Economics Letters 105 (2009) 32–35

Contents lists available at ScienceDirect

Economics Letters

journal homepage: www.elsevier.com/locate/ecolet

On the heterogeneous impact of public capital and current spending on growth across nations

Andros Gregoriou [a,*], Sugata Ghosh [b]

[a] Norwich Business School, University of East Anglia, Norwich, NR4 7TJ, UK
[b] Department of Economics and Finance, Brunel University, UK

ARTICLE INFO

Article history:
Received 18 January 2007
Received in revised form 26 April 2009
Accepted 11 May 2009
Available online 15 May 2009

Keywords:
Public capital and current spending
Economic growth
Heterogeneous panel
GMM system estimator

JEL classification:
C33
E62

ABSTRACT

This paper captures the heterogeneous impact on growth, of public capital and current spending, for 15 developing countries. Using the GMM system panel estimator, we show that countries with substantial public capital (current) spending have strong negative (positive) growth effects.

1. Introduction

Since the influential paper by Barro (1990), there has been a burgeoning literature on the effects of fiscal policy on long-run growth (see, for example, Slemrod (1995), Temple (1999), and Easterly and Levine (2001) for surveys on this topic). As regards the empirical literature in the area, it can be observed that a broad consensus has not always existed on the appropriateness of the methodology adopted, or in the nature of the impact of fiscal policy on growth (see, for example, the debate between Folster and Henrekson (1999, 2001) and Agell et al. (1997, 2006)).

Although some of the earlier research in the area used cross-section analysis, there has since then been increasing use of panel data (see Islam, 1995), which can capture country- and time-specific fixed effects, and these have been shown to be quite important. However, Lee et al. (1998), commenting on Islam (1995), observe that slope heterogeneity, even when random, causes major difficulties for estimation in dynamic panels. They contend that potential heterogeneity in growth rates of different countries renders the standard fixed effects panel estimator to be biased. Further, Luintel and Khan (2004) show lack of correspondence between panel and country-specific estimates. Thus, the generalizations of panel-based results may proffer incorrect inferences for several countries of the panel. In this paper, we explicitly capture the potential cross-country heterogeneity in public spending, and its differential effects on growth across nations, by adopting a heterogeneous panel approach.

Within the empirical research using panel data, some of the papers have looked at the impact of overall government expenditure on growth, while many others have focused on the growth effects of some of the important components of such expenditure like education and infrastructure (see Nijkamp and Poot (2004) for details). Some of these studies pool developed and developing countries within the same sample, while others, like Devarajan et al. (1996), which deals with the composition of government expenditure and growth for primarily a sample of developing countries, do not.[1] We concentrate on this paper for our research, as it is the first important study of how the composition of a country's public expenditure affects its growth rate. Moreover, Devarajan et al. (1996) consider the growth effects of the capital and current components of public spending separately, which is something we intend to focus on as well. They found a negative (positive) and significant relationship between the capital (current) component of public expenditure and per capita real GDP growth for 43 countries over the period 1970–1990.

Given the importance of slope heterogeneity as an econometric issue (see, amongst others, Baltagi (1995), and Pesaran and Smith (1995)), we extend the methodology implemented by Devarajan et al. (1996) by explicitly modelling the potential cross-country heterogeneity in

* Corresponding author. Tel.: +44 1603 591321; fax: +44 1603 593343.
E-mail address: a.gregoriou@uea.ac.uk (A. Gregoriou).

[1] It is now 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).

0165-1765/$ – see front matter © 2009 Elsevier B.V. All rights reserved.
doi:10.1016/j.econlet.2009.05.009

capital and current expenditure. The fixed effects panel estimator used in Devarajan et al. (1996) assumes that all the slope coefficients, adjustment dynamics and error variances are invariant across all countries. Neglecting parameter heterogeneity across the countries in the panel results in biased and inconsistent parameter estimates (Pesaran et al., 2000). However, these assumptions are unlikely to hold in reality, because countries are not unanimous in their views on the role of government expenditure in fostering growth, and this largely depends on the political stance of the party in power. The importance assigned to capital and current expenditures, i.e., the commitment to spend on viable long-term capital projects *vis-a-vis* the spending on recurrent types of expenditure like wages and salaries, subsidies and pension arrangements, also varies across countries. The potential cross-country variations in the parameters of the level and composition of public expenditure are consequently modelled as a linear function of country-specific levels of capital and current spending in this paper.

In addition, we address the issue of endogeneity in the panel by using the GMM system estimator, first established by Blundell and Bond (1998). Our choice of panel estimator follows Ghosh and Gregoriou (2008), who capture optimal fiscal policy in the Devarajan et al. (1996) model with the use of a GMM system technique.

