national accounting practices and references to the practices in other OECD countries.
assumed that inputs are fully and efficiently utilised, so possibly overstating the level of public sector productivity.

The net result of national accounting procedures is that we may expect measured public sector productivity to be below that of the private sector. Without measurement of true outputs, however, we cannot safely infer whether any measured productivity lag either under- or over-estimates the true productivity differences.

**external effects of government**

It is often suggested that the government sector can have positive external effects on the private sector. Government can produce pure public goods such as information, security and social cohesion which promote private sector productivity. Government can also provide services such as physical infrastructure (roads and telecommunications networks) and human capital infrastructure (education and training) which act as additional inputs into the production process of the private sector.

Carr (1989) argues strongly that national accounting procedures misrepresent a substantial portion of government services as final outputs instead of intermediate inputs. As a result real final output is overestimated since the government services are double counted, first as final government output and second as embodied in the output of the private sector. Carr argues that this accounting practice induces a spurious correlation between the growth of government services and the growth of measured national output. Whilst such spurious correlation may indeed pose a problem in estimating the true effects of government, such arguments cannot be used to totally discount the possibility that government activity may indeed promote real output. Carr's argument revolves around an example of national accounting methods in their different treatment of the provision of a road according to whether it is publicly or privately provided. What he fails to consider, however, is the possibility that in, the absence of public provision, market failure might lead to no road being
provided at all. In this case, whilst national accounting methods might overstate the
effects of public provision the true effect would still be positive.

It is quite possible, of course, that public sector activity may have negative
external effects. Kormendi and McGuire (1985), for instance, suggest that the
taxation which is required to fund government expenditure will distort market signals
and guide the allocation of resources away from their most productive activities.
Moreover, arguments can be mounted from the perspective of public choice theory to
the effect that government activity may be directed according to the interests of
special groups rather than the collective interests of the society.

modelling the effects of government

In order to formally model the possible effects of government on economic
growth I follow Ram (1986) and Dowrick and Gemmell (1991) in adapting Feder’s
(1983) approach to inter-sectoral transfer of resources within an aggregate accounting
framework. I extend Ram’s treatment by allowing for different rates of technical
progress between the government and private sectors and show that this allows us to
integrate his approach with that of Landau (1983).

The model is based on separable production functions for the production of
government output \( G(L^G, K^G, t) \) and private sector output \( P(L^P, K^P, G, t) \) where \( K \) and
\( L \) refer to capital and labour services and \( t \) indexes time. Aggregate output \( Y = G + P \).

Hypotheses concerning productivity differentials between the sectors can be
captured by assuming that the marginal factor productivities differ systematically
across the two sectors. In particular we can impose a simplifying restriction that the
productivity differential is a constant, \( \delta \), which is the same for each factor. Denoting
marginal products by subscripts, we can write these restrictions as:

\[
\frac{G_L}{F_L} = \frac{G_K}{F_K} = 1 + \delta
\]  
(1)
The externality hypothesis is captured by assuming that government output enters into the private sector production function. Imposing constant elasticity gives:

$$P_G \cdot G/P = 0$$

(2)

I assume that the rate of technical progress in the government sector is a fixed amount, \(\gamma_i\), above that found in the private sector:

$$G_i/G - P_i/P = \gamma_i$$

(3)

Finally, following Dowrick and Nguyen (1989) let the rate of technical progress in the private sector be composed of a time-specific component, \(\lambda_t\), a technological catch-up factor \(\lambda \log(y/y^*)\), where \(y\) is per capita GDP and the star indicates the country with the highest level of \(y\), and a randomly distributed error term \(\epsilon\).

$$P_i/P = \lambda_t + \lambda \log(y/y^*) + \epsilon$$

(4)

Differentiation of the production functions, substitution of (1) to (4) and aggregation gives the following expression for the growth rate of aggregate output, \(\hat{Y} = \hat{d}Y/Y\).

