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New Econometric Estimates of Long-term Growth Effects of Different Areas of Public Spending

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ABSTRACT/ RÉSUMÉ

New econometric estimates of long-term growth effects of different areas of public spending

Using panel data for OECD countries, this study investigates the extent to which changes in government spending on education, health and other areas influence long-term growth. The results suggest that, if total government spending is kept unchanged, increasing expenditure on health, education and transport raises long-term GDP growth. In contrast, government spending on housing is found to weaken long-term GDP growth. The error-correction specification used allows assessing adjustment speed which, consistent with intuition, is estimated to be slow. According to the econometric results, it takes more than five years for half of the effect of a change in the structure of government spending to be reflected in long-term growth.

JEL classification codes: H11; H51; H52

Keywords: public spending, government expenditure, public health spending, public education spending, government infrastructure spending, economic growth, long-term growth.

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Nouvelles évaluations économétriques de l'effet à long terme sur la croissance de différentes catégories de dépense publique

Au moyen de données de panel pour les pays de l'OCDE, cette étude examine la manière dont les modifications du niveau des dépenses publiques d'éducation, de santé et dans d'autres domaines influencent la croissance à long terme. Les résultats suggèrent que, pour un niveau donné de dépenses publiques totales, une augmentation des dépenses de santé, d'éducation et de transport augmente la croissance à long terme. À l'inverse, les dépenses publiques de logement semblent affaiblir la croissance à long terme. Le modèle à correction d'erreur employé pour cette étude permet d'évaluer la vitesse d'ajustement qui, conformément à l'intuition, se révèle être lente. D'après les résultats économétriques, il faut compter plus de cinq ans avant que 50% des effets d'un changement de la structure des dépenses publiques ne se fassent sentir dans la croissance à long terme.

JEL classification codes: H11 ; H51 ; H52

Mots-clefs: dépenses publiques, dépenses publiques de santé, dépenses publiques d'éducation, dépenses publiques d'infrastructure, croissance économique, croissance à long terme.

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NEW ECONOMETRIC ESTIMATES OF LONG-TERM GROWTH EFFECTS OF DIFFERENT AREAS OF PUBLIC SPENDING

By Omar Barbiero and Boris Cournède[1]

1. Introduction

1. This paper investigates the long-run effect of public expenditure instruments on growth. It focuses particularly on the effects of government spending on education, health and social policy. Based on approximately 40 years of data for 17 OECD countries, the results point in particular to substantial positive contributions of government expenditure on education and health to long-run potential growth. Other expenditure sub-categories are also investigated, producing estimates broadly in line with past results, in particular a strong positive contribution from government investment.

2. The growth effects of permanent changes in government spending are estimated to take more than ten years to materialise in full. A *caveat* around the estimated effects is that slow adjustment speed made it necessary to use long time series, a requirement which, as in previous studies of the subject, led to using statistics for central rather than general government spending for availability reasons. This focus on central rather than general government may explain the relative fragility of the results especially regarding the growth effect of public education spending since much of this service is provided by local governments in many OECD countries.

3. Following this introduction, the second section presents the econometric specification which is estimated on a database presented in the third section.[2] The fourth section spells out the main results before a final section discusses a number of robustness checks.

2. Econometric specification

4. This study uses the conceptual framework introduced by Barro (1990) distinguishing between productive and non-productive government spending categories and between distortionary and non-distortionary taxes. By entering directly the production function of the economy, productive expenditure and distortionary taxes influence steady-state economic growth. However, evidence on the long-term growth effects of the public sector is still uncertain. In a comprehensive meta-analysis, Nijkamp and Poot (2004) report that, while the impacts of total government consumption or tax rates are weakly identified, the majority of studies confirm the growth-enhancing effect of public spending on education and infrastructure. By comparison, the growth effects of health and social expenditures remain a relatively neglected topic. Two recent studies further investigate growth effects of fiscal policies: Romero-Avila and Strauch (2008) and Gemmell et al. (2011). Using data for European countries, the first paper finds that, while total public spending and government consumption negatively affect GDP growth per capita, public investment has a positive impact. Gemmell et al. (2011) split public spending into two categories,

