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IS THERE A CONNECTION BETWEEN THE TAX ADMINISTRATION AND THE POLITICAL POWER?*

Alejandro Esteller-Moré (UB & IEB)
aesteller@ub.edu

Address for correspondence:
Alejandro Esteller-Moré
Institut d'Economia de Barcelona (IEB)
Parc Científic de Barcelona
Edifici Florensa
C/Adolf Florensa, s/n
08028-Barcelona (Spain)

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Abstract: This paper offers empirical evidence from Spain of a connection between the tax administration and the political power. Firstly, the regional tax administration is not immune to the budgetary situation of regional government, and tends to exert a greater (or lesser) effort in tax collection the greater (or lower) the (expected) public deficit. At the same time, the system of unconditional grants from the central layer of government provokes an "income effect" which disincentivises the efforts of the tax administration. Secondly, these efforts also decrease when the margin to lose a parliamentary seat in an electoral district is cut, although the importance of this disincentive decreases according to the parliamentary strength of the incumbent.

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1. Introduction

There is no consensus in the relatively scarce literature on public finance and tax administration about how the objective function of a tax administration should be characterised (see Shoup, 1969; or, for a recent review, Slemrod and Yitzhaki, 2000). The most common approach considers it to be a public agency which attempts to maximise the amount of gross tax revenue collected[1]. However, some empirical papers have shown that the efforts made by a tax administration are also guided by electoral concerns (Hunter and Nelson, 1995; or, more recently, Young et al., 2001) and, in the case of the sub-central tax administrations, conditioned by the system of unconditional grants (Jha et al., 1999; Baretti et al., 2002). This paper aims to test several hypotheses concerning the political determinants of the activities of the regional tax administration in Spain, in contrast to previous papers which have only tested one connection at a time.

First, we check whether there is a link between the tax administration and the public budget, or whether the tax administration is simply a "black box" that - irrespective of the "health" of public finances, which are under the direct control of politicians (i.e., the Finance Ministry) - aims to obtain as much tax revenue as possible from taxpayers[2]. Thus, for instance, we test whether the tax administration exerts a greater effort in collecting taxes when the (expected) public deficit is greater, and vice versa. Second, we analyse whether those efforts depend on the political strength of government in the regional parliament *and* electoral competitiveness in each electoral district (or province). According

[1] According to Slemrod and Yitzhaki (1987), this rule – which in equilibrium implies equality between marginal cost and marginal benefit - will not be optimal, as while the former is a real cost, the latter is simply a transfer from the taxpayer to the tax administration. That objective function would only be optimal as long as the tax administration operates given a level of inputs (Andreoni et al., 1998; Slemrod and Yitzhaki, 2000).

[2] In this sense, the spirit of the present analysis is also very close to Toma and Toma's (1986) framework, in which "... the tax rates [emerge]... as a consequence of competition among political actors in the legislative arena. Once this structure has been established, a separate government body, the treasury, will devote resources toward the collection of revenue. The question of relevance then becomes how treasury bureaucrats will vary their collection activity in response to changes in the legislative determined tax rate" (pp. 141-142). However, there are two differences between the present approach and that of Toma and Toma (1986): firstly, in their paper the reaction is only caused by the variation in statutory tax parameters, while we consider any source of budgetary shock (e.g., an increase in the cost or the demand of provision of public goods); and secondly, in Toma and Toma (1986) the influence of politicians on bureaucrats is only due to an appropriation process by the latter, while we do not make explicit the source of connection between these two actors.

to this hypothesis of "electoral competition", we would expect to see less effort in those electoral districts where the margin for winning or losing a parliamentary seat is smaller, although *a priori* such an incentive should be less important the greater the parliamentary strength of the incumbent (e.g., measured through her percentage of seats in the regional parliament)[3].

The empirical validation of either of these two hypotheses would confirm the connection between the tax administration and the political power, though each one of them embodies totally different normative implications. In the first case, the tax administration becomes an extra tax instrument - apart from statutory tax parameters - for the government, and is used in order to obtain additional tax revenues (and so meet the constituency expenditure needs); therefore, it must increase the overall efficiency of the tax system (Slemrod, 1990). In the second case, however, there would be less overall efficiency (and inter-provincial equity) since the efforts of the tax administration are simply guided by electoral motives.