$$\hat{Y} = \alpha \hat{L} + \frac{dK}{Y} + \lambda_t + \epsilon + \frac{\delta}{1+\delta} \frac{G^i}{Y} + \theta \frac{P^i}{Y} (production\ externality\ effect) \left[ \frac{\lambda^C}{1+\delta} \right] \frac{G}{Y} (innovation\ effect)$$

(5)
The last three terms in (5) show the way in which the various effects of
government can enter the growth equation. If factor inputs are systematically more
or less productive at the margin in the government sector than in the private sector,
then government growth which takes factor inputs away from the private sector will
raise or lower aggregate growth. The size of this factor productivity effect depends
not only on the productivity differential, $\delta$, and the rate of growth of the government
sector, $dG/G$, but also on the relative size of the government sector, $G/Y$. For
instance, if productivity is lower in the government sector than in the private sector,
expansion of the government sector will tend to lower aggregate growth inasmuch as
it takes resources away from higher productivity activities. But the magnitude of this
effect will be small unless the government sector is of a substantial size in the first
place.

The externality effect is also dependent not only on the rate of growth of
government output but also on the relative size of the two sectors. In this case,
however, the effect is larger the smaller the relative size of government - since the
greater the size of the private sector, $P/Y$, the more widespread is the externality
effect.

The technological change effect, on the other hand, is a function only of the
size of the government sector, not of its rate of growth.

It is worth comparing the growth equation (5) with that derived by Ram
(1986, p.192, eq. 5). Expressing the externality effect in terms of $G$, as Ram does,
simply leads to a more complicated coefficient on the variable $(G/Y)G$ but is
algebraically equivalent to (5). On the other hand, Ram's omission of technological

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3 Note, however, that this specification is far from the only way in which the effects of government
can be modelled. An alternative hypothesis concerning the externality effect, for instance, might be
that it is not the absolute size of government that affects output in the private sector but the size of
government relative to that of the private sector. Such modifications to the underlying hypotheses
will obviously lead to changes in the specification of the growth equation.

4 This is because $(P/Y)G = (1 - G/Y)G$. This point is due to Falvey and Gemmell (1983).
growth from the sectoral production functions leads to his omission of the term in \( G/Y \) and to his unjustified criticism of Landau's (1983) specification which does include this term. So equation (5) is a general specification which nests both the Landau and Ram models.

Before we proceed to estimate (5) we should critically examine some of the assumptions which have been built into this model. Most fundamentally, equations such as (5) are essentially growth accounting relationships which explain and/or help to measure the different components of aggregate growth without necessarily attributing causality. If we wish to isolate the contribution of government in a causal rather than an accounting sense we need to examine some further assumptions which are implicit in much of the previous work. These assumptions concern the effects of government on factor supplies and the effects of economic growth on government.

First consider the relationship between government and the employment of labour services. A simplistic interpretation of the growth accounting relationship takes the employment of labour as exogenous. In this case any expansion of the government sector necessarily takes labour away from the private sector and may reduce aggregate growth. On the other hand, if government expansion involves the employment of otherwise idle labour (and, less likely, idle capital) there is a positive net productivity effect on aggregate growth even if marginal productivity is higher in the private sector. In terms of the growth accounting equation (5), this would be captured by the effects of an increase in labour utilisation, \( \hat{L} \). Unfortunately much of the empirical work carried out suffers from an absence of data on labour and capacity utilisation. It is common practice to proxy labour utilisation with aggregate employment data or even with population data. Without more detailed data it becomes then impossible to say whether any positive productivity coefficient is measuring the differential between government and the private sector or between government activities and idle resources.
Similar reasoning suggests that we should also consider the effect of government on investment rates \((I/Y)\). Treating investment as exogenous, as Ram and others have done, may underestimate the true impact of government in either a positive or negative direction. On the one hand, to the extent that the size of the public sector is an effective tool of Keynesian demand management, government growth may stimulate activity, expectations and investment. On the other hand, to the extent that government funding absorbs savings, government size may crowd out private investment.