The rest of the paper is organized as follows: Section 2 discusses the heterogeneity in public spending across nations, Section 3 outlines the empirical model and methodology, Section 4 presents our empirical estimates, and Section 5 concludes.

2. Heterogeneity in public spending across nations

For our empirical analysis, we use annual data on government expenditure for 15 developing countries from three continents (listed in Table 1) over 1972–1999, obtainable from the Global Development Network Growth Database. We compute the mean capital expenditure and mean current expenditure (both as percentage of GDP) for these countries (see Table 1 below).

The data in Table 1 clearly reveal the cross-country differences in the levels of capital and current expenditure for the 15 countries in our sample. For example, Sudan and Zimbabwe have the lowest average capital and current expenditure as a percentage of GDP. On the other hand, Brazil and Thailand appear to have the highest capital and current expenditure. With respect to the heterogeneity in total government expenditure, as evidenced from the data, we can see that Sudan (the country with the lowest public expenditure) spends less than 5% of its GDP on public goods and services, whereas Brazil (the highest public expenditure country) spends more than 39% of its GDP on these.

3. Model and estimation technique

The econometric models to be estimated are represented by Eqs. (1) and (2) below. If combined, Eqs. (1) and (2) would be identical

Table 1
Heterogeneity in the data on public spending across countries.

Country	Mean capital spending (% of GDP)	Mean current spending (% of GDP)
Sudan	1.94	2.41
Zimbabwe	2.25	4.71
Pakistan	2.29	6.47
Malaysia	2.38	9.45
Kenya	2.76	13.21
Cameroon	2.79	14.75
Tanzania	3.00	16.76
Colombia	3.22	17.27
Mexico	3.33	18.58
Chile	3.41	19.57
Indonesia	3.57	29.64
Argentina	3.70	31.41
India	3.75	33.78
Thailand	3.94	35.17
Brazil	4.05	35.34

Table 2
Heterogeneous panel estimates of the contribution of capital and current components of public spending.

Capital		Current	
Parameter	GMM system	Parameter	GMM system
Constant	23.50 (**2.55**)*	constant	23.88 (**2.50**)*
λ	−0.29 (**−2.82**)*	γ	0.49 (**2.84**)*
δ_1	0.54 (**2.94**)*	δ_2	0.55 (**2.80**)*
j	0.117 (**1.02**)	j	0.124 (**0.99**)
l	−0.221 (**−2.04**)*	l	−0.226 (**−2.01**)*
a_i	(0.00)	a_i	(0.00)
b_t	(0.00)	b_t	(0.00)
SE	0.120	SE	0.120
AR(1)	(0.430)	AR(1)	(0.441)
Diff-Sargan	(0.59)	Diff-Sargan	(0.60)
NORM (2)	0.186	NORM (2)	0.187
Observations	267	Observations	267

AR(1) is the first order Lagrange Multiplier test for residual serial correlation. SE represents the standard error of the panel estimator. Under the GMM system, this test is undertaken on the first difference of the residuals because of the transformations involved. a_i and b_t are the fixed and time effects. Sargan tests follow a χ^2 distribution with r degrees of freedom under the null hypothesis of valid instruments. NORM (2) is the p-value for the Jarque–Bera normality test. The endogenous explanatory variables in the panel are GMM instrumented setting $z \geq 2$. (.) are p values, (**.**) are t statistics, and * indicate significant at all conventional levels.

to Eq. (13) of Devarajan et al. (1996), which is adapted appropriately by them (page 331) to enable the fixed effects method to be applied.[2]

$$G_{it} = a_i + b_t + \phi\left(\frac{g_{1,it}}{g_{1,it} + g_{2,it}}\right) + h\left(\frac{g_{1,it} + g_{2,it}}{y_{it}}\right) + j(shock_{it}) + l(bmp_{it}) + e_{it} \tag{1}$$

$$G_{it} = a_i + b_t + \mu\left(\frac{g_{2,it}}{g_{1,it} + g_{2,it}}\right) + h\left(\frac{g_{1,it} + g_{2,it}}{y_{it}}\right) + j(shock_{it}) + l(bmp_{it}) + e_{it} \tag{2}$$

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_1 is public capital expenditure, g_2 is public current expenditure, and y is GDP at market prices. The 'shock' variable is constructed as in Devarajan et al. (1996), and 'bmp' is the black market premium as defined in their paper.