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1. The authors are research assistant at Bocconi University and senior economist in the OECD Economics Department, respectively. This is one of the background papers for the OECD project on achieving growth- and equity-friendly fiscal consolidation (see Cournède et al., 2013 for the main paper). They are indebted to Antoine Goujard, Álvaro Pina, Oliver Röhn, Alain de Serres and Jean-Luc Schneider for helpful comments and to Caroline Abettan for excellent technical support. The opinions expressed in this paper are the authors' and do not necessarily correspond to those of the OECD or its member countries.

2. Special thanks are expressed to Norman Gemmell, Richard Kneller and Ismael Sanz for sharing the database that served as a basis for the present study.

productive and unproductive, and find that increases in the former enhance growth but that this effect is often counteracted by contemporaneous growth-diminishing tax changes. This finding highlights the importance of controlling for tax movements when assessing the impact of changes in spending. Romero-Avila Strauch (2008) and Gemmell et al. (2011) note that estimation frameworks should allow for changes in the composition of government accounts to have different growth effects in the short and the long run.

5. The present study builds on Gemmell et al. (2009, 2011) but differs in important ways: it estimates effects on potential rather than actual growth, a number of steps are taken to adjust output and expenditure for the cycle, and the original database has been corrected for breaks systematically (see below). More generally the econometric specifications have been tailored to focus on estimating the impact of the variables that correspond to the taxonomy of consolidation instruments used in Cournède, Goujard and Pina (2013). While the estimation strategy includes short-term effects to ensure consistency, the study concentrates on the long-term growth impact of changes in government spending by area.

6. To gauge the impact of public expenditure on output growth in a way that allows focussing on long-term effects, an error-correction equation has been estimated:

$$\Delta^2 y_{it} = \phi_i\left(\Delta y_{i,t-1} - \beta_i x_{i,t-1}\right) + \sum_{j=1}^{p-1} \zeta_{ij}\Delta^2 y_{i,t-j} + \sum_{j=0}^{p-1} \theta_{ij}\Delta x_{i,t-j} + \varepsilon_{it} \qquad \text{(E1)}$$

where i and t represent the country and time period considered. The dependent variable Δy_{it} corresponds to potential output growth, while x_{it} is a vector of government account variables and other controls. In the specification above, β_i can be regarded as the long-run co-integrating parameter between Δy and x, while ζ_{ij} and θ_{ij} are the coefficients that capture the short-term dynamics of the model. The error correction parameter, or adjustment coefficient, ϕ_i measures the speed at which potential growth adjusts after a shock in x.

7. These coefficients could be estimated by averaging different regressions across countries (Mean Group estimation) or by pooling the data after assuming that coefficients and error variances are identical across countries (Dynamic Fixed Effect estimation). The econometric technique used in this paper is an intermediate step between these two called Pooled Mean Group estimation (PMG, introduced by Pesaran et al. (1999). PMG assumes identical long-run coefficients while allowing for cross-country heterogeneity in the short-run coefficients and error variances. This is equivalent to constraining $\beta_i = \beta$ in (E1).

8. Pesaran et al. (1999) quotes many reasons to expect the long-run equilibrium relationships between variables to be similar across groups, due to budget solvency constraints, arbitrage conditions or common technologies influencing all groups in similar way. On the contrary, equality of short-run coefficients is less compelling, especially for the characteristics of the database used in this research and outlined in the following section. Under the assumption of common long-run effects, the PMG method is more efficient than the MG estimator and at the same time allows cross-section heterogeneity in the short term.

9. Following Kneller et al. (1999) and Gemmell et al. (2011), the vector x_{it} includes elements of the government budget constraint as controls. These controls are total spending, less distortionary taxes (consumption taxes) and more distortive sources of revenues. The fiscal balance does not enter the group of controls to avoid collinearity. The level of potential GDP per capita is also included in the long-term relationship to take economic convergence effects into account.