Most important perhaps is the question of whether or not the growth of the economy exerts some systematic influence on government. If government services are normal goods, demand for government will rise as incomes rise, so fast growing economies will tend to produce faster growing government. This positive reverse causation implies an upward bias in the estimation of the impact of government growth on economic growth.\(^5\) On the other hand, to the extent that the supply of government services lags behind growth in demand, a fast growing economy may experience (temporarily) smaller government size than another country which has reached the same level of development but has been growing at a slower growth rate. If so, this negative reverse causation implies that estimates of the impact of government size \((G/Y)\) on economic growth may be biased downwards. Accordingly it may be possible to reconcile Ram's positive findings concerning the impact of government growth rates and Landau's negative findings concerning the impact of government levels. It may be the case that their apparently significant but contradictory results stem from simultaneous equation bias.

Finally, it is important to be clear about the structure of the error term in equation (5). OLS estimation is valid only under the usual white noise assumptions. With a panel data set, containing a number of observations for each country, there may be country-specific effects which are not captured by the explanatory variables,

\(^5\) This point has been made forcibly by Rao (1989).
in which case the error term will be autocorrelated within a set of country observations. Greene (1990) explains how it is possible to test for such effects and to obtain unbiased estimates if they are present. The Least Squares Dummy Variable (LSDV) estimates, corresponding to a model of fixed country specific effects, are obtained by adding to the Ordinary Least Squares (OLS) regression a dummy variable for each country. This method is equivalent to first differencing the data.

In other words, if there is evidence that a country is consistently above or below the 'regression line' we may infer that there are some unmeasured features of that country (eg its political and business institutions) which are systematically affecting its performance. If these unmeasured features are correlated with government size, then OLS cross-section estimates may be biased. The effect of the LSDV procedure is to ignore the cross-sectional variation in the mean values of the regression variables. (While this procedure avoids bias, there is a cost of potential inefficiency due to the loss of the aggregate cross-section information.)

2. Data and estimation

I use the data set updated recently by Summers and Heston (1991). They provide annual data for real GDP on an internationally comparable basis. GDP is broken down into investment, government consumption and private consumption. The time series start wherever possible from 1950. But for many of the non-OECD countries data are unavailable before 1960 or later. It is important in investigating questions of causality to have lagged data available. In order to control for country-specific effects it is also important to have as long a run of the time-series as possible. Accordingly I use the sub-sample of the 24 member countries of the OECD. In order to abstract from short-term cyclical fluctuations the data have been averaged into five year units, eg 1950-54, 1955-59 etc. ending with a 4 year period 1985-88. All data
are expressed as annual averages with growth rates and shares expressed as percentages. Sample means for some of the key variables are given in Table 1.

Some of the principal features of the data are illustrated in Figures 1 to 4. First, Figure 1 displays for each OECD country its level of government consumption (expressed as a percentage of GDP) in 1950-54 and the corresponding level in 1985-88. We can observe strong growth in government in the Scandinavian countries, leaving Sweden, Denmark and Finland with the biggest governments of the 1980s, whilst government has contracted (relative to GDP) in the USA, the Netherlands, the UK and, especially, Japan. Over four decades, Switzerland has held its government share around the remarkably low level of five percent.

Is there any systematic relationship between growth, or decline, in government and growth in GDP as suggested by the analysis of the factor productivity effect and the production externality effect, as in equation (5)? Figure 2 plots the growth in the real size of government against the growth of real GDP. A strong positive correlation is evident. It is, presumably, this correlation which has been picked up in previous regression analysis.

Figure 3 plots the growth in real GDP against government size. There is only weak evidence of a negative correlation \( r=-0.09 \). If, however, we exclude the observations for Switzerland (the eight observations to the extreme left of the scatter plot) the correlation rises to \(-0.15\).

