

## Referee report

### Review

This article studies tax effort in the Spanish regions during the period 2002-2012. The paper uses the Stochastic Frontier Approach (SFA), which is a method that applies a maximum likelihood technique to estimate a stochastic tax frontier. Authors argue that the SFA approach allows them to estimate the tax capacity of regions (or the maximum tax revenue that it could obtain with a set of tax bases and tax rates). Hence, the SFA estimate becomes a benchmark of “best results” that can lead to a comparative analysis of tax effort of some regions of interest.

In their approach, authors estimate a model in which the dependent variable is tax revenue for each region and the independent variables include income, population, regional dummies, stock of private capital, expenditure on regional gambling and a set of explanatory variables to explain tax effort such as political variables, population growth, per capita revenue from own taxes, per capita income from transfers from the central government, per capita current spending, etc. Finally authors include a robustness check by estimating an additional regression with robust errors using a model proposed by Driscoll and Kraay (1998).

The main findings of the paper are the following: first, an estimate of the tax effort for the Spanish regions in the period 2002-2012. This exercise is worthwhile for the purpose of public policy design. Besides, most papers have focused on tax revenue from the central government, and there are few applications of this analysis to subnational governments. Second, the analysis extends the explanatory hypotheses of tax revenue, by including specific indicators of tax capacity, in particular, they include political, budget, demographic factors and the economic cycle to control for unobserved heterogeneity.

This is an interesting paper for students of public economics with potentially significant applications for the design of subnational public policy and fiscal federalism. The novelty of the paper is the application of the SFA technique to the estimates of sub-national tax revenue. However, the paper is difficult to read due to lack of proper definitions of many variables, and some parts of the text are confusing. More importantly, the estimates suffer from endogeneity, which I explain in detail in the following page. The problem of endogeneity means that the present estimates are biased and the inference of the paper is not fully credible.

In your letter of invitation to review the paper, I was invited to answer two basic questions related with the paper; (i) Is the contribution of the paper potentially significant? My answer is yes (I explained why in the text above) and (ii) Is the analysis correct? In this case, my opinion is that, because many variables used in the regression analysis are endogenous, the analysis does not seem correct to me. Based on the relative merits and shortcomings of the paper, my recommendation is to accept the paper only if authors can solve the issues raised in this review .

## Further Comments:

### On Issues of Style

- The paper is, in general, well written. However, many variables are not well explained. Although the variables are defined, the meaning of these variables is not clear. For example, what is the difference between per capita current spending NFEXP and per capita financial spending FEXP? Other examples that require a more detailed explanation of the economic meaning are:
  - o Per capita income from transfers. It is not clear to me what is the meaning of this definition.
  - o On page 10 the paper says: "Given that assigned taxes represent approximately 90% of the non-financial revenues of the regions" What is non-financial revenues?
  - o At page 11 the paper says: "This methodology generates robust estimates of tax capacity and can be used when the residuals are nonspherical, and without the need for the sample to be homoscedastic". What is the meaning of sample to be homoscedastic?

### On the Econometric Analysis

- In the identification of the model. It is not well explained why authors use GLS, and the order  $m$  and order  $\alpha$ . A more detailed explanation is required.
- In the context of modern economies, taxes and transfers from the central government to the different regions are important determinants of the ability of subnational governments to collect tax revenue. In the literature this issue has been recognized in the large literature of vertical tax externalities. That is, taxes from the central government affect tax bases of subnational governments and their ability to collect subnational tax revenue. This issue is absent in this paper. Authors should look to incorporate this issue, specially the role of taxation from the central government and its effect on subnational tax bases and consequently on subnational tax revenue, in their analysis.
- It seems to me that there is an endogeneity problem of the models estimated in table 2. Clearly, tax revenue depends on gross domestic product (in the paper this is called income) and gross domestic product must be affected by the collection of tax revenue. Here the endogeneity problem that biases estimates and the probability distributions of the estimators, which in turn, affects the inference of the econometric model.
- Moreover, in the context of sub national governments, individuals might choose their location of residence based on tax and spending decisions of sub national governments. Therefore, sub national tax revenue is likely to affect population and/or population growth and the analysis shown in this paper demonstrates that population affects sub national tax revenue. Again, we have a potential problem of simultaneity between these variables and therefore endogeneity.
- There could also be endogeneity in the political variables considered in the model. Tax rates and tax revenue might affect the electoral prospects of parties(candidates) (whether a left or right party wins local elections) and the type of government in power might affect the tax structure and tax revenue of subnational governments. A growing body of international evidence shows that taxation

and spending are important determinants of the share of the vote of parties and therefore the identity of the party in government.

- In the context of fiscal federalism, grants received by subnational governments might be contingent to tax effort. Therefore, tax revenue of sub national governments might depend on grants and grants might depend on tax revenue. Again we have a potential problem of simultaneity between these variables and therefore endogeneity.
- The simultaneity problem might also arise between the variables of tax revenue and per capita current spending (the NFEXP variable). Tax revenue affects government spending and the local spending of sub national governments affect tax revenue.