The Composition of Government Spending and Growth: The Role of Corruption

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Abstract: In this paper, we analytically derive the optimal composition of government spending in an endogenous growth model in the presence of corruption. Corruption results in a loss of productivity, but could have a favourable effect in diverting resources towards the sector that is more productive, net of corruption. Empirical analysis for a sample of developing countries shows that corruption does not turn out to be a factor that is significant enough to warrant a shift in spending from current to capital spending, and for OECD countries, the effect of corruption is small.

Keywords: corruption, capital and current spending, endogenous growth, panel GMM system estimator.

JEL Classification: E62, H50, O40.

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1. Introduction

This paper attempts to draw upon two strands in the literature on fiscal policy and growth, the first dealing with the effects of optimal composition of government spending on growth, and the second concerning the impact of corruption on growth.

Interest regarding the composition of government expenditure and growth was sparked off by the paper by Devarajan *et al*. (1996). The authors showed theoretically that a shift in favour of an 'objectively' more productive type of expenditure may *not* raise the growth rate if its initial share is 'too high'. Somewhat surprisingly, in their empirical section they found, for their sample of developing countries, that an increase in the share of current – rather than capital – expenditure has positive and statistically significant growth effects. In a recent paper, Ghosh and Gregoriou (2008) investigate the same, but from an optimal fiscal policy perspective. Within a decentralised economy set-up, the authors analytically derive the welfare-maximising fiscal policy chosen by a benevolent government, and the effects of this on the long-run growth rate. From an optimal fiscal policy perspective, it can be argued that their empirical results demonstrate that developing countries which have correctly perceived current spending as being the more productive have increased the share of spending on this category of public goods, and this has led to higher growth, while countries that have not done this have lost out.

The other important aspect that we study in this paper is the effect of corruption on growth. Since the influential paper by Mauro (1995), it is acknowledged that corruption has significant effects on an economy's growth rate. In his paper, Mauro compiles indices on corruption and other institutional efficiency indices, and finds that corruption lowers private investment and thereby growth, even in sub-samples of countries where bureaucratic regulations are rather cumbersome. In this respect, the findings of Mauro's study differ from those of authors like Leff (1964), Huntington (1968), Leys (1970), and Lui (1985), who have suggested that corrupt practices such as "speed money" might raise economic growth by enabling individuals to get things done by circumventing bureaucratic delay and red-tape. Proponents of this view also feel that when bribes act as a piece rate, it is likely that bureaucrats would be more helpful when paid directly.

Shleifer and Vishny (1993) show that corruption may be costly because (1) the central government is weak, allowing "various governmental agencies and bureaucracies to impose independent bribes on private agents seeking complementary permits from these agencies"; and (2) the demands of secrecy can case a shift in a country's investments away from the highest value projects, such as health and education, into potentially useless projects, such as defence and infrastructure, if the latter offer better opportunities for secret corruption. They argue that economic and political competition can reduce the level of corruption and its adverse effects. The effects of competition on corruption are explored also by Ades and Di Tella (1999). This effect turns out to be ambiguous in their theoretical model, but their empirical results strongly show that in countries where firms enjoy higher rents, the corruption levels tend to be higher. Using data on corruption from two different sources, they find that corruption is higher in countries where domestic firms are sheltered from foreign competition by trade barriers, and also in economies dominated by few firms. Their results suggest that policies aimed at making markets more competitive could play a role in controlling corruption.[1]

The impact that corruption may have on certain components of government expenditure is quite important, and this provides a link between how the effects of the composition of government expenditure on growth can be associated with corruption. In an important paper on the effects of corruption on the composition of government expenditure, Mauro (1998) shows that improvements in corruption index coincide with declines (increases) in capital (current) expenditure. In this paper, the negative relation between corruption and government expenditure on education seems to be robust to a number of changes in specification, which is particularly worrying from a policy-making perspective, given that educational attainment and human capital accumulation are important determinants of long-run growth. Using corruption indices for the chosen countries, Mauro shows that corruption reduces the spending on education, as it does not provide as many lucrative opportunities and bribes for government officials as certain other components of spending. This is mainly because its provision typically does not require high technology inputs provided by oligopolistic suppliers.[2] In a similar vein, Tanzi and Davoodi (1997) find that corruption underpins the bias in the composition of government spending towards large-scale capital investment (in infrastructure, etc.) because such projects facilitate the use of hefty bribes for bureaucrats; so, while the actual expenditure incurred by government officials increases, the productivity of such projects does not.

What we intend to do in this paper is to link the optimal composition of government spending to growth in the presence of corruption. As noted, Devarajan *et al*. (1996) and Ghosh and Gregoriou (2008) link the composition of government spending to growth, but neither of these studies considers the role of corruption in the process, although in Ghosh and

[1] See also Ades and Di Tella (1997).
[2] See also Mauro (1997).

Gregoriou, a possible reason for current spending being more productive than capital spending was attributed to the possible presence of widespread corruption that generally exists in capital spending.

In this paper, we capture corruption in terms of a parameter that potentially reduces the productivity of public spending in our analytical model. As we have considered spending on two types of public goods, and corruption could impact on the two public goods to differing extents, we can study the impact of corruption on growth via the composition of public spending. We can then test whether public capital spending, the component that is usually associated with higher corruption, (1) actually turns out to have a higher 'pure' productivity effect when the effect of corruption is netted out, and also (2) whether this pure productivity coefficient turns out to have a higher coefficient than that of current spending. Through (1), we can also study whether corruption causes lower growth via the loss of productivity of the sort discussed by Mauro (1995, 1998), Tanzi and Davoodi (1997), etc., or whether it actually raises productivity via (perhaps) speed money channels as outlined by Leff (1964), Huntington (1968), and others. And as is clear from (2) above, apart from isolating the pure productivity effect of capital spending and comparing this with the 'unadjusted' coefficient of the same, we compare in our framework the coefficient of current spending with that of capital spending with and without the corruption-adjusted effect on productivity.

Devarajan *et al*. (1996) link their key empirical result to their theoretical model in suggesting that 'expenditures which are normally considered productive could become unproductive if there is an excessive amount of them', and capital spending in developing countries may have squeezed current spending at the margin. But it could be that corruption in the economy has made expenditure on items like education quite low to start with (*a la* Mauro (1998)). So, the Devarajan *et al*. (1996) contention that there is "too much" of such things as education provision (which leads to lower growth) is open to question.

Let us try to analyse this result in the context of what we obtain from our empirical results on the growth effects of capital spending in general, and on education and health spending in particular, from our developing country sample. We find that such spending has a negative impact on the growth rate even after taking into account the effect of corruption, while current spending has a positive effect. One can argue here that the correct thing for the government to do would be to switch its spending from health and education and other components of capital spending to current spending categories like operations and maintenance expenditure, which are more productive, *ex post*. This would be our position on the issue from an optimal fiscal policy perspective. In this sense, corruption in education (or, for that matter, any other component of public spending that has similar effects as education) could be a 'good' thing in the sense that it enables a government to divert resources towards the components of spending where the productivity, net of corruption, is higher. However, this could be potentially problematic in the sense that this may mean the diversion of resources away from an important component of public spending to less than socially desirable levels. Given that this is an important issue, attention should be focused on how to increase the productivity of human and other components of public capital if corruption can only provide a partial explanation of productivity loss from capital spending.

The rest of the paper is organised as follows. Section 2 sets up the theoretical model with two public goods, and derives the analytical results under optimal fiscal policy, when corruption is present in both categories of public spending. Section 3 discusses the data, and specifies the econometric model and methodology. Section 4 reports the empirical estimates, and links these with the analytical results. In Section 5, robustness tests are carried out on some functional components of government expenditure. Finally, Section 6 concludes.