These bivariate correlations cannot tell us whether it is government which is influencing GDP growth or vice versa. Nor can we tell from these charts whether the observed correlations might not be spurious in the sense that some other variable is influencing both government size and GDP growth. For instance, both government size and economic growth might be functions of the level of development through the operation of Wagner's Law and technological catch-up respectively. In order to
Table 1
Descriptive Statistics

<table>
<thead>
<tr>
<th>Variable</th>
<th>Symbol</th>
<th>mean</th>
<th>s.d.</th>
</tr>
</thead>
<tbody>
<tr>
<td>growth of real GDP (% p.a.)</td>
<td>$\hat{Y}$</td>
<td>3.90</td>
<td>1.95</td>
</tr>
<tr>
<td>growth of population (% p.a.)</td>
<td>$\hat{N}$</td>
<td>0.86</td>
<td>0.67</td>
</tr>
<tr>
<td>log of relative per capita GDP $^2$</td>
<td>$\log(y/y^*)$</td>
<td>-0.65</td>
<td>0.46</td>
</tr>
<tr>
<td>investment ratio (% of GDP)</td>
<td>$I/Y$</td>
<td>24.8</td>
<td>5.4</td>
</tr>
<tr>
<td>government size (% of GDP)</td>
<td>$G/Y$</td>
<td>14.3</td>
<td>4.2</td>
</tr>
<tr>
<td>growth in government (% p.a.)</td>
<td>$\hat{G} - \hat{Y}$</td>
<td>-0.038</td>
<td>2.05</td>
</tr>
<tr>
<td>weighted growth in government (% p.a.)</td>
<td>$G \hat{Y}$</td>
<td>0.54</td>
<td>0.33</td>
</tr>
<tr>
<td></td>
<td>$P \hat{Y}$</td>
<td>3.32</td>
<td>1.88</td>
</tr>
</tbody>
</table>

Notes
1. The number of observations in the OECD sample is 192, made up of 7 observations for five year periods starting 1950 and an eighth observation for 1983-88 for each of the 24 OECD countries. All variables are expressed as annual averages.
2. $y$ is per capita GDP ($Y/N$) and * denotes the value for the USA.
Figure 3

Level of government and growth of real GDP

Figure 4

Government and investment shares in GDP
test for such effects we have to use multivariate regression techniques and employ diagnostic tests for endogeneity.

Table 2 reports regression results estimating equation (5) on the OECD sample. There are 24 countries, and 6 observations are used for each country, each observation corresponding to an annual average over a five year period. (The first two observations, 1950-54 and 1955-59, are used as lagged instruments). Only the regression coefficients on the government variables are reported in the main table. The results in row 1a are taken from OLS estimation of the full equation. The government variables are apparently statistically significant in that the hypothesis that all three coefficients are zero is clearly rejected at the 1 percent level. The standard errors on the individual coefficients are large because of collinearity between the two government growth variables, but when one of these variables is dropped as in specification 2a the standard error falls and the coefficient a is strongly significant. These OLS results imply that the production externality effect is positive, with an elasticity of about 0.3. It is difficult to identify a separate factor productivity effect, b, and the innovation effect does not appear to be significant, even when the growth variables are omitted as in specification 3a.

Results similar to these have sometimes been taken as evidence of a strong positive externality effect. But the exogeneity tests reported in the final column of Table 2 throw such a conclusion into doubt. Using lagged values of the government variables as exogenous instruments, the Hausman test strongly rejects the hypothesis that the government variables are exogenous in specifications 1a and 2a. In other words, at least some of the observed correlation between government and economic growth appears to result from the impact of the growth process on the growth of government. On the other hand, tests on specification 3a suggest that the level of government activity is not endogenous.
Table 2
Regression estimates of the impact of government consumption expenditures on economic growth 1960-88.
The regression estimates the coefficients of equation (5). Only the coefficients on the government variables are reported. The dependent variable is the rate of growth of real GDP. The unit of observation is the country annual average over successive five-year periods: 1960-64, 65-69,... up to the final four year period 1985-88. There are 24 countries and 6 time periods. n=144. Estimation was carried out using Shazam, see White (1978).