10. The dependent variable used is the growth rate of potential GDP taken from the OECD Economic Outlook No. 86 database.[3] In countries where this database does not provide potential output estimates throughout the sample period (Spain, Finland, Iceland, Luxembourg, Norway, New Zealand and Turkey), an HP–filtered time series (λ=6.25) of GDP volume was computed for the missing period and spliced to the available estimates. The lag order p is chosen so that lags are statistically significant.

3. The data

11. The database is a modified version of the one used and kindly provided by Gemmell et al. (2011). It is based on IMF Government Finance Statistics covering central government expenditures and following the 1986 GFS Manual classification of fiscal variables.

12. The dataset ranges from 1970 to 2008. In the 1973-2007 period, there are almost no missing values for the 17 countries covered: Australia, Austria, Canada, Denmark, Finland, France, Germany, Iceland, Luxembourg, Netherlands, New Zealand, Norway, Spain, Sweden, Turkey, the United Kingdom and the United States.

13. The dataset suffers from several limitations. The most serious one is that, as in Kneller et al. (1999) and Gemmell et al. (2011), the expenditure and revenue accounts refer to the consolidated central government functions only. This is bound to introduce some distortion when the same expenditure function is provided at different levels of government across countries or especially over time. The use of a model specification that allows heterogeneous short-term effects across countries can partly, though not fully, reduce the impact of this limitation of the dataset on estimates. A direct remedy to this issue would be to use data for the general government. However, such data is available only from the mid-1990s or at best the early 1990s in most countries, thereby covering a time span that is too short to identify effects of changes on long-run growth.

14. Another limitation is that in 2001 the GFS Database moved from "cash" to "accrual" accounting. Updating and linking the two classifications might have introduced measurement errors and inaccuracies of unknown magnitude.

15. Finally, sub-aggregates categories of government expenditure reported by Gemmell et al. (2011) exhibit many breaks. The present study addresses this issue by applying remedies to every break that is reported as such in previous GFS manuals and by smoothing out anomalous values in the database (sudden large jumps that are reversed the following year). These corrections were necessary to guarantee that the variation of public expenditure functions was not artificially led by breaks in the series. Appendix Table A1 reports every single change implemented in the database.

4. Results

16. Table 1 shows the long-term percentage change in potential GDP growth from a one per cent of potential GDP increase in public expenditure on a given item. Potential GDP was used as the dependent variable to abstract inasmuch as possible from short-term effects and focus on the long-term implications of fiscal changes. To further reduce the impact of cyclical movements, the controls for total expenditures

3. This database, which provides potential output estimates with a good coverage of the 1970s, has been preferred to more recent versions where potential output series start in 1985.

were taken as shares of spending over potential GDP. However, the controls for revenues were taken as shares of receipts over actual GDP because tax receipts vary substantially with the cycle.[4]

17. Simultaneous effects of shares of education, social protection and health are shown in column (1) of Table 1 in order to assess their interdependence. Column (2) presents instead the estimated long-run effects when instruments are considered individually. The joint estimation reported in Column (1) shows a strongly positive effect of health on long-run potential growth while education has a positive effect that is not statistically significant at usual confidence levels and social protection has an effect that is small and not significant. However, column (2) shows that when taken separately, the effect of the three variables of interest are all positive and significant, especially government spending on education and health. As detailed in the next section, health presents the most robust positive effect while the growth effect of education spending is also very stable when it is estimated simultaneously with the other two variables despite its lack of significance at usual confidence levels.