2. *The analytical framework*

2.1. *Optimal fiscal policy with corruption*

In this section, we modify the model of optimal fiscal policy and growth developed by Ghosh and Gregoriou (2008) to include corruption in public spending. A CES technology (where y is output, k is private capital, and g_1, g_2 are two types of government spending) is considered, which is given by

$$y = [\alpha k^{-\zeta} + \beta_P(1-\delta_1)g_1^{-\zeta} + \gamma_P(1-\delta_2)g_2^{-\zeta}]^{-1/\zeta} \tag{1}$$

where $\alpha > 0$, $\beta_P(1-\delta_1) \geq 0$, $\gamma_P(1-\delta_2) \geq 0$, $\alpha + \beta_P(1-\delta_1) + \gamma_P(1-\delta_2) = 1$, $\zeta \geq -1$.

In this specification, we define β_P and γ_P as the "pure" productivity parameters associated with the two types of public spending. In other words, these could be defined as the productivities when corruption (or any other potentially productivity-reducing effect) distorts the positive effect of public spending on output, in which case, the "net" productivities of public investment are given by $\beta_P(1-\delta_1)$ and $\gamma_P(1-\delta_2)$ respectively. Corruption in this set-up is like a leakage that reduces the returns to public investment, and drives a wedge between the growth rate that society could have achieved in its absence, and what it actually achieves. In this specification, higher corruption in g_1 (g_2) is captured by a higher value of δ_1 (δ_2), and the corruption parameter is bounded between 0 and 1.[3] Clearly, in the absence of corruption in g_1

[3] Alternatively, corruption could be modelled using the production function,

$$y = [\alpha k^{-\zeta} + (\beta_P - \delta_1)g_1^{-\zeta} + (\gamma_P - \delta_2)g_2^{-\zeta}]^{-1/\zeta},$$

where $\alpha > 0$, $(\beta_P-\delta_1) \geq 0$, $(\gamma_P-\delta_2) \geq 0$, $\alpha + (\beta_P-\delta_1) + (\gamma_P-\delta_2) = 1$, $\zeta \geq -1$.

(g_2), there is no difference between the pure and net productivities, as defined above. Here $0 < \delta_1, \delta_2 < 1$, because activities like bribe-taking, inflating costs of procurement of public goods, and procurement of low-quality products typically reduce the productivity of the goods purchased by bureaucrats which ought to stifle growth.[4]

The government's budget constraint is

$$g_1 + g_2 = \tau y \qquad (2),$$

where τ is the income tax rate.

The shares of government expenditure that go toward g_1 (ϕ) and g_2 (1-ϕ) are given by

$$g_1 = \phi\tau y \quad and \quad g_2 = (1-\phi)\tau y \qquad (3),$$

where $0 \le \phi \le 1$.

The representative agent's utility function is isoelastic, and utility is derived from private consumption (c), and is given by

$$U = \int_0^\infty \frac{c^{1-\sigma} - 1}{1-\sigma} e^{-\rho t} dt \qquad (4),$$

where ρ (> 0) is the rate of time preference.

The agent's budget constraint is

$$\dot{k} = (1-\tau)y - c \qquad (5).$$

An expression for the ratio, g/k, which can be derived is given by

$$\frac{g}{k} = \left[\frac{\tau^{\zeta} - \beta_P(1-\delta_1)\phi^{-\zeta} - \gamma_P(1-\delta_2)(1-\phi)^{-\zeta}}{\alpha}\right]^{1/\zeta} \qquad (6),$$

and of the economy's (endogenous) growth rate, λ, given by

$$\lambda = \frac{\alpha(1-\tau)\{\alpha\tau^{\zeta} / [\tau^{\zeta} - \beta_P(1-\delta_1)\phi^{-\zeta} - \gamma_P(1-\delta_2)(1-\phi)^{-\zeta}]\}^{-(1+\zeta)/\zeta} - \rho}{\sigma} \qquad (7).$$

The representative agent's problem is to choose c and $\dot{k}$ to maximise utility—which is U in (4)—subject to (5), taking τ, g_1 and g_2, and also k_0 as given. The first order conditions give rise to the Euler equation:

The only difference with the previous case is that the corruption parameter can now take on values from 0 to β_P, γ_P (instead of from 0 to 1).

[4] We have noted that in some circumstances, corruption could have a positive effect on growth through the avoidance of bureaucratic delays and red-tape in getting things done more efficiently. Despite specifying the range of δ_1, δ_2 as we have here, we will explore in the empirical section whether it is possible for corruption to increase the growth rate.

$$\lambda \equiv \frac{\dot{c}}{c} = \frac{1}{\sigma}\left[(1-\tau)\frac{\partial y}{\partial k} - \rho\right] \qquad (8).$$

The objective of the government in a decentralised economy is to run the public sector in the nation's interest, taking the private sector's choices as given. In other words, the government's problem is to choose τ, g_1 and g_2 to maximise the representative agent's utility subject to (2), (5) and (8), taking k_0 as given. The first order conditions with respect to τ, g_1 and g_2 respectively yield $\frac{\partial y}{\partial g_1} = \frac{\partial y}{\partial g_2} = 1$, from which we can obtain the optimal ratio of the two public goods when we have a benevolent government:

$$\left(\frac{g_1}{g_2}\right)^* = \left(\frac{\beta_P(1-\delta_1)}{\gamma_P(1-\delta_2)}\right)^{\frac{1}{\zeta+1}} \qquad (9).$$

So, the ratio of optimal values of the two types of spending is given by the ratio of net productivities (i.e., pure productivities less corruption) of the two types of spending. So, even if g_1 in the absence of corruption is more productive than g_2 in the absence of corruption (i.e., both δ_1 and δ_2 equal 0), the presence of corruption could make g_1 effectively less productive than g_2, in which case, the optimal thing for a government to do, if its objective is to raise the growth rate, is to switch its spending in favour of sector 2.

The value of g/k is given in (6) above. Hence, using (9), we can obtain the individual values of g_1/k and g_2/k (not reported).

From $\frac{\partial y}{\partial g_1} = 1$, we obtain $$g_1^* = \left[\beta_P(1-\delta_1)\right]^{\frac{1}{1+\zeta}}.y \qquad (10),$$

and from $\frac{\partial y}{\partial g_2} = 1$, we obtain $$g_2^* = \left[\gamma_P(1-\delta_2)\right]^{\frac{1}{1+\zeta}}.y \qquad (11).$$

We are now in a position to find an expression for the optimal tax rate for the decentralised economy under a benevolent government. From the government budget constraint given by (2), and given the optimal shares (of output) of the two productive inputs given by (10) and (11) above, the optimal tax rate is given by

$$\tau^* = \left[\beta_P(1-\delta_1)\right]^{\frac{1}{\zeta+1}} + \left[\gamma_P(1-\delta_2)\right]^{\frac{1}{\zeta+1}} \qquad (12).$$

The optimal share of the two public services from a welfare-maximising point of view is obtained by combining equations (3), (10) and (12), which can then be combined with (9) to obtain

$$\left(\frac{g_1}{g_2}\right)^* = \frac{\phi^*}{1-\phi^*} = \left(\frac{\beta_P(1-\delta_1)}{\gamma_P(1-\delta_2)}\right)^{\frac{1}{\zeta+1}} \quad (13).$$

This shows that the ratio of optimal shares of spending in the two sectors equals the ratio of net productivities in the two sectors.

Finally, one can derive an expression for the growth rate that could be achieved in this set-up. This optimal growth rate expression can be obtained by combining equation (7) with equations (12) and (13), and is given by

$$\lambda^* = \frac{\alpha^{-1/\zeta}[1-\{\beta_P(1-\delta_1)\}^{1/(\zeta+1)} - \{\gamma_P(1-\delta_2)\}^{1/(\zeta+1)}]^{(1+2\zeta)/\zeta} - \rho}{\sigma} \quad (14).$$

As expected, the growth rate of the economy depends on the net productivities of the two types of public goods. So, there are interesting implications for policy when we consider the cases where the pure productivities of public goods which impact on the growth rate via the government spending ratios, and also on the effects of corruption on the growth rate. This is shown in the section below.

2.2. Comparative statics

In this section, we first study how the optimal growth rate (λ^*), responds to a change in the pure productivity parameters, β_P and γ_P.