<table>
<thead>
<tr>
<th>Estimation method</th>
<th>coefficient estimates (\delta / 1+\delta)</th>
<th>Joint hypothesis tests</th>
<th>(R^2)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(\gamma^G / 1+\lambda^P)</td>
<td>(\theta)</td>
<td>(\hat{\pi}_3)</td>
</tr>
<tr>
<td>1a: OLS</td>
<td>-0.008 (-0.15)</td>
<td>0.306 (1.37)</td>
<td>-0.046 (-0.04)</td>
</tr>
<tr>
<td>2a: OLS</td>
<td>-0.010 (-0.29)</td>
<td>0.299 (3.76)**</td>
<td></td>
</tr>
<tr>
<td>3a: OLS</td>
<td>-0.025 (-0.69)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1b: 2SLS^5</td>
<td>-0.257 (-1.73)</td>
<td>-1.286 (-1.89)</td>
<td>5.67 (1.64)</td>
</tr>
<tr>
<td>2b: 2SLS^5</td>
<td>-0.027 (-0.58)</td>
<td>-0.306 (-1.01)</td>
<td></td>
</tr>
</tbody>
</table>

** indicates statistical significance at the 1% level.
1. Parameter estimates are not reported above for the non-government variables: population growth, investment, \(\log(y)\) and decade dummies for the 1970s and 1980s. In specification 1a the coefficient estimates (t-statistics) for these variables are, respectively: 0.63 (3.42), 0.061 (2.74), -1.5265 (-3.82), -0.95 (-3.38), -1.50 (-4.87).
2. OLS t-statistics are calculated using the heteroscedasticity-consistent covariance matrix.
3. This column reports the chi-square statistic, with \(v\) degrees of freedom, for the null hypothesis that the coefficients on the government variables are jointly zero.
4. This column reports the chi-square statistic for the null hypothesis that the government variables are jointly exogenous using the Hausman test as described in Beggs (1988). The additional instrumenting variables are investment and the government variables lagged one and two periods.
5. Instrumental variables are used to estimate the government coefficients. The \(R^2\) statistics for the three instrumenting regressions are 0.97, 0.77 and 0.71. The LSDV model was also estimated for specification 1b, but the country dummy variables are not statistically significant: \(\chi^2(23)=17.5.\)
Re-estimating the growth equation using the two stage least squares procedure, with the government growth variables instrumented by their lagged values, the joint significance of the government variables disappears altogether - see specifications 1b and 2b in Table 2. Nor are there significant country fixed effects.\textsuperscript{5} Note that this result is not caused by the use of inadequate instruments - the instrumenting equations for the three variables each explain over 70\% of the variance (see footnote 5 to Table 2).

There is an important conclusion to be drawn from these results. It appears that the single equation findings that growth is systematically affected by government growth are invalid; it is in fact economic growth which is influencing the growth of government. We cannot reject, at conventional significance levels, the hypothesis that the externality effect and the productivity differential are both zero.

Nor can we reject the hypothesis that the innovation effect is zero - ie that the rate of technical progress in the government sector, $\lambda^{g}$, equals the rate of technical progress in the private sector, $\lambda^{p}$. It is of interest to note, however, from specification 3a in Table 2 that the point estimate of the gap in annual rates of technical progress is -2.5 percentage points. This estimate is not inconsistent with the hypothesis that measured government productivity growth is actually zero - an assumption that is imposed in many cases by national accounting procedures where it is deemed too difficult to measure real government output.