The specification represented by Eqs. (1) and (2) allows only for unobservable individual and time effects. All other parameters are assumed homogeneous across all countries in the panel. In order to allow for heterogeneity in the parameters of the panel, we model cross-country heterogeneity in capital and current expenditure directly by estimating the following models:

$$G_{it} = a_i + b_t + \lambda\left(\phi_{it}{*}\,\bar{g}_{1,i}\right) + \delta_1\left(h_{it}{*}\,\bar{g}_{1,i}\right) + j(shock_{it}) + l(bmp_{it}) + e_{it} \tag{3}$$

$$G_{it} = a_i + b_t + \gamma\left(\mu_{it}{*}\,\bar{g}_{2,i}\right) + \delta_2\left(h_{it}{*}\,\bar{g}_{2,i}\right) + j(shock_{it}) + l(bmp_{it}) + e_{it} \tag{4}$$

where $\bar{g}_{1,i} = T_i^{-1}\sum_{t=1}^{T_i} g_{1,it}$ and $\bar{g}_{2,i} = T_i^{-1}\sum_{t=1}^{T_i} g_{2,it}$, and the other variables are as previously defined. Eqs. (3) and (4) represent the

[2] We do not combine (1) and (2) — this is similar to Devarajan et al. (1996) — because of possible collinearity among regressors.

heterogeneous panel model. They allow the slope parameters (λ, γ, δ) of the capital and current expenditure to vary across countries. Heterogeneity in parameters is assumed to be a linear function of country-specific mean levels of capital and current expenditure ($\bar{g}_{1,i}$ and $\bar{g}_{2,i}$). From Eqs. (3) and (4), the respective country-specific parameters for capital and current expenditure are computed as:

$$\omega_1 = \left(\lambda^* \bar{g}_{1,i}\right); \quad \omega_2 = \left(\gamma^* \bar{g}_{2,i}\right). \tag{5}$$

As previously mentioned, in order to capture the cross-country heterogeneity in Eqs. (3) and (4), we use the system GMM estimator, unlike Devarajan et al. (1996), who use the OLS estimator. This econometric methodology makes use of lagged instruments of the endogenous variables for each time period to tackle possible endogeneity of the explanatory variables in the panel. Although the GMM single equation estimator developed by Arellano and Bond (1991) also performs a similar task, it suffers from the problem of weak correlation between the regressors and the instruments when the time-series dimension of the panel is fairly small.

The consistency of the GMM system hinges crucially on whether the lagged values of the explanatory variables are a valid set of instruments, and whether e_{it} is not serially correlated. We undertake the Difference-Sargan test to establish the validity of the instrument set. A first order serial correlation test is performed to test whether the error term suffers from serial correlation.

4. Empirical estimates

Table 2 reports the results obtained for the heterogeneous panel data model specified in Eqs. (3) and (4). The parameters that are associated with the variables that interact with $\bar{g}_{1,i}$ and $\bar{g}_{2,i}$ are all highly significant, implying significant cross-country variations. Therefore, the parameters of economic growth are country-specific and depend upon the levels of capital and current expenditure of each nation. The models reported in Table 2 pass all the diagnostic tests. The fixed and time effects of the panels appear significant, implying that the country and time-specific shocks differ significantly across the countries in our sample. Also, the test for first order residual serial correlation is insignificant, which shows that the panels do not suffer from serial correlation. The results from the Sargan tests confirm the validity of the instruments in the GMM system.[3]

Table 3 reports the country-specific capital and current expenditure parameters computed from the results in Table 2, following the methodology of Eq. (5). The capital (current) expenditure parameter shows a negative (positive) effect with respect to economic growth for all countries; however, there is pronounced cross-country variation. The capital expenditure parameter ranges from −0.56 for Sudan to −1.18 for Brazil, which represents quite a substantial difference. The cross-sectional variation is also observed for current expenditure, for which the parameter ranges from a minimum of 1.18 (Sudan) to a maximum of 17.32 (Brazil), which implies that the parameter for Brazil is as much as 15 times that for Sudan. The cross-sectional variation amongst the countries in our sample is clearly more apparent for current expenditure, and this is due to the higher proportion of current expenditure in total public expenditure in all countries (see Table 1).[4]

Table 3
Country-specific parameters obtained from the estimates of Table 2.

Country	Capital spending (ω_1)	Current spending (ω_2)
Sudan	−0.56	1.18
Zimbabwe	−0.65	2.31
Pakistan	−0.66	3.17
Malaysia	−0.69	4.63
Kenya	−0.80	6.47
Cameroon	−0.81	7.23
Tanzania	−0.87	8.21
Colombia	−0.93	8.46
Mexico	−0.97	9.10
Chile	−0.99	9.59
Indonesia	−1.04	14.52
Argentina	−1.07	15.39
India	−1.09	16.55
Thailand	−1.14	17.23
Brazil	−1.18	17.32