First, from eq. (14), we find $d\lambda^*/d\beta_P$ and $d\lambda^*/d\gamma_P$.

Clearly, $\frac{d\lambda^*}{d\beta_P} > (<) \ 0 \quad \textit{if} \quad \beta_P(1-\delta_1) > (<) \ \gamma_P(1-\delta_2)$. (15a)

Similarly, $\frac{d\lambda^*}{d\gamma_P} < (>) \ 0 \quad \textit{if} \quad \beta_P(1-\delta_1) > (<) \ \gamma_P(1-\delta_2)$. (15b)

What expression (15a) tells us is that if the pure productivity of g_1 rises (which is proportional to the share of the first public good in overall tax revenue), then this will raise the economy's growth rate only if the productivity net of corruption in sector 1 is higher than that of sector 2. But if corruption erodes the productivity of sector 1 to the extent that the productivity net of corruption in this sector is lower than the net productivity of sector 2 to start with, then higher pure productivity will actually lower the growth rate of the economy. The intuition behind this result is that in an optimal fiscal policy set-up, where the shares of expenditure devoted to the different public goods are directly linked to the productivities, being *per se* more productive ($\beta_P > \gamma_P$) is not enough; the economy will grow at a higher rate if productivity *net of corruption* is higher in this sector, i.e., $\beta_P(1-\delta_1) > \gamma_P(1-\delta_2)$. If this is not the case, then it is better to shift resources towards the sector where productivity net of corruption is higher.

This also explains why, in (15b), higher γ_P could result in lower growth. Clearly, the government should channel its spending to the sector with the overall higher productivity net of corruption, even if the pure productivity of the other sector rises. So, it is important to identify which in reality is the sector that is more productive after taking into account the effect of corruption.[5]

Next, from eq. (14), we find $d\lambda^*/d\delta_1$ and $d\lambda^*/d\delta_2$:

Clearly, $\frac{d\lambda^*}{d\delta_1} \;<\; (>) \;\; 0 \quad if \quad \beta_P(1-\delta_1) \;>\; (<) \;\; \gamma_P(1-\delta_2)$. (16a)

Similarly, $\frac{d\lambda^*}{d\delta_2} \;>\; (<) \;\; 0 \quad if \quad \beta_P(1-\delta_1) \;>\; (<) \;\; \gamma_P(1-\delta_2)$. (16b)

The results demonstrate that although corruption *per se* is bad in the sense that it reduces the productivity of public spending, higher corruption in the more (less) efficient sector, i.e., where net productivity of the public good is higher (lower) would reduce (enhance) growth. Thus, a larger value of δ_1, which is the corruption associated with the more productive sector, if $\beta_P(1-\delta_1) \;>\; \gamma_P(1-\delta_2)$, is bad for growth, as this would erode the productivity of the relatively more efficient sector. This condition is given by (16a). Looking at it from another angle, if corruption in sector 1 gives the incentive to the government to switch spending to sector 2, which is the sector that is less productive overall, the effect on growth would be adverse.

By contrast, as (16b) shows, a higher value of δ_2, which represents a higher level of corruption in sector 2, would increase the economy's growth rate, if the net productivity of sector 1 is higher than that of sector 2. This is because optimal fiscal policy would dictate that government expenditure be channelled to the sector where net productivity is higher, and higher corruption in the less efficient sector (sector 2) would give the government the incentive to do exactly that. Here corruption in sector 2 could encourage the government to apportion more of its spending towards sector 1. But this would only increase growth if the

[5] As we shall see later, empirically it turns out that the current (rather than capital) component of expenditure is the more productive, net of corruption, for developing countries, while the opposite holds for OECD countries. In the light of this, g_1 should be interpreted as current rather than capital expenditure for our developing country sample, while g_1 should be interpreted as capital rather than current expenditure for our OECD country sample.

net productivity of sector 1 is higher than sector 2. If $\beta_P(1-\delta_1) > \gamma_P(1-\delta_2)$ in (16b) above, then this is, indeed, the case; hence, a higher value of δ_2 would increase the growth rate. So, although this result may seem surprising in the context of a one-sector growth model, it can be rationalised in a framework that focuses on the composition of government expenditure and optimal growth, and does a sectoral analysis of the effects of corruption on growth.

3. Empirical specification

In this section, we perform an empirical analysis to ascertain the effect on growth of the two types of public spending, one more productive than the other, in the presence of corruption. Although the *economic* classification of expenditure is considered for much of the empirical analysis of this paper, we also consider the *functional* classification in Section 5, where we study the impact of expenditure on health and education (both being components of capital expenditure) on the growth rate, as in Ghosh and Gregoriou (2008).[6]

Within the economic classification, we choose the two most commonly used categories of spending, current and capital, which are distinguished in terms of the type of expenditure: (a) capital expenditure covers expenses incurred for the purchase or production of new or existing durable goods, and (b) current expenditure, which includes wages and salaries, other goods and services, interest payments, and subsidies. Typically, capital spending is expected to be more productive, as it constitutes spending on infrastructure, human capital, etc., which have obvious productivity benefits from the perspective of long-run growth. On the other hand, current spending is typically the less productive component of spending from a growth perspective, as it constitutes recurrent spending like wages and salaries, subsidies, transfers, etc. But as Devarajan *et al*. (1996) and Ghosh and Gregoriou (2008) have shown, for a sample of countries, in reality, the opposite seems to be the case. It is recurrent rather than investment spending that has higher growth effects, and capital spending in fact turns out to have a negative coefficient in the growth regression. In Ghosh and Gregoriou (2008) it is suggested that one possibility for this result is the presence of corruption in capital spending which perhaps assumes away the productivity benefits of the latter. It is this possibility that we test in this section.

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[6] For a detailed description of the classification of expenditure, see Devarajan et al. (1996), p. 323, footnote 9.

One variable of considerable interest in this empirical exercise is, of course, corruption. The data for corruption indices are obtained from the International Country Risk Guide (ICRG). In the ICRG index, higher corruption indicates that "high government officials are likely to demand special payments" and "illegal payments are generally expected throughout lower levels of government" in the forms of "bribes connected with import and export licenses, exchange controls, tax assessment, police protection, or loans". The ICRG corruption index is an ordered variable taking values from 0 (most corrupt) to 6 (least corrupt). As the δ parameters in our theoretical model range between 0 and 1, and are a positive function of corruption, we have re-ordered the ICRG indices in a way that assigns 0 to the least corrupt category and 6 to the most corrupt category, and used a scale conversion to transform the numbers to be within the 0-1 range.[7]

For our empirical analysis, we assume there is no corruption in current spending, and whatever corruption there is in the economy can be solely attributed to capital spending.[8] Although this is a simplification, it fits in rather well with reality, because current spending includes items like wages and salaries, transfer payments, etc., where the possibility of corruption is much less, compared to capital spending, which involves discretionary payments, and so the incidence of corruption is much more (see, for example, Tanzi and Davoodi (1997), Mauro (1998)).

Rather than classifying public expenditures as being productive and unproductive to begin with, we let the observed productivity, net of corruption, of the two kinds of spending from the regression results to show us which component is more productive. If capital expenditures, which are thought to be more productive than current expenditure *a priori*, do show up as having more growth effects, then we can say that capital items (net of corruption) are, indeed, more productive than current items. If, on the other hand, the regressions show that this is *not* the case, then we can conclude that current rather than capital spending has been the more productive component, contrary to popular belief.

[7] One advantage of the ICRG index is that it is an annual index, unlike the Business International (BI) index used by Mauro (1995), among others, which is available over the 1980-83 period, and has only one observation per country.

[8] In the context of our theoretical model, this amounts to setting $\delta_1 = 0$ if g_1 is identified as current spending, and $\delta_2 = 0$ if g_2 is identified as current spending. As we shall see later, empirically, current spending is more productive in developing countries and capital spending in OECD countries; so g_1 is current spending and g_2 is capital spending in developing countries, while g_1 is capital spending and g_2 is current spending in OECD countries.