A neglected area in this growth accounting approach is the effect of government on investment. Figure 4 illustrates the relationship between investment rates and government consumption for the OECD between 1950 and 1988 using 192 observations (24 countries x 8 periods). A negative correlation is evident, with a simple correlation coefficient $r = -0.39$. Such correlations do not, of course,\textsuperscript{6}

\textsuperscript{5} Panel data tests, using the LIMDEP econometric package, find that there are no significant fixed effects in specification 1b. The test statistic $\chi^2_{(23)} = 17.5$ is insignificant at the 20\% level.
d also consider the effect of investment as exogenous, as is the impact of government in either to the extent that the size of the demand management, government, and it is the extent that the supply of invested, a fast growing economy may be less than another economy which has been growing at a slower growth rate, so that estimates of the impact of be biased downwards. Accordingly, the findings concerning the impact of the findings concerning the impact of the apparent significance has been bias.

The structure of the error term is under the usual white noise assumptions, of observations for each country, then captured by the explanatory variables.
average, only just over half the size of investment. \( \beta_2 \) is expected to be positive if saving/investment is a normal good, and greater than unity if saving/investment is a luxury good.

The coefficients of equations (6) and (7) have been estimated using various regression methods. The simple OLS estimates are \( \alpha_1 = -0.58 \) (t=-6.2) and \( \beta_1 = 0.22 \) (t=-5.1). But these estimates may be biased by country-specific effects and/or by endogeneity.

Since we have 6 observations for each country it is appropriate to treat the data set as a panel. In each specification there are found to be strong country specific effects - that is to say some countries are consistently above or below the investment rates predicted by simple OLS estimation. If these unexplained country differences are due to omitted variables which are correlated with government size, then OLS estimates of the government coefficient \( \alpha_1 \) are biased. Accordingly, estimation is carried out controlling for fixed country effects. Time dummies are also included where they are statistically significant. The fixed effects estimates are \( \alpha_1 = -0.61 \) (t=-4.2) and \( \beta_1 = -0.31 \) (t=-3.8).

Both of these estimates assume, however, that government size is an exogenous variable. The Hausman test rejects this assumption for equation (6): t=-2.9. Since \( (G/Y) \) does appear to be endogenous, lagged values are used as instruments in two-stage least squares estimation. The regression results are reported in Table 3. The crowding-out parameter estimate is \( \alpha_1 = -0.37 \) (t=-2.2). While this estimate is still significantly different from zero, it is substantially smaller than the single equation estimates, indicating that at least some of the observed negative correlation between government and investment shares in GDP is due to reverse causation.

The alternative specification of the investment equation, (7), has also been tested for endogeneity of the government term. Here, however, exogeneity is not
Table 3
Regression estimates of the impact of government consumption (as % GDP) on investment (as % GDP)

Estimating equation (6) with the addition of a quadratic term in \( Y \). Estimation is by Two-Stage Least Squares using the fixed effects panel routine in LIMDEP (equivalent to adding a dummy variable for each country). The dependent variable is real investment expressed as a percentage share of real GDP. Government expenditures are instrumented using one and two period lags of government levels and rates of growth.

<table>
<thead>
<tr>
<th></th>
<th>coefficients</th>
<th>t-statistic</th>
</tr>
</thead>
<tbody>
<tr>
<td>government size: ((G/Y))</td>
<td>-0.37</td>
<td>-2.23 *</td>
</tr>
<tr>
<td>per capita GDP($000): ( Y )</td>
<td>-0.68</td>
<td>-1.15</td>
</tr>
<tr>
<td>( Y^2 )</td>
<td>0.025</td>
<td>0.97</td>
</tr>
<tr>
<td>population growth: ( N )</td>
<td>2.7</td>
<td>3.58 **</td>
</tr>
<tr>
<td>Dummy=1 for 1970s</td>
<td>2.08</td>
<td>2.37 *</td>
</tr>
<tr>
<td>Dummy=1 for 1970s</td>
<td>0.50</td>
<td>0.38</td>
</tr>
<tr>
<td>explanatory power ( R^2 )</td>
<td>0.745</td>
<td></td>
</tr>
<tr>
<td>exogeneity test on ( G/Y )</td>
<td>-2.87 **</td>
<td></td>
</tr>
<tr>
<td>significance of fixed effects ( \chi^2(23)=178 ) **</td>
<td></td>
<td></td>
</tr>
<tr>
<td>sample size ( n )</td>
<td>144</td>
<td></td>
</tr>
<tr>
<td>degrees of freedom ( v )</td>
<td>114</td>
<td></td>
</tr>
</tbody>
</table>