These hypotheses are tested through an empirical analysis based on the estimation of stochastic frontiers (Aigner et al., 1977; Meeusen and van den Broeck, 1977), and a frontier function is obtained from the estimation of a tax revenue function. The fact that certain observations lie below the frontier may be due either to an estimation error or to inefficiency on the part of the tax administration (i.e., less effort in tax collection). This technique disentangles both effects. Thus, we aim to identify which factors explain the distance of each decision unit to the frontier (what is known as the *inefficiency effects model*) by applying the methodology developed by Battese and Coelli (1995) to a panel of

[3] Among other studies that have tested the importance of the marginal "electoral productivity" by district in the design of public policies, see Wallis (1996), for the distribution of federal grants to the US states; Case (2001), who tests the political criteria that guide the allocation of block grants from federal to sub-federal layers of government in Albania; Castells and Solé-Ollé (2002), for the allocation of national investment across Spanish regions; Garrett and Sobel (2002), who test the presidential influence on the rate of disaster declaration and the allocation of emergency funds across US states; Besley and Burgess (2002), Besley and Case (2002), or Besley and Preston (2002), all of whom show that the responsiveness of government is greater the greater the electoral competition; or Young et al. (2001) - already cited in the main text – who test whether the tax audit probability by district depends on the electoral importance of that district to the president. Certainly, all these studies show the importance of electoral motives for the design of public policies, though the measurement of "electoral competition" differs in each case according to the way in which regional representatives are elected to the national assembly. This has to be appropriately dealt with in our analysis, given the multi-party system prevailing in Spain (unlike the US system, where most of the cited studies have been applied) and the functioning of the d'Hondt formula to transform the votes obtained in a district into seats in the regional parliament.

data. This methodology has already been used in another paper to study the behaviour of the tax administration (Jha et al., 1999).

The empirical analysis is based on the behaviour of the Spanish tax administration at the regional level (in Spanish, *Comunidades Autónomas*, CA's). However, in order to enlarge the database, each province (or in political terminology, electoral district) of a CA is considered as a decision unit in the analysis. In Spain, the CA's have the power to administer certain taxes ceded by central government at the beginning of the 1980's, while their right to vary their statutory tax parameters has been null, at least prior to 1997. This institutional framework seems especially suitable for the analysis of the hypothesis of "electoral competition", since given the null fiscal responsibility in setting statutory tax parameters by regional governments, we expect a greater importance of this hypothesis than in the US case - which has been the case analysed in the papers previously cited - where state governments can also react by modifying statutory tax parameters. Moreover, the importance of the unconditional grants in regional budgets enables us to test the extent to which their relative importance influences efficiency in tax administration (in our case, exclusively through an "income effect"), as Jha et al. (1999) and Baretti et al. (2002) have shown for India and Germany, respectively.

The results obtained suggest a close connection between the political power and the tax administration. Firstly, it was found that the level of efficiency (i.e., the effort in collecting taxes) tends to be greater the greater the level of (expected) public deficit. However, if the level of unconditional grants from central government is high enough (approximately 41% with respect to public expenditure, which is above the average during the period of analysis), efficiency diminishes. Secondly, the tax administration is also guided by electoral concerns, since it tends to decrease its level of efficiency in a district (with the aim of increasing the level of popularity of the incumbent) when the margin for *losing* a parliamentary seat in that district is narrow, while this decrease is lower the higher the political strength of the incumbent in the regional parliament. Thus, there is an interesting asymmetric impact of electoral concerns on tax administration, since "electoral competition" only becomes an important factor with respect to the possibility of losing a parliamentary seat, and not with respect to the possibility of winning an additional one. All these results are quite robust to different specifications of the empirical model, as will be shown.

The remainder of the paper is organised as follows. In the next section, we set up the basic hypotheses concerning the empirical analysis, firstly, with respect to the tax revenue function and then with respect to the determinants of effort in tax administration. In the third section, we describe the empirical methodology and the database constructed for the analysis. Section four presents the results of the empirical estimation, while section five contains some concluding remarks.

2. Characterisation of the process of collecting tax revenue

2.1. *The tax revenue technology*

In this section we will define the "tax technology", as this enables the motives which guide the efforts of the tax administration to be identified. The tax technology - which will later be estimated in the empirical analysis - is a function that translates the inputs of the tax administration (basically, number of tax inspectors and general staff, on the one hand, and stock of capital, on the other), I, the (marginal) statutory tax rate, t, and the tax capacity, B, into the tax revenue collected, T (Mayshar, 1991). However, given the value of these variables, not all potential revenue will presumably be collected, given the presence of tax avoidance and/or evasion[4], S, such that $1 \geq S \geq 0$. Therefore, the tax technology is a function $T(I,t,B,S)$. The main differences from the function originally proposed by Mayshar are that we have distinguished between the inputs of the tax administration and the statutory tax rate, while he includes both factors into just one variable, θ. Furthermore, Mayshar calls S "tax-shielding activity", though he himself shows that it can also be interpreted as the level of tax evasion (Mayshar, 1991, fn. 5).