We consider first a sample consisting of only developing countries, and then a sample of developed (OECD) countries.[9] We perform panel data analysis, the details of which are outlined below.

3.1. Data and choice of variables

The empirical analysis uses panel data on 15 developing countries and 21 OECD countries[10] from 1984 to 1999, to examine the link between components of government expenditure and growth from a welfare-maximising perspective.[11] We use annual data obtainable from the Global Development Network Growth Database compiled by William Easterly.

The model in Section 2 linked growth with productivities from an optimal fiscal policy perspective: clearly, from eq. (14), the optimal growth rate, λ^* is linked to the parameters, α, β_P, γ_P, σ and ρ, and quite importantly, to the corruption parameters, δ_1 and δ_2. As eq. (15a), Section 3 shows, $d\lambda^*/d\beta_P > 0$ depends on whether β_P $(1-\delta_1) > \gamma_P$ $(1-\delta_2)$. And as eq. (16b) shows, $d\lambda^*/d\delta_2 > 0$ depends on whether β_P $(1-\delta_1) > \gamma_P$ $(1-\delta_2)$. In other words, the growth rate will increase with the rise in the share of the more productive input in the production function, where the (overall) more productive input is the one with the higher productivity less the impact of corruption. It now remains to be seen whether it is the capital component of expenditure that is the more productive input and the current component of expenditure that is the less productive input, or the other way round.

To control for level effects, we include the share of government spending in GDP. This also allows us to control for the effects of financing government expenditure on growth. It can be shown from the theoretical model, the optimal income tax rate (which turns out to be the share of government spending in GDP, given that government spending is wholly productive,

[9] It is a well-accepted empirical criterion that data from the developed and developing countries should not be pooled – see the discussion in Folster and Henrekson (1999). Grier and Tullock (1989) present evidence showing that data from the OECD and the rest of the world do not share a common set of coefficients. To cite other examples, Devarajan *et. al.* (1996) perform their analysis of developed and developing countries separately rather than pooling all countries. Folster and Henrekson (1999, 2001) consider only developed (OECD) countries in studying the effects of government size on growth. Kneller *et al.* (1999) also study the effects of fiscal policy on growth for OECD countries. Ghosh and Gregoriou (2008) consider only developing countries, and Gupta *et al.* (2005) consider only low-income countries in their analysis.

[10] The 15 developing countries chosen for our study are as follows: Argentina, Brazil, Chile, Colombia, Mexico (South America), Cameroon, Kenya, Sudan, Tanzania, Zimbabwe (Africa), India, Indonesia, Malaysia, Pakistan, Thailand (Asia).

The 21 OECD countries chosen are as follows: Australia, Austria, Belgium, Canada, Czech Republic, Denmark, Finland, France, Germany, Ireland, Italy, Japan, Netherlands, New Zealand, Norway, Portugal, Spain, Sweden, Switzerland, United Kingdom, and United States.

[11] On the panel data approach to studying empirical growth models, see Islam (1995).

and income taxes are the only form of taxes) is a function of the parameters, α, β_P, γ_P, δ_1 and δ_2, with $d\tau^*/d\beta_P < (>) 0$ depending on $\beta_P (1-\delta_1) > (<) \gamma_P (1-\delta_2)$.

The other important determinant of the growth rate that we consider for our empirical analysis is the ratio of private to public capital. This follows directly from our theoretical model of Section 2 (see eq. (6) for the expression for g/k). Consequently, the capital-output ratio as a proportion of the public spending-output ratio is treated as a regressor in the growth equation.[12]

The dependent variable is chosen as the per capita real GDP growth rate in the first set of regressions (Table 2). As pointed out by Devarajan *et al*. (1996), in order to account for the possible reverse causality between spending on public goods and the effect on output growth, we use a five-year forward moving average of growth to eliminate business cycle-type short-run fluctuations induced by shifts in public spending, and this also increases the number of time series observations in our panel data.[13]

As in Devarajan *et al*. (1996), we include the 'black market premium' (bmp) variable to capture the effects of other domestic policies (i.e., other than productive public spending) in countries that also affect the growth rate, given that there is generally a black market for foreign exchange in developing countries. This variable, obtained from the Easterly database, is the premium on the official rate in the black market for foreign exchange. Here bmp_{it} in country i at time t is calculated as $bmp_{it} = [(bmer_{it} - oer_{it})/oer_{it}]*100$, where $bmer \equiv$ black market exchange rate, and $oer \equiv$ official exchange rate.

Finally, we include two explanatory independent variables to capture the 'international' dimension. Given that ours is a sample of developing countries, a measure to control for external shocks could be quite important (see Easterly *et al*. (1993)). The 'shock' term that we use is a weighted average of changes in the world interest rate, the export price index and the import price index for each country, to capture the effects of external shocks to these economies, as in Devarajan *et al*. (1996). Also, *a la* Rodrik (1998), who argues that openness to international trade is an important variable in empirical models testing fiscal policy and growth, we include 'openness' which is the sum of exports and imports as a ratio of GDP as a regressor.

[12] For robustness, we have re-run the regressions after taking out the k/g variable from the set of explanatory variables, given that it does not directly appear in the growth rate expression given by (7). Our results do not change, and are available upon request.

[13] The empirical results with the five-year moving average are provided in an Appendix available upon request.

Given our plausible assumption that corruption applies only to capital spending, we modify the corresponding equation in Ghosh and Gregoriou (2008) to include δ, the modified ICRG index. Since δ is the corruption index, which takes on a higher value corresponding to higher corruption, $\delta.g_{cap}$ is an interaction term that captures the effect of capital spending on growth, conditional on corruption. The term $(1-\delta).g_{cap}$ is, therefore, the net productivity effect of capital spending, i.e., the productivity of capital spending net of corruption. In other words, conceptually, the term $(1-\delta).g_{cap}$ is somewhat similar to the "pure" productivity effect of capital spending. (Thus, if g_2 is interpreted as capital spending, then γ_P - the coefficient on g_2 in the theoretical model - would be the theoretical counterpart to $(1-\delta).g_{cap}$ in the empirical model).[14]

In this set-up, we first find the effect of $(1-\delta).g_{cap}$ on the growth rate, and compare this coefficient of the modified Ghosh and Gregoriou (2008) with the original coefficient of g_{cap}. Since the simple g_{cap} coefficient does not include the corruption variable, it can be conceptually aligned to the net productivity effect of g_{cap}, given by the $\gamma_P(1-\delta_2)$ coefficient in the theoretical model (if g_2 is interpreted as capital spending, of course). The idea is that if the $(1-\delta).g_{cap}$ coefficient turns out to be greater than the g_{cap} coefficient, this implies that the pure productivity effect of capital expenditure exceeds the productivity of g_{cap} net of corruption. In other words, this indicates that when we take into account the interaction of corruption with public capital expenditure, corruption has a negative effect on growth ($\delta.g_{cap} < 0$) in the sense that the productivity of capital spending net of corruption (pure productivity) exceeds that of unadjusted productivity of this type of spending. This means that the effect of corruption is along the lines of what Mauro (1995), Tanzi and Davoodi (1997), etc., have to say, rather than what the advocates of the speed money hypothesis believe.

The model specification for the first set of regressions is

$$G_{it} = a_i + b_t + f_1\left(\frac{(1-\delta)g_{cap,it}}{(1-\delta)g_{cap,it} + g_{cur,it}}\right) + h\left(\frac{(1-\delta)g_{cap,it} + g_{cur,it}}{y_{it}}\right) + j\left(\frac{k_{it}}{(1-\delta)g_{cap,it} + g_{cur,it}}\right)$$
$$+l(bmp_{it}) + m(shock_{it}) + n(openness_{it}) + e_{it} \qquad (17)$$

where i and t denote the cross-sectional and time series dimensions respectively; a_i captures the time-invariant unobserved country-specific fixed effects and b_t captures the unobservable individual-invariant time effects. G is the per capita real GDP growth rate, g_{cap} is public 'capital expenditure', and g_{cur} is public 'current expenditure', y is GDP at market prices, k is

[14] Note that in order to capture the effect of corruption on the growth rate, we tried the corruption variable (on its own) as an independent explanatory variable, instead of interacting it with the capital spending variable, but the effect of corruption on the growth rate did not turn out to be significant.

the gross fixed capital formation as a percentage of GDP, bmp is the black market premium, and the 'shock' and 'openness' variables are as defined in the previous paragraph.