Table 1. Main results

	(1) Potential GDP	(2) Potential GDP
	Joint effect	Separate effect
Education	0.0179	0.0661***
	(0.0132)	(0.0220)
Social protection	0.0117	0.0180*
	(0.00781)	(0.00988)
Health	0.0592***	0.0343***
	(0.0148)	(0.0104)
Transport and Communication		0.168***
		(0.0347)
General Public Services		0.0875***
		(0.0269)
Housing		-0.205**
		(0.104)
Recreation		0.195
		(0.199)
Number of observations	588	588
Number of countries	17	17

Note: Error correction form as in equation (E1). Regression (1) estimates the three spending instruments simultaneously. Regression (2) estimates every instrument separately. *Dependent variable*: potential GDP. *Included controls* in both regressions are: total outlays relative to potential GDP, less distortionary taxes, other revenues as a percentage of GDP and lagged potential output per head. Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

Sources: Modified Gemmell et al. (2011) Database; *OECD Economic Outlook No. 86. Database*, authors' calculations.

4. Since revenue items have an elasticity to activity that is closer to one than to zero **Invalid source specified.**, their ratio to actual GDP will be less influenced by the cycle than their ratio to potential GDP. In contrast, as the elasticity of spending items to activity is closer to zero than to one, their ratio to potential GDP will be better insulated from cyclical effects than their ratio to actual GDP.

18. As far as the other sub-categories of expenditure are concerned, the results are in line with the previous literature. In particular, public expenditure on transport and communication, a category that provides a good proxy for government investment, has the strongest estimated effect on potential GDP and is statistically significant at the 99.9% confidence level. General and economic services both exhibit significant positive estimated effects on potential growth. In contrast, government spending on housing is estimated to substantially reduce potential GDP growth with high statistical confidence.

19. The estimated effects are small quantitatively. For instance, modifying the composition of government expenditure to allocate an additional per cent of GDP to public-sector education is estimated to raise the rate of potential growth by 0.07 percentage points. Over a long period of time, however, the effects on growth accumulate. With a discount rate of 5%, the net present value of all future estimated output gains from reallocating one per cent of GDP of public spending toward education amounts to 20% of GDP. [5] The estimated effects are quantitatively larger for government spending on transport and communication where the annual impact of a one per cent of GDP reallocation is 0.17 percentage points, which cumulate to a net present value of 56% of initial GDP. All these estimates however rely on the assumption that the quality of spending on a particular area is maintained as its amount increases.

20. Regressions (1) and (2) control for total government outlays and the structure of revenues and for convergence effects by including the lagged level of potential output per capita in the long run equation[6]. The coefficients for total government spending and for less distortionary and other taxation are not displayed for brevity and because they do not represent the focus of this section. However, they are consistent with most of the literature that finds a small negative effect of total government expenditure on growth, even when controlling for the level of taxation.

21. The present set of estimates suggests that effects of changes in government spending on potential growth are felt in full only after considerable time (more than ten years). The adjustment coefficient ϕ_i in Equation E1 is estimated at -0.138 in the regression of column (1) and varies between -0.11 and -0.14 in the regressions summarised in column (2). This means that 50% of the effect of a change in expenditure is felt on average only after five years and 80% only after twelve years. The adjustment coefficients are always significant at the 99.9% confidence level.

5. Robustness checks

22. Table 2 provides a number of robustness checks on the main specification (itself repeated in column 1). The second column checks the consistency of the coefficients when the sample is restricted to a balanced panel for the 1973-2007 period. Column (3) estimates (E1) on the original database provided by Gemmell et al. (2011) in order to check whether the results were driven by the modifications explained in the appendix table. The fourth column implements a model with two lags (whereas the main specification uses one lag because higher-order lags are not significant). The last two columns assess robustness to adding or dropping some controls.

5. For government spending on health, the impact on potential growth of a similar one per cent of GDP reallocation is 0.03 percentage points, and the net present value of future gains is 12% of GDP.

6. This is equivalent to imposing a zero value on the short term coefficient ($\theta_{ij}^{GDP\ per\ head} = 0$) in equation (E1).

