E C O N O M I C S B U L L E T I N

ESTIMATING SPENDING NEEDS IN FEDERAL COUNTRIES: A METHODOLOGICAL SUGGESTION

Santiago Lago-Peñas
REDE and University of Vigo

Abstract

Differences in local or regional public spending needs are a serious concern in many countries, boosting the implementation of equalization grants. In order to quantify the amount of grants, assessments of spending needs are needed. One standard technical approach is to rely on econometric estimates of equations in which the dependent variable is spending on the different services and the set of explanatory variables contains both proxies standing in for factors determining spending needs and also control variables. While this is a sound methodology, usual panel data estimators may be biased due to the low within-variation of some observed and unobserved variables. This short paper shows this potential problem and makes a methodological suggestion to overcome it: the use of a new estimator for panel data with time-invariant regressors.

Citation: Lago-Peñas, Santiago, (2008) "ESTIMATING SPENDING NEEDS IN FEDERAL COUNTRIES: A METHODOLOGICAL SUGGESTION." *Economics Bulletin,* Vol. 8, No. 4 pp. 1-5
Submitted: June 27, 2008. **Accepted:** July 16, 2008.
URL: http://economicsbulletin.vanderbilt.edu/2008/volume8/EB-08H70011A.pdf

1. Introduction

Fiscal equalization is a key issue in federal countries[1]. Regional disparities in fiscal capacities or spending needs claim for the design of an equalization grants system based on estimates of those disparities. Measuring differences in tax capacities (tax bases) uses to be easier than estimating differences in spending needs. The most usual technical approach in this second case is to rely on econometric estimates of equations in which the dependent variable is spending on service j and the set of explanatory variables contains both proxies standing in for factors determining spending needs and also control variables[2]. While this is a sound methodology, usual panel data estimators may be biased due to the low within-variation of some observed and unobserved variables. This short paper shows this potential problem and makes a methodological suggestion to overcome it.

2. The problem

Per capita public spending on a given service in a given region can be decomposed as follows (Castells and Solé, 2000):

$$\frac{S}{P} = u \cdot o \cdot i \cdot e; \quad u = \frac{U}{P}, \; o = \frac{O}{U}, \; i = \frac{I}{O}, \; a = \frac{S}{I} \qquad (1)$$

where S is public spending, P the population, U the number of users, I the total input and O the total amount of the service that is provided (output); u is the proportion of the

[1] In fact, the problem is present in all countries insofar as those differences also may affect local governments.

[2] Among others, this approach has been used for Spain by Bosch and Escribano (1988), for the United Kingdom by Bramley (1990), for the United States by Ladd (1994), and for Canada by Shah (1996). An alternative approach is followed in Australia. Differences in spending needs and cost are evaluated in great detail by the Commonwealth Grants Commission using several methods (Williams, 1995)

population that uses the service, *o* the service provision per user, *i* the input required for each unit of service provided, and *a* the average unit cost of inputs.

Equalization of inter-regional differences in per capita spending is only legitimate if higher spending is due to the percentage of the population who are users (*u*) being larger, to average inputs cost (*a*) being higher, or to productivity (*i*) being lower because of factors outside the control of the regional government, such as scale costs due to the population being smaller or more disperse. On the contrary, differences in per capita spending due to differences in preferences or efficiency in management should not be compensated.

Let us consider two regions (1 and 2) with the same population. In both regions identical individuals derive utility from net personal revenue $y(1-t)$ –where *y* is revenue and *t* is the tax rate- and from a local public service (*g*) according to the following utility function for region i:

$$U_i\left(y_i \cdot [1-t_i],\ g_i\right)$$

The public service does not affect productivity and tax bases. Assuming a constant marginal cost of *g*, government budget constraint is:

$$c_i \cdot g_i = t_i \cdot y_i + s_i$$

where *c* is the unitary cost of *g*, and *s* are the intergovernmental grants received. Then, regional governments choose *t* and *g* to maximize the utility level of individuals. Maximizing the expression with respect to both variables yields the following condition:

$$\left|\frac{U_i'(t_i)}{U_i'(g_i)}\right| = \frac{y_i}{c_i}$$

The optimal levels of spending ($g*_1$ and $g*_2$) and taxes ($t*_1$ and $t*_2$) will be the same when $c_1 = c_2$; $y_1 = y_2$; $s_1 = s_2$; U_1 (•)=U_2 (•). Hence, divergences in regional public choices are explained by differences in marginal costs and in tax bases, but also by differences in preferences or efficiency. However, controlling the influence of the latter in econometric estimates is not easy, insofar as they use to be unobserved variables.