** (*) indicates statistical significance at the 1 (5) percent level.
rejected for the variable G (t=1.50) presumably because Y has been removed from the
denominator of both the government variable and the dependent variable. So the
OLS estimates with fixed effects are preferred for this equation. These estimates are
reported in Table 4.

3. Conclusions

I have presented evidence which suggests that some of the recent economics
literature concerning the effects of government on growth has been following a red
herring. There is indeed a strong correlation between GDP growth and the growth
rate of government, and there is a somewhat weaker correlation between GDP growth
and the size of government. The first correlation, between rates of growth, has been
used to suggest that government has a strong positive externality on the rest of the
economy. But formal statistical tests suggest that the direction of causation is
probably the reverse. Controlling for simultaneous interactions, there is no evidence
of a statistically significant externality effect.

The relationship between GDP growth and the level of government activity
does not appear to be due to reverse causation, but the relationship is statistically
insignificant and we cannot discount the possibility that it reflects nothing more than
the inability of many national accounting systems to measure government
productivity.

This is not to say, however, that government size has no systematic effect on
economic growth. It is through the crowding out of investment, rather than
productivity, that these effects appear to work. The statistical evidence here is quite
compelling. Controlling for reverse causation and country-specific effects, each
dollar of government consumption crowds out around 40 cents of aggregate
investment.
Table 4
Regression estimates of the impact of government consumption on investment

Estimating equation (7) using OLS with fixed country effects. The dependent variable is the natural logarithm of real investment, ln(I).

<table>
<thead>
<tr>
<th>Coefficients</th>
<th>t-statistic</th>
</tr>
</thead>
<tbody>
<tr>
<td>government size: ln(G)</td>
<td>-0.31</td>
</tr>
<tr>
<td>per capita GDP: ln(Y)</td>
<td>1.35</td>
</tr>
<tr>
<td>population growth: ( \hat{N} )</td>
<td>0.09</td>
</tr>
<tr>
<td>Dummy=1 for 1965-69</td>
<td>0.06</td>
</tr>
<tr>
<td>Dummy=1 for 1970-74</td>
<td>0.09</td>
</tr>
</tbody>
</table>

| Exploratory power | \( R^2 = 0.965 \) |
| Exogeneity test on \( G/Y \) | \( t = 1.50 \) |
| Significance of fixed effects | \( \chi^2(23) = 202 ** \) |
| Sample size | \( n = 144 \) |
| Degrees of freedom | \( \nu = 115 \) |

** (**) indicates statistical significance at the 1 (5) percent level.
We need, however, to be cautious about applying these broad picture regression results to specific instances. Whilst we can infer that on average government consumption in OECD countries does not influence productivity growth but does affect investment rates, it is still quite possible that particular types of government activity may help or hinder technical progress and also that particular ways of funding government consumption may have a greater or lesser effect on investment. For instance, Castles and Dowrick (1990) suggest that there may be systematic differences between the effects of social transfer spending, spending on health and education services, and non-social spending. Furthermore, we expect the extent of crowding out to depend on the way in which government funds its activities, whether through taxation or through borrowing or through money creation.

The analysis presented here does not deny the need for detailed assessment of particular government programs and financing schemes in order to assess their net economic effects. While there need not be any presumption that government activity per se is either helpful or harmful to productivity growth, schemes need to be judged on their own micro-economic merits. At the same time, the benefits of particular government activities should be assessed their financing costs and the potential for a partial crowding out of private sector investment.
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