5. Conclusion

The literature on fiscal policy and growth has typically investigated the effects of overall public spending on growth, or the differential effects of the various components of public expenditure on growth. While there has not been unanimity in the findings as to which of capital and current spending has contributed favourably to growth, the literature — dealing with a homogeneous panel set-up — has not generally explored the heterogeneous impact of public capital/current spending on growth across the nations. This is exactly what we did in this paper, where we explicitly modelled the potential cross-country heterogeneity in capital and current expenditure on economic growth, using a heterogeneous panel framework. The heterogeneity was modelled as a function of country-specific mean levels of capital and current expenditure. We were able to capture effectively the cross-country variations in the parameters of the model, which clearly suggest that for nations such as Brazil and Thailand, capital spending has a fairly significant negative effect, while current expenditures have a major positive role to play in determining long-run growth; on the other hand, for countries like Sudan and Zimbabwe, neither capital nor current expenditure has a substantial impact on the growth of the nations.

References

Agell, Jonas, Lindh, Thomas, Ohlsson, Henry, 1997. Growth and the public sector: a critical review essay. European Journal of Political Economy 13, 33–52.
Agell, Jonas, Ohlsson, Henry, Thoursie, Peter S., 2006. Growth effects of government expenditure and taxation in rich countries: a comment. European Economic Review 50, 211–218.
Arellano, Manuel, Bond, Stephen R., 1991. Some tests of specification for panel data: Monte Carlo evidence and an application to employment equations. Review of Economic Studies 58, 277–297.
Baltagi, Badi H., 1995. Econometric Analysis of Panel Data. John Wiley & Sons, New York.
Barro, Robert J., 1990. Government spending in a simple model of endogenous growth. Journal of Political Economy 98, S103–S125.
Blundell, Richard, Bond, Stephen R., 1998. Initial conditions and moment restrictions in dynamic panel data models. Journal of Econometrics 87, 115–143.
Devarajan, Shantayanan, Swaroop, Vinaya, Zou, Hengfu, 1996. The composition of public expenditure and economic growth. Journal of Monetary Economics 37, 313–344.

[3] The dependent variable chosen by Devarajan et al. (1996) is the five-year forward moving average of the per capita real GDP growth rate. This is chosen to eliminate short-term fluctuations, and also the possibility of reverse causality. Therefore, for robustness we also estimated our empirical models using the five-year moving average. The results (not reported, but available upon request) do not change.

[4] One potential shortcoming with the use of the GMM 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 countries. An alternative approach to the GMM system estimator for small samples is the fixed effects estimator corrected for small sample bias, devised by Kiviet (1995). For robustness, we re-estimate Tables 2 and 3 using the Kiviet (1995) estimator, and the GMM results hold, even though we only have 15 countries. These results (not reported) are available upon request.

Easterly, William, Levine, Ross, 2001. It's not factor accumulation: stylized facts and growth models. World Bank Economic Review 15, 177–219.
Folster, Stefan, Henrekson, Magnus, 1999. Growth and the public sector: a critique of the critics. European Journal of Political Economy 15, 337–358.
Folster, Stefan, Henrekson, Magnus, 2001. Growth effects of government expenditure and taxation in rich countries. European Economic Review 45, 1501–1520.
Ghosh, Sugata, Gregoriou, Andros, 2008. The composition of government spending and growth: is current or capital spending better? Oxford Economic Papers 60, 484–516.
Islam, Nazrul, 1995. Growth empirics: a panel data approach. Quarterly Journal of Economics 110, 1127–1170.
Kiviet, Jan F., 1995. On bias, inconsistency and efficiency of various estimators in dynamic panel data models. Journal of Econometrics 68, 53–78.
Lee, Kevin, Pesaran, M. Hashem, Smith, Ron, 1998. Growth empirics: a panel data approach — a comment. Quarterly Journal of Economics 113, 319–323.
Luintel, Kul B., Khan, Mosahid, 2004. Are international R&D spillovers costly for the US? Review of Economics and Statistics 86, 896–910.
Nijkamp, Peter, Poot, Jacques, 2004. Meta-analysis of the effect of fiscal policies on long-run growth. European Journal of Political Economy 20, 91–124.
Pesaran, M. Hashem, Smith, Ron, 1995. Estimating long-run relationships from dynamic heterogeneous panels. Journal of Econometrics 68, 79–113.
Pesaran, M. Hashem, Haque, Nadeem U., Sharma, Sunil, 2000. Neglected heterogeneity and dynamics in cross country savings. In: Krishnakumar, J., Ronchetti, E. (Eds.), Panel Data Econometrics — Future Directions. In Elsevier Science, pp. 53–82. chapter 3.
Slemrod, Joel, 1995. What do cross-country studies teach about government involvement, prosperity, and economic growth? Brookings Papers on Economic Activity 1995 (2), 373–431.
Temple, Jonathan, 1999. The new growth evidence. Journal of Economic Literature 37, 112–156.