If we work with panel data with a fairly small time span, one possibility might seem to be the inclusion of individual effects; for if the preferences and efficiency of the administration change relatively slowly then their influence can largely be treated as such. Note, however, that some of the variables usually employed in econometric estimates to represent differences in costs or needs (e.g. population, or demographic structure) also vary in time very much less markedly than between regions; or indeed do not change (area). This can cause multicollinearity problems if the individual effects modeling preferences and efficiency are treated as fixed. Let be x an explanatory variable with very small within-group variability and d_i a set of regional dummy variables accounting for individual fixed effects, each of which is unity for observations of x for the corresponding region and zero otherwise. Then x is very highly correlated with $\sum_i d_i \cdot \bar{x}_i$, where $\bar{x}_i$ is the sample mean of x in region i. As pointed out by Beck (2001), there is a trade-off between the gains in precision from using individual fixed-effects against the cost of not being able to asses the effect of time-invariant or rarely changing variables.

This multicollinearity problem does not arise if the individual effects are modeled as random instead of fixed. But it requires to make the very often untenable assumption that the individual effects are uncorrelated with the other independent variables.

In this point, we should test whether we really do need to take inter-regional differences in preferences and efficiency into account. Some light may be shed on this question by some simple simulations with cross-sectional data.

Consider a 20-region nation in which regional spending needs *S* depend exclusively on a single variable, *x* (e.g. area, or population). If all regions have the same preferences, the same budget and the same efficiency in management, then there is perfect correlation between *S* and *x*: if both are expressed as percentages of their means and standardized, both variables have the same values and if *S* is then regressed on *x* ($S^* = \beta \cdot x$), R^2 and the slope β are both unity. Now represent proportional deviations in efficiency and preferences by random variables z_1 and z_2, so that actual spending S^* is given by $S^* = S \cdot z_1 \cdot z_2$ and assume that *x* (and *S*) has a normal distribution with mean 100 and standard deviation σ, and that z_1 and z_2 have normal distributions with mean 1 and standard deviation σ'. While *S* would be the spending needed to provide a standard level of public services in region i, S^* would be the spending observed and hence used in econometric studies with real data.

Then examples of four different situations are obtained by generating 100 samples (20-member each one) of N(100,σ) for σ = 1, 5, and 200 samples of N(1,σ') for σ' = 0.01 and 0.05. These samples are used to calculate corresponding samples of (S^*, *x*), and then estimating the equation $S^* = \beta \cdot x$ in each case. Table 1 shows that the mistake in the estimate of β -the deviation from unity- increases both with increasing inter-regional uniformity in x and with increasing heterogeneity of preferences and efficiency.

It may be concluded that inter-regional differences in preferences and efficiency might only be confidently ignored in econometric estimates if such differences are proportionately very small compared to inter-regional heterogeneity in spending needs.

Table 1. Mean and standard deviation (in parenthesis) of the Parameter β for various combinations of σ and σ'. 100 Regressions have been estimated in each case

	$\sigma = 1$	$\sigma = 5$
$\sigma' = 0.01$	1.00 (0.29)	0.99 (0.07)
$\sigma' = 0.05$	1.11 (1.48)	0.96 (0.31)

3. A suggestion

A solution to this problem to be explored in future works is the use of the three-stage estimator recently proposed by Plümper and Troeger (2005 and 2007). This estimator, called *xtfevd*, allows to simultaneously include time-invariant variables and individual fixed effects. Moreover, according to simulations carried up by authors, *xtfevd* outperforms the standard fixed effects model if the within variance of rarely changing variables is small and the between variance significantly larger. By using this estimator, the effect of four kind of variables may be simultaneously estimated when individual effects are not orthogonal to explanatory variables and random effects must be discarded: i)variables with a significant within-variation (e.g. per capita income), ii) rarely changing variables (e.g. population density), iii) observed time-invariant variables (e.g. area), and iv) unobserved time-invariant variables (e.g. preferences).

REFERENCES

-Beck, N. (2001) “Time-Series Cross-Section Data: What have We Learned in the Last Few Years?” *Annual Review of Political Science* **4**, 271-293.

-Bosch, A. and C. Escribano (1988) "Regional Allocation of Public Funds: An Evaluation Index" *Environment and Planning C. Government and Policy* **20**, 1323-1333.

-Bramley, G. (1990) *Equalization Grants and Local Expenditure Needs*, Aldershot: Avebury.

-Ladd, H.F. (1994) “Measuring Disparities in the Fiscal Condition of Local Governments” in *Fiscal Equalization for State and Local Government Finance* by J.E. Anderson, Ed., Praeger Publishers: Wesport, 21-55.

-Castells, A. and A. Solé, (2000) *Cuantificación de las necesidades de gasto de las Comunidades Autónomas: metodología y aplicación práctica*, IEF: Madrid.

-Plumpër, T. and V. Troger (2005) “The Estimation of Time-Invariant Variables in Panel Analyses with Unit Fixed Effects”, (http://www.allacademic.com/meta/p40221_index.html).

-Plumpër, T. and V. Troger (2007) “Efficient Estimation of Rarely Changing Variables in Fixed Effects Models” *Political Analysis* **15**,124-139.

-Shah, A. (1996) "A Fiscal Need Approach to Equalization" *Canadian Public Policy* **22(2)**, 99-115.

-Williams, R. (1995) “State Government Expenditure in a Federal System: Cost and Revenue Equalization Effects in Australia” *Applied Economics* **27**, 139-146.