The model specification for the second set of regressions is

$$G_{it} = a_i + b_t + f_2\left(\frac{g_{cur,it}}{(1-\delta)g_{cap,it} + g_{cur,it}}\right) + h\left(\frac{(1-\delta)g_{cap,it} + g_{cur,it}}{y_{it}}\right) + j\left(\frac{k_{it}}{(1-\delta)g_{cap,it} + g_{cur,it}}\right)$$
$$+l(bmp_{it}) + m(shock_{it}) + n(openness_{it}) + e_{it} \qquad (18)$$

which differs from equation (17) in that the first term in brackets on the right-hand side of the equality in (18) is current expenditure as a proportion of total government expenditure. Clearly, although corruption does not affect current spending (or does so to a much lesser degree than it affects capital spending), the effect of corruption on the economy in this equation comes via its inclusion within capital spending, which appears in three places in the equation above – corruption affects the share of current to overall public spending, the share of overall public spending to output, and the ratio of private to public capital.

3.2. Methodology

Empirically, we deal with the endogeneity and simultaneity aspects of our model by means of the system GMM for the reasons spelled out below. Obviously, because our focus is on long-run growth in developing and OECD countries, we explicitly deal with the determinants of growth (rather than of the other endogenous variables like the optimal tax rate) in this paper.

The fixed effects model is the most commonly used panel estimation technique. However, one of the shortcomings of the fixed effects model is that it fails to capture possible endogeneity in the explanatory variables of the panel.

Initially, we embark upon the use of the single equation GMM panel estimator developed by Arellano and Bond (1991) to deal with the endogeneity of our explanatory variables. Like Gupta *et al*. (2005), we implement the GMM single equation estimator instead of this because, as mentioned in Biorn and Klette (1999), the GMM is asymptotically efficient under non-restrictive assumptions about error autocorrelation and heteroscedasticity. We test the validity of the instruments with the use of the Sargan test under the null hypothesis that the instruments used are valid. The Sargan test results in a p-value of 0.02 confirming that the instruments used are not valid.

A possible reason for the weak instruments in our study is that the time dimension of the panel is relatively small (16 annual observations). The single equation estimator, whether it is

2SLS (as used by Folster and Henrekson (2001)) or a GMM technique, suffers from the problem of weak instruments when the cross-sectional component of the panel is small. This implies that there is a weak correlation between the regressors and the instruments. As a result of this problem, the estimated coefficients suffer from poor precision (see, among others, Staiger and Stock (1997)). We can overcome this problem by using the panel GMM system estimator proposed by Blundell and Bond (1998), which radically reduces the imprecision associated with the single equation estimator.

The system GMM estimator estimates a system of equations in first differences and levels. The system estimator combines the standard set of transformed equations in first differences (used in the GMM single equation estimator) with an additional set of equations in levels. The first set of transformed equations continues to use the lag levels as instruments. The level equation, on the other hand, uses the lagged first differences as instruments.

In addition to reducing the poor precision of the GMM and 2SLS single equation estimators, the GMM system has the added advantage of dealing with explanatory variables being jointly determined with the growth rate. The issue of joint determination was recognized by both Folster and Henrekson (2001) and Agell *et al*. (2006) as an econometric problem that remained unresolved with the use of the single equation estimator.[15]

The estimation of systems of equations simultaneously ensures that the aspect of joint determination of variables is captured, and this ties in with the solution to the theoretical model, where the key endogenous variables are, indeed, solved simultaneously, as we have noted.

4. Empirical estimates and explanation of results

In all the empirical estimates, the fixed and time effects of the panel both appear significant, implying that the country- and time-specific shocks differ significantly across the nations in our sample. All empirical tables report Hausman tests for the hypothesis that the explanatory variables are strictly exogenous. In our empirical estimates, this test strongly rejects the null hypothesis. This leads to the conclusion that the explanatory variables in the fixed effects model are endogenously determined (apart from the bmp, shock and openness variables, which are exogenous).

[15] The Three Stage Least Squares (3SLS) panel estimator also estimates a system of equations simultaneously and is regarded as an alternative to the GMM system estimator. However, we implement the GMM system estimator given that it accommodates for the possibility of joint determination of an equation system with different instruments for different equations (Schmidt, 1990).

In addition, all estimated models pass the diagnostic tests.[16] A test for first order residual serial correlation is insignificant which suggests that the panels do not suffer from serial correlation.[17] Sargan tests confirm the validity of the instruments in the GMM model.

[INSERT TABLES 1 AND 2 HERE]

Table 1 shows that there is a *negative* and statistically significant relationship between the capital component of public expenditure and optimal growth in our developing country sample, and this is surprising at first glance, although a similar negative relation is obtained by Devarajan *et al*. (1996) and Ghosh and Gregoriou (2008).[18] From the GMM system model, we find that the coefficient on g_{cap} is –0.14, which implies that a unit increase in the ratio of public capital to total public spending decreases per capita real GDP growth by 14 percentage points. Comparing this with Table 2, we can see that when we re-run the regressions taking into account corruption in capital spending (through the interaction term, $\delta.g_{cap}$), the coefficient on $(1-\delta).g_{cap}$ is –0.10. Having argued that $(1-\delta).g_{cap}$ is an indicator of the pure productivity effect of capital spending, we can see that the corruption-adjusted coefficient of capital spending is still negative, but is not as negative as when we did not take into account corruption. So, netting out the effect of corruption in capital goods provides a better outlook for the productivity of capital spending on growth (the $\delta.g_{cap}$ term equals –0.04), but clearly does not make the coefficient positive. So, although corruption worsens the productivity of capital spending, it does not worsen it significantly, in the sense that in order to make the coefficient of capital spending positive, one needs to take account of other factors that eat into the productivity benefits from capital spending (that we were not able to consider in this paper).

[INSERT TABLE 3 HERE]

Table 3 presents the results for the regression of growth against the ratio of current public spending to total public spending for developing countries, with other variables remaining as they were in Tables 1 and 2. Corruption is not directly present in current spending, but affects the ratio of current to capital spending via its effects on capital spending. The coefficient on $g_{cur}/((1-\delta)g_{cap}+g_{cur})$ is *positive* and significant for developing countries (0.10), which contradicts accepted notions of how current spending ought to affect the growth rate, but is in accordance with the results obtained by Devarajan *et al*. (1996) for the same variable (their

[16] We used three lags in our estimations, but also experimented with other lag structures. Our results are robust to 1, 2 and 4 lags. These results are obtainable upon request.
[17] It should be noted that the serial correlation test for the GMM is done on the first difference of the residuals.
[18] We report only the growth rate estimates here as – from an empirical standpoint – we are primarily interested in the growth effects of the different components of government spending.

Eq. (3.1), p. 332), and with the Ghosh and Gregoriou (2008) results. However, it ought to be noted that neither of these papers considers corruption explicitly in its framework.

Comparing the corruption-adjusted coefficient of capital spending with the coefficient of current spending (i.e., comparing Tables 2 and 3), and linking this to our theoretical model of Section 2, we find *ex post* that $\beta_P(1-\delta_1) > \gamma_P(1-\delta_2)$, with $\delta_1 = 0$, as the more productive component of spending (g_1), for developing countries, is *current* spending, and we have assumed that there is no corruption in this category of spending. Relating this to eqs. (15a) and (16b), it is clear that $\frac{d\lambda^*}{d\beta_P} > 0, \ and \ \frac{d\lambda^*}{d\delta_2} > 0$. From this it is clear that for a benevolent government, it is worth assigning a larger share of spending to the current component (ϕ) as it affects the growth rate positively via its direct effect on productivity, β_P. Also, in a sense, it is 'worth' having corruption in the capital component of spending (despite the fact that corruption lowers the productivity of capital goods) because, being the less productive of the two sectors, corruption would induce an optimising government to switch its spending in favour of current spending, which would favour growth. So, in a two-sector set-up, corruption in the less productive sector is good in terms of switching resources to the more efficient sector, even though corruption *per se* is bad.[19]

[INSERT TABLES 4 AND 5 HERE]

Tables 4 and 5 repeat the results of Tables 1 and 2, but for OECD countries. It can be seen from Table 4 that in the benchmark case, capital spending now has a positive and significant effect on growth (with a coefficient of 0.09), which is generally the sort of effect that we expect in developed countries. When the effect of corruption is netted out, the productivity benefits of capital spending turn out to be higher (the coefficient becomes 0.10), which shows that corruption is bad in the context of the productivity of capital spending (as for developing countries), but the effect is rather small (in this case, $\delta.g_{cap} = -0.01$). This can be explained by the relatively low degree of corruption that exists in OECD countries, as is evident from the ICRG indices of corruption.

[INSERT TABLE 6 HERE]

Table 6 presents the results for the regression of growth against the ratio of current public spending to total public spending for OECD countries, with other variables remaining as they were in Tables 4 and 5. Corruption is not directly present in current spending, but affects the ratio of current to capital spending via its effects on capital spending, as for developing

[19] Note that here, $\beta_P > 0, \ \gamma_P < 0, \ and \ \gamma_P > \gamma_P(1-\delta_2)$. This confirms that $\delta_2 > 0$ (i.e., corruption has a productivity-reducing effect, as assumed in the theoretical model).

countries. The coefficient on $g_{cur}/((1\text{-}\delta)g_{cap}+g_{cur})$ is *negative* and significant (–0.07) for OECD countries, and this is quite different from what is observed for developing countries. This is also unsurprising, given that this component is generally regarded as the unproductive component of spending.

Finally, we compare the corruption-adjusted coefficient of capital spending with the coefficient of current spending for the OECD countries (i.e., compare Tables 5 and 6), and link this with our theoretical model. So here, *ex post*, we have $\beta_P(1-\delta_1) > \gamma_P(1-\delta_2)$, with $\delta_2 = 0$, as the more productive component of spending (g_1), for OECD countries, is *capital* spending, and δ_1 is the corruption parameter associated with this category of spending. Relating this to eqs. (15a) and (16a), it is clear that $\frac{d\lambda^*}{d\beta_P} > 0, \; and \; \frac{d\lambda^*}{d\delta_1} < 0$. So, it is worth incurring more capital expenditure, as this is the more productive of the two sectors for OECD countries. The difference with the previous (developing country) result is that here, corruption is associated with the sector that is more productive. Given that the capital goods sector is more productive overall (taking into account corruption), a benevolent government would channel spending towards this sector, and corruption in this sector would reduce the productivity benefits, and therefore growth, of the economy.[20]

So, our empirical results suggest that although corruption in capital spending has a small negative effect on the productivity of capital spending itself, from a two-sector perspective, it has the adverse effect on the economy of lowering the productivity of the component of spending that the benevolent government uses in targeting its expenditure.

We now turn our attention to the other explanatory variables affecting the growth rate. The public expenditure-to-GDP ratio is positive and statistically significant in all regressions. This is the level effect of total government spending on per capita growth, which has been found to be positive but *insignificant* by Devarajan *et al*. (1996). So this result of ours is somewhat different from their findings, but in conformity with the results of Ghosh and Gregoriou (2008). This is intuitive, since we would generally expect that under optimal fiscal policy, the desirable condition that the productivity of public spending (that is financed by income taxes) exceeds the deadweight loss associated with distortionary taxation would be satisfied.

[20] Note that here, $\beta_P > 0, \; \gamma_P < 0, \; and \; \beta_P > \beta_P(1-\delta_1)$. This confirms that $\delta_1 > 0$ (i.e., corruption has a productivity-reducing effect, as assumed in the theoretical model; only difference with the developing country sample being that here, the capital (not current) spending coefficient is positive.

As mentioned earlier, our theoretical model of Section 2 solves for an optimal value of k/g (ratio of private capital to public services), which is why we included this as an important determinant of the optimal growth rate. The coefficient on this variable is positive and significant in all regressions. The positive sign is clearly intuitive, given that public services in this model augment the productivity of private capital, and we would expect it to be significant.

The black market premium is statistically insignificant in all the regressions. This shows that factors other than the shares of public spending, the public spending-to-output ratio and the private-to-public spending ratio are insignificant in determining the welfare-maximising growth rate. Note that in Devarajan *et al*. (1996), this variable is statistically significant in most of the regressions. The reason for this could be that this variable picks up some of the effects of the private-to-public spending ratio in their regressions, whereas in our case the latter variable is clearly an important determinant of the growth rate.

As is clear from the results, the shock variable is insignificant, and so is the openness variable. A possible reason why the shock is not important could be that the time dummy is picking up the influence of the shock. This is because it is likely that any shock will be time varying.

In sum, by comparing the corruption-adjusted coefficient of capital spending with the coefficient on current spending for both developing and OECD countries, it is clear that although corruption affects the productivity of capital spending adversely, this effect is not strong enough to warrant the typical developing country government to switch its spending plans in favour of capital spending (and away from current spending), or the OECD government to spend more on capital goods items than what it used to spend.

One potential problem with the use of the GMM system estimator is that the properties hold when the number of countries is large. Therefore, the GMM system estimator may be biased and imprecise in our sample, given that we only have 15 developing countries in one sample, and 21 OECD countries in another. An alternative approach to the GMM system estimator is based on the bias- correction of the LSDV model. Nickell (1981) demonstrates that the standard LSDV estimator is not consistent when the number of countries in the panel is small. Kiviet (1995) uses higher order asymptotic expansion techniques to approximate the small sample bias of the LSDV estimator. These approximations are evaluated at the unobserved true parameter values, so they cannot be estimated. Kiviet (1995) overcomes this shortcoming by replacing the true unobserved parameters with the estimates from some consistent estimators.

Therefore, for robustness we re-estimate the OLS fixed effects model in Tables 1-6 using the small sample bias correction provided by Kiviet (1995).[21] As we can see, the OLS fixed effects results do not change, providing evidence that the panel GMM system estimator computes reliable parameter estimates for our sample, even though we only have 15 countries in one sample and 21 in another.

5. Robustness tests by inclusion of some functional components of capital expenditure

In this section, we check for the robustness of our empirical results with respect to some important (functional) components of government capital expenditure (like education and health), because it is possible that though overall public capital expenditure may show a negative relationship with growth, both in the presence and absence of corruption, some functional components within overall capital spending may actually have done well in terms of contributing to growth, when we explicitly take into account the role of corruption. This means that although overall capital spending may turn out to be unproductive, there could be a case for increasing expenditure on some of its components at the expense of current spending. Consequently, we replace the explanatory variable, $(1-\delta)g_{cap}/((1-\delta)g_{cap}+g_{cur})$ by two separate explanatory variables, $(1-\delta)$.health/$((1-\delta)g_{cap}+g_{cur})$ and $(1-\delta)$.education/$((1-\delta)g_{cap}+g_{cur})$ in (17), as health and education constitute two important functional components of public capital expenditure in boosting human capital (see, for instance, Barro (1991)).

[INSERT TABLES 7 AND 8 HERE]

Our regression results of Tables 7 and 8 for developing countries show that the coefficient on the health variable turns out to be negative and significant, both with and without corruption, although it shows a slight improvement when we factor out the negative effect of corruption (-0.04 compared to -0.07). As regards the education variable, the same could be said (-0.01 compared to -0.04), which means that if we take out the effect of corruption, then it slightly improves the performance of education, but is still not good enough to compare with the positive effects of current spending (Table 3).

The results of our paper point to the negative effect of corruption in health and education on growth, but controlling corruption may not make education that much more productive. So, these results are in line with those obtained for the overall capital component of public expenditure. Devarajan *et al*. (1996) and Ghosh and Gregoriou (2008) obtain the same result without considering corruption; and the results of our paper confirm that those results are robust even after taking into account the effect of corruption.

[21] These results, not reported, are available upon request.

[INSERT TABLES 9 AND 10 HERE]

When we do the same analysis (with respect to health and education spending) for our sample of OECD countries, corruption seems to make even less of a difference to the results, although once again, it exerts a slightly negative effect on the growth rate, as is clear from Tables 9 and 10. Of course, as is clear from our earlier results, capital spending itself has a positive effect on the growth rate for OECD countries, and although corruption reduces this positive effect, it does so only slightly. And as regards education, the effect of corruption on growth is actually negligible, providing indirect evidence in favour of the Mauro (1998) result, which we can interpret, in the context of our results, as follows: as it is difficult to gain from corrupt practices as regards education, this category of spending is somewhat immune from corruption, particularly in developed countries.

6. Conclusion

This paper adds to the literature on optimal fiscal policy within an endogenous growth framework by introducing corruption in the different components of public spending (e.g., capital and current), when one of the components is *a priori* more productive than another. Corruption is modelled analytically as something that reduces the productivity of public spending. It is important to note that even if capital spending is *per se* more productive than current spending, increasing its share will be counterproductive to growth prospects if its productivity net of corruption is lower than for current spending. Also, in a sense, it is 'worth' having corruption in capital spending (despite the fact that corruption lowers its productivity) because, being the less productive (net of corruption) of the two sectors, this would induce an optimising government to switch its spending in favour of current spending, which would favour growth because of its higher overall productivity. So, in a two-sector set-up, corruption in the less productive sector is good in terms of channelling resources to the more efficient sector, even though corruption *per se* is bad.

Empirically, corruption was captured by an interaction term, where corruption interacted with capital spending. We found, for both developing and developed countries, that corruption reduces the productivity benefits from capital spending, although the effect of corruption on growth for OECD countries was small. The effect of corruption was not large enough to warrant a switch from current to capital spending for developing countries in the interest of long-run growth, even if those governments were able to control corruption effectively. It is worth investigating, in future research, the factors other than corruption that reduce the productivity of capital spending, something that was beyond the scope of the present paper.

References

Ades, A. and Di Tella, R. (1997). National champions and corruption: Some unpleasant interventionist arithmetic, *Economic Journal*, 107, 1023-42.

Ades, A. and Di Tella, R. (1999). Rents, competition and corruption, *American Economic Review*, 89, 982-93.

Agell, J., Ohlsson, H., and Thoursie, P. S. (2006). 'Growth Effects of Government Expenditure and Taxation in Rich Countries: A Comment', *European Economic Review*, 50, 211-18.

Arellano, M. and Bond, S. R. (1991) Some tests of specification for panel data: Monte Carlo evidence and an application to employment equations, *Review of Economic Studies*, 58, 277-97.

Barro, R. J. (1991) Economic growth in a cross-section of countries, *Quarterly Journal of Economics*, 106, 407-44.

Biorn, E. and Klette, T. J. (1999). The Labour Input Response to Permanent Changes in Output: An Errors-in-Variables Analysis Based on Panel Data, *Scandinavian Journal of Economics*, 101, 379-404.

Blundell, R. and Bond, S. R. (1998) Initial conditions and moment restrictions in dynamic panel data models, *Journal of Econometrics*, 87, 115-43.

Devarajan, S., Swaroop, V., and Zou, H. (1996) The composition of public expenditure and economic growth, *Journal of Monetary Economics*, 37, 313-44.

Easterly, W., *Global Development Network Growth Database*, Development Research Institute, New York University
(website:http://www.nyu.edu/fas/institute/dri/global%20development%20network%20growth%20data base.htm)

Easterly, W., Kremer, M., Pritchett, L., and Summers, L.H. (1993) Good policy or good luck? Country growth performance and temporary shocks', *Journal of Monetary Economics*, 32, 459-83.

Folster, S. and Henrekson, M. (1999). 'Growth and the Public Sector: A Critique of the Critics.' *European Journal of Political Economy*, 15, 337-58.

Folster, S. and Henrekson, M. (2001). 'Growth Effects of Government Expenditure and Taxation in Rich Countries', *European Economic Review*, 45, 1501-20.

Ghosh, S. and Gregoriou, A. (2008). 'The Composition of Government Spending and Growth: Is Current or Capital Spending Better?' *Oxford Economic Papers*, 60, 484-516.

Grier, Kevin B. and Gordon Tullock (1989). 'An Empirical Analysis of Cross-National Economic Growth, 1951-80'. *Journal of Monetary Economics*, Vol. 24, 259-76.

Gupta, S., Clements, B., Baldacci, E., and Mulas-Granados, C. (2005) Fiscal policy, expenditure composition, and growth in low-income countries, *Journal of International Money and Finance*, 24, 441-63.

Huntington, S. P. (1968). *Political Order in Changing Societies*, Yale University Press, New Haven, CT.

International Monetary Fund (1986) *A Manual on Government Finance Statistics*, Washington DC.
Islam, N. (1995) Growth empirics: A panel data approach, *Quarterly Journal of Economics*, 110, 1127-70.

Kiviet, J. F. (1995) On bias, inconsistency and efficiency of various estimators in dynamic panel data models, *Journal of Econometrics*, 68, 53-78.

Kneller, R., Bleaney, M. F., and Gemmell, N. (1999) Fiscal policy and growth: Evidence from OECD countries, *Journal of Public Economics*, 74, 171-90.

Leff, N. (1964). Economic development through bureaucratic corruption, *American Behavioral Scientist*, 8-14.

Leys, C. (1970). What is the problem about corruption? In A. J. Heidenheimer (ed.), *Political Corruption: Readings in Comparative Analysis*, Holt Reinehart, New York.

Lui, F. T. (1985). An equilibrium queuing model of bribery, *Journal of Political Economy*, 93, 760-81.

Mauro, P. (1995). Corruption and growth, *Quarterly Journal of Economics*, 110, 681-712.

Mauro, P. (1997). The effects of corruption on growth, investment and government expenditure: A cross-country analysis. In K. A. Elliott (ed.), *Corruption and the Global Economy*, Institute for International Economics, Washington D.C.

Mauro, P. (1998). Corruption and the composition of government expenditure, *Journal of Public Economics*, 69, 263-79.

Nickell, S. J. (1981). Biases in dynamic models with fixed effects, *Econometrica*, 49, 1417-26.

Rodrik, D. (1998). Why do more open economies have bigger governments? *Journal of Political Economy*, 106, 997-1034.

Schmidt, P. (1990). 'Three-Stage Least Squares with Different Instruments for Different Equations', *Journal of Econometrics*, 43, 389-94.

Shleifer, A. and Vishny, R. W. (1993). Corruption, *Quarterly Journal of Economics*, 108, 599-617.

Staiger, D. and Stock, J. H. (1997). Instrumental variables regression with weak instruments, *Econometrica*, 65, 557-86.

Tanzi, V. and Davoodi, H. (1997). Corruption, public investment, and growth, *IMF Working Paper 97/139*, International Monetary Fund, Washington.

TABLES

Table 1: Contribution of capital spending to growth in developing countries - benchmark (corruption not taken into account)

Variable	GMM System
Constant	12.56**(2.82)***
$g_{cap}/(g_{cap}+g_{cur})$	-0.14**(-2.49)***
$(g_{cap}+g_{cur})/y$	0.24**(2.82)***
$k/(g_{cap}+g_{cur})$	0.60**(2.40)***
Bmp	0.066**(1.05)**
Shock	0.171**(0.94)**
Openness	0.401**(1.24)**
a_i	(0.00)
b_t	(0.00)
SE	0.129
AR(1)	(0.44)
Diff Sargan	(0.73)
NORM(2)	(0.45)
Hausman test	94.21
Observations	201

AR(1) is the first order Lagrange Multiplier test for the first difference of residual serial correlation. SE represents the standard error of the panel estimator. a_i and b_t are the fixed and time effects. The Difference Sargan test follows a χ^2 distribution with r degrees of freedom under the null hypothesis of valid instruments. NORM(2) is the p value of the Jarque-Bera normality tests. The Hausman test follows a χ^2 distribution with 6 degrees of freedom, resulting in a critical value of 14.45, at the 95% confidence level. The endogenous explanatory variables in the panel are GMM instrumented setting $z \geq 3$. (.) are p values, **(.)** are t statistics, * indicate significant at the 95% confidence level.

Table 2: Contribution of capital spending to growth in developing countries - corruption captured explicitly

Variable	GMM System
Constant	12.36**(2.76)***
$(1-\delta)g_{cap}/((1-\delta)\, g_{cap}+g_{cur})$	-0.10**(-2.44)***
$((1-\delta)\, g_{cap}+g_{cur})/y$	0.27**(2.77)***
$k/((1-\delta)\, g_{cap}+g_{cur})$	0.64**(2.33)***
Bmp	0.034**(0.99)**
Shock	0.163**(0.92)**
Openness	0.378**(1.22)**
a_i	(0.00)
b_t	(0.00)
SE	0.120
AR(1)	(0.39)
Diff Sargan	(0.67)
NORM(2)	(0.50)
Hausman test	97.23
Observations	201

See notes for Table 1.

Table 3: Contribution of current spending to growth (with corruption in the system) for developing countries

Variable	GMM System
Constant	14.72**(3.12)***
$g_{cur}/((1-\delta)\ g_{cap}+g_{cur})$	0.10**(2.51)***
$((1-\delta)\ g_{cap}+g_{cur})/y$	0.29**(2.91)***
$k/((1-\delta)\ g_{cap}+g_{cur})$	0.36**(2.29)***
Bmp	0.038**(0.91)**
Shock	0.167**(0.90)**
Openness	0.441**(1.31)**
a_i	(0.00)
b_t	(0.00)
SE	0.136
AR(1)	(0.29)
Diff Sargan	(0.51)
NORM(2)	(0.63)
Hausman test	105.65
Observations	201

See notes for Table 1.

Table 4: Contribution of capital spending to growth in OECD countries - benchmark (corruption not taken into account)

Variable	GMM System
Constant	11.44**(2.46)***
$g_{cap}/(g_{cap}+g_{cur})$	0.09**(2.22)***
$(g_{cap}+g_{cur})/y$	0.25**(2.24)***
$k/(g_{cap}+g_{cur})$	0.54**(2.39)***
Bmp	0.008**(0.95)**
Shock	0.114**(1.11)***
Openness	0.556**(1.26)**
a_i	(0.00)
b_t	(0.00)
SE	0.128
AR(1)	(0.33)
Diff Sargan	(0.64)
NORM(2)	(0.38)
Hausman test	80.24
Observations	305

See notes for Table 1.

Table 5: Contribution of capital spending to growth in OECD countries - corruption captured explicitly

Variable	GMM System
Constant	12.66**(2.58)***
(1-δ) g_{cap}/((1-δ) g_{cap}+g_{cur})	0.10**(2.41)***
((1-δ) g_{cap}+g_{cur})/y	0.32**(2.11)***
k/((1-δ) g_{cap}+g_{cur})	0.57**(2.30)***
Bmp	0.009**(0.99)**
Shock	0.133**(1.17)**
Openness	0.559**(1.30)**
a_i	(0.00)
b_t	(0.00)
SE	0.129
AR(1)	(0.38)
Diff Sargan	(0.60)
NORM(2)	(0.25)
Hausman test	87.65
Observations	305

See notes for Table 1.

Table 6: Contribution of current spending to growth (with corruption in the system) for OECD countries

Variable	GMM System
Constant	12.66**(2.68)***
g_{cur}/((1-δ)g_{cap}+g_{cur})	-0.07**(-2.14)***
((1-δ)g_{cap}+g_{cur})/y	0.34**(3.13)***
k/((1-δ)g_{cap}+g_{cur})	0.48**(2.13)***
Bmp	0.059**(0.97)**
Shock	0.151**(1.06)**
Openness	0.555**(1.20)**
a_i	(0.00)
b_t	(0.00)
SE	0.139
AR(1)	(0.39)
Diff Sargan	(0.43)
NORM(2)	(0.69)
Hausman test	99.44
Observations	305

See notes for Table 1.

Table 7: Contribution of health and education spending to growth in developing countries - benchmark (corruption not captured)

Variable	GMM System
Constant	13.47**(2.76)***
Hea/(g_{cap}+g_{cur})	-0.07**(-2.14)***
Edu/(g_{cap}+g_{cur})	-0.04**(-2.22)***
(g_{cap}+g_{cur})/y	0.21**(2.66)***
k/(g_{cap}+g_{cur})	0.48**(2.35)***
Bmp	0.007**(0.87)**
shock	0.147**(0.90)**
Openness	0.331**(1.02)**
a_i	(0.00)
b_t	(0.00)
SE	0.124
AR(1)	(0.24)
Diff Sargan	(0.59)
NORM(2)	(0.53)
Hausman test	95.32
Observations	201

See notes for Table 1.

Table 8: Contribution of health and education spending to growth in developing countries - corruption captured

Variable	GMM System
Constant	14.27**(2.87)***
(1-δ)Hea/((1-δ) g_{cap}+g_{cur})	-0.04**(-2.11)***
(1-δ)Edu/((1-δ) g_{cap}+g_{cur})	-0.01**(-2.17)***
((1-δ) g_{cap}+g_{cur})/y	0.27**(2.70)***
k/((1-δ) g_{cap}+g_{cur})	0.46**(2.31)***
Bmp	0.003**(0.91)**
Shock	0.142**(0.83)**
Openness	0.325**(1.00)**
a_i	(0.00)
b_t	(0.00)
SE	0.118
AR(1)	(0.28)
Diff Sargan	(0.54)
NORM(2)	(0.48)
Hausman test	91.46
Observations	201

See notes for Table 1.

Table 9: Contribution of health and education spending to growth in OECD countries - benchmark (corruption not captured)

Variable	GMM System
Constant	11.55**(2.51)***
$Hea/(g_{cap}+g_{cur})$	0.05**(2.80)***
$Edu/(g_{cap}+g_{cur})$	0.02**(2.57)***
$(g_{cap}+g_{cur})/y$	0.30**(2.58)***
$k/(g_{cap}+g_{cur})$	0.35**(2.15)***
bmp	0.005**(0.88)**
shock	0.119**(0.90)**
Openness	0.441**(1.22)**
a_i	(0.00)
b_t	(0.00)
SE	0.130
AR(1)	(0.30)
Diff Sargan	(0.51)
NORM(2)	(0.34)
Hausman test	89.25
Observations	305

See notes for Table 1.

Table 10: Contribution of health and education spending to growth in OECD countries - corruption captured

Variable	GMM System
Constant	11.66**(2.59)***
$(1-\delta)Hea/((1-\delta)g_{cap}+g_{cur})$	0.06**(2.84)***
$(1-\delta)Edu/((1-\delta)\ g_{cap}+g_{cur})$	0.02**(2.02)***
$((1-\delta)\ g_{cap}+g_{cur})/y$	0.42**(2.70)***
$k/((1-\delta)\ g_{cap}+g_{cur})$	0.42**(2.27)***
bmp	0.008**(0.92)**
shock	0.124**(1.07)**
Openness	0.444**(1.17)**
a_i	(0.00)
b_t	(0.00)
SE	0.138
AR(1)	(0.32)
Diff Sargan	(0.69)
NORM(2)	(0.55)
Hausman test	90.76
Observations	305

See notes for Table 1.