Table 2. Robustness checks

	(1) Main	(2) 1973-2007	(3) Original DB	(4) Two lags	(5) Controls	(6) Controls
Education	0.0179	0.0196	0.0145	0.0302**	0.0143***	0.00765
	(0.0132)	(0.0134)	(0.0133)	(0.0134)	(0.0199)	(0.0129)
Social Protection	0.0117	0.0139*	0.0124	0.00842	-0.0151	-0.00685
	(0.00781)	(0.00792)	(0.00811)	(0.00843)	(0.00974)	(0.00722)
Health	0.0592***	0.0625***	0.0555***	0.0254*	0.0308*	0.0404***
	(0.0148)	(0.0152)	(0.0142)	(0.0132)	(0.0175)	(0.0103)
Employment growth	-	-	-	-	0.349***	-
Potential GDP per head	-0.0556***	-0.0643***	-0.0506***	-0.0526	0.0142	-
	(0.0196)	(0.0203)	(0.0192)	(0.0119)	(0.0145)	
Observations	588	580	588	571	588	588

Note: One-lag error correction form as in equation (E1). All regressions estimate the three spending instruments simultaneously. *Dependent variable*: potential GDP. *Included controls* in all regressions are: total outlays, less distortionary taxes and other revenues as a percentage of potential GDP. Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

Source: Modified Gemmell et al. (2011) Database; *OECD Economic Outlook No. 86 Database*, authors' calculations.

23. The coefficient on health appears to be the most robust across these different specifications. Despite not being significant at usual statistical confidence levels, the coefficient on education is robust in size and sign across specifications, with the exception of dropping the control for convergence. The coefficient on social protection, which is not significant in the main specification, is quite variable across robustness checks.

24. The relative fragility of some results may be due to a number of factors. First, potential growth is influenced by the volume and quality of relevant public services, but the coefficients are estimated on the value of inputs that governments spend to provide these services. The efficiency with which governments transform inputs into outputs is a critical driver of their growth impact which is not controlled for in the present framework. Another important limitation is the scope of the expenditure database used, which is restricted to the central government (see section on data above). Besides, expenditure items evolve fairly smoothly over time, especially in the modified dataset that removes breaks, so that there is limited variability in the time dimension. Furthermore, despite the use of potential GDP as a dependent variable and denominator for expenditure items, some cyclical variation may remain in the sample, especially for social protection expenditure, which includes unemployment benefits.[7] Some noise is also likely to be present in the dataset due to changes in the definition or collection of government statistics.

7. An attempt was made at adjusting social protection for the cycle but proved unworkable at this level. The lack of data for *central* government spending on unemployment benefits precluded a way of adjusting social protection at a higher level of disaggregation.

6. Conclusions

25. The results emphasis that the composition of public spending matters for growth. For a given level of total expenditure, greater spending on education, health or transport infrastructure appears to support long-term growth while more spending on housing seems to reduce it. Nevertheless, the assessment of the effects is surrounded by substantial uncertainty. This largely stems from limitations of the available data which only cover the central level, rather than the whole, of government. Another factor behind the uncertainty is that the impact of each public spending category on growth does not depend solely from its amount but also very importantly from the degree of efficiency with which the government provides its services.

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APPENDIX

Table A1. List of changes on Gemmell et al. (2011) updated database

Country	Years	Variable	Treatment
Austria	1984/1988	Housing	Smoothing
Canada	1987/1988	Recreation	Backcasting and splicing
Finland	1990/1991	Health	Backcasting and splicing
France	1983/1986	Health	Smoothing
France	1992/1995	Health	Smoothing
France	1983/1986	Social Protection	Smoothing
France	1992/1994	Transp. & Comm.	Forecasting and splicing
France	1992/1993	Economic Services	Forecasting and splicing
France	1983*1984	Housing	Backcasting and splicing
Germany	1989/1992	General Public Services	Smoothing
Spain	1989/90	Health	Backcasting and splicing
Spain	1983/84	Health	Backcasting and splicing
Sweden	1992/1995	Economic Services	Smoothing
Turkey	1972	Recreation	Missing reintroduced
Turkey	1996/1997	General Public Services	Forecasting and splicing

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