The literature has identified several factors which might explain tax evasion. Following Andreoni et al. (1998), these can be classified into three main groups: (i) income and tax rates; (ii) demographic and social factors; and (iii) penalties and audit probabilities. However, the expected sign of each one of these variables is not clear-cut, since the results of the theoretical and empirical models do not always coincide (see Andreoni et al., 1998, pp. 838-47, for a detailed discussion of these issues). The classical theoretical models of tax evasion (Allingham and Sandmo, 1972) predict that the greater the audit probability,

[4] See, e.g., Slemrod and Yitzhaki (2000) for a definition of each of these two concepts, though they both have the same consequence: a reduction in the amount of tax revenue collected.

the lower the level of tax evasion, which will also happen in the case of a greater penalty. The same result is obtained with respect to income as long as the taxpayer exhibits decreasing risk aversion with respect to income. Finally, the effect of an increase in the (marginal) tax rate is not obvious, since it depends on an "income effect" (in favour of less tax evasion) and on a "substitution effect" (that promotes more tax evasion). However, if the penalty is proportional to the amount of tax evaded, the "substitution effect" disappears, and so an increase in *t* always promotes more tax compliance (Yitzhaki, 1974). Due to the multiplicity of factors which might exert some influence on the decision to evade taxes, some empirical (and experimental) analyses have also included socio-economic variables such as the level of education, age, race or occupation of the taxpayer (see Andreoni et al., 1998, pp. 840-1).

According to the traditional analysis, the level of tax evasion can therefore be expressed as follows:

$$S = S(\underset{+}{Y}, \underset{-}{t}, \underset{-}{p}, \underset{-}{F}) \qquad [1]$$

where *Y* is the level of income, *p* is the audit probability, and *F* is the penalty proportional to the amount of evaded tax. Indicated below each variable in [1] is the expected sign of the relationship of that variable with respect to *S* according to the traditional analysis. Among the variables included in [1], *p* is the only one that will be at the disposal of the tax administration, since *t* and *F* are established by law[5], while the other variables are exogenous. Finally, note that *S* could be interpreted more broadly. For example, it could be that $S<1$ merely because the tax administration has not carried out a proper assessment of the tax bases, which is very important in the case of wealth taxation (the main tax base in our empirical analysis), or simply because it has not administered diligently enough the tax returns submitted by taxpayers, which would cause a delay in payment (and so *de facto* a reduction in the present value of the tax base). Thus, once *S* is defined in a broader way, other instruments at the disposal of the tax administration - apart from *p* – should also be included in [1]. All these instruments - including *p* - are summarized into a single variable,

[5] Although in certain institutional contexts there might be certain discretionary power on the part of the tax administration in order to negotiate with the tax evader the effective penalty. See, for example, OCDE (1990), Table 11, pp. 57-59.

E, which from now on will refer to the efforts of the tax administration in reducing *S*.

If we insert expression [1] into the function *T*, and given the definition of *E*, we get:

$$T = T(I, t, B, S(Y, t, E, F)) \qquad [2]$$

Defined in this way, the tax technology shows a third difference with respect to the original model of Mayshar (1991). In his model, he does not explicitly differentiate between *I* and the variables at the disposal of the tax administration, *E*. However, in the present paper such a difference is crucial to understanding the empirical framework used, and becomes clear if we suppose that the problem of collecting tax revenue consists of two steps (see Andreoni et al., 1998, pp. 826-827):

1st. A social planner chooses all relevant policy parameters (including the statutory tax rate) and the technical means at the disposal of the tax administration (which include the number of personnel and the stock of capital). Hence, the social planner has chosen *t* and *I*, but also *F* (see fn. 5).

2nd. The tax administration is delegated the responsibility of enforcing the tax obligations of taxpayers through a diligent administration of tax returns, the realisation of tax audits or the proper assessment of tax bases, among other tasks. Thus, the tax administration, given the budget at its disposal, the statutory tax parameters and *F*, chooses *E*.

It is important to bear in mind that the main aim of this paper is to find the variables that explain the behaviour of the tax administration, i.e., those variables that guide the selection of *E*[6]. According to the empirical methodology - which is explained in detail in section 3.1. - both *T* and *S* will (consistently) be estimated. Thus, given the supposedly positive relationship between *S* and *E* (e.g., a greater *p*), and bearing in mind the other variables included in [1], then as long as a positive relationship between the potentially explanatory variables of *E* and *S* is found we will have indirectly shown the influence of the former

[6] Note that our approach not only enables the audit probability, *p*, to be explained, as other papers have done (Hunter and Nelson, 1995; Young et al., 2001), but all the efforts made by the tax administration in collecting tax revenue – including *p* - through the definition of *E*.

group of variables on the choice of E[7]. That is why it is crucial for our empirical analysis to set up certain basic hypotheses concerning the choice of E.

2.2. *The determinants of efforts in tax administration*

All the variables identified as potentially explanatory of E are qualified as *political* in the sense that: (i) they are connected with the "health" or composition of the public budget (from now on, *budget connection*), the responsibility for which falls on a political actor; or (ii) the tax administration is used in order to gain electoral popularity by the incumbent (*electoral competition*); or finally, (iii) the government exerts its influence on the tax administration in order to impose its partisan preferences on the effort put into tax collection (*partisan preferences*).

The hypotheses concerning each one of these three groups of factors that could potentially affect the choice of E are as follows:

(i) *Budget connection*. In the empirical analysis, two different hypotheses with respect to the budget connection are tested:

(i.1) Firstly, whether the government conditions the efforts made by the tax administration according to the "health" of public finances. That is, faced with a negative (positive) shock in public finances, does the tax administration – induced somehow by the political power - react by increasing (or reducing) its efforts in collecting taxes? Note that the negative (positive) shock could be due to a demand of citizens in favour of a higher (lower) level of public goods[8] or, alternatively, to a decrease (increase) in the level of tax bases, maintaining the statutory tax rates, or

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[7] For example, this approach has also been followed by Grossman et al. (1999) in estimating the efficiency of US local government in "producing" local property value, and also employs the methodology proposed by Battese and Coelli. Thus, the authors state that "... such deviations from the maximum value are affected by local governance decisions; these in turn are affected by observable characteristics regarding the level of competition faced by the city and its policymakers" (p. 281). In our case, the "deviations from the maximum value" correspond to S, while those "observable characteristics" are precisely those included as explanatory variables of S.

[8] See Dušek (2002), who very appropriately calls this effect a "demand effect" in the process of tax revenue collection, different from a "technological shock" in the process of generating revenue, or from a "political effect".

to a reduction (increase) of the latter as established in the annual budget, maintaining the level of tax bases[9], or to a combination of all these causes. This hypothesis is tested by using the (expected) public deficit at the beginning of the fiscal year as an explanatory variable, and so it is not possible to discern the cause(s) that has (or have) provoked the financial needs (or surplus).

(i.2) Secondly, the efforts of the tax administration may be affected not only by the "health" of public finances, but also by the composition of the public budget. Thus, we test whether the relative importance of the amount of unconditional grants received by a region from central government provokes an "income effect" that lowers the marginal value of any additional tax revenue collected, to the extent that there is no benefit in the tax administration making additional (costly) efforts (see Jha et al., 1999, for India; and Baretti et al., 2002, for Germany, who also found a "substitution effect" that, in addition to the "income effect", disincentivises the efforts in tax administration).

(ii) *Electoral competition*. It is usually believed that tighter races for political office force the incumbent to be more responsive to constituency needs, due to the higher risk of political defeat[10]. Thus, as long as voters dislike the burden of taxes, the political power - through the tax administration - will be induced, in order to minimise the risk of defeat in an electoral district (plurality system) or of losing/winning a parliamentary seat assigned to a district (proportional system), to reduce the efforts in collecting taxes in those districts where political competition is stronger. Therefore, the key question in testing this hypothesis is how to measure "electoral competition"[11]. All the measures proposed in the literature are based on the assumption that political parties look at past electoral results to get an idea of how tight the next election contest will be (see fn. 10). However, it is self-evident that the way of measuring "electoral competition" depends on the electoral system. In Spain, the selection of regional representatives in the lower house is done according to a

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[9] See Toma and Toma (1986).

[10] Among many others, see on this issue Holbrook and van Dunk (1993), Besley and Case (2002), and the references cited therein. In the first case, the authors offer a review of the main index used to measure "electoral competition".

[11] Besley and Case (2002), p.23, recognise that "there is no unanimously agreed method of measuring this ["electoral competition"]".

proportional system, in which Hondt's law is used to transform provincial votes into seats in the regional assembly[12]. Hence, in order to measure political competition in an electoral district, the most natural way of doing so is to calculate the minimum number of votes the incumbent should lose (win) in order to lose (obtain) one additional seat in the regional parliament (see the Appendix for a description of this calculation). This is what we call "district competition": the narrower the margin, the higher the electoral competition in that district. However, such a marginal loss (gain) will be relevant to the incumbent depending on her strength in the regional parliament. For example, if the margin to lose a seat in a certain electoral district is very small, but the government has a "comfortable" majority in the regional parliament, such a loss will be less important than when the seat is crucial to obtain a majority in parliament. This second factor is termed "parliamentary power". On the whole, we propose to estimate "electoral competition" as follows:

$$\text{Electoral Competition} = \underset{+}{\text{District Competition}} * \underset{-}{\text{Parliamentary Power}} \qquad [3]$$

Thus, the measure of "electoral competition" is a combination of two factors, which tend to vanish with each other. Later, in the empirical section, other measures of "electoral competition" are also tested, although they are all based on [3].

(iii) *Partisan preferences*. Given that the efforts in tax administration eventually influence the effective tax burden borne by citizens, it seems reasonable to assume that governments – as long as they are connected with the tax administration - will condition such efforts in order to determine the final weight of the public sector in the economy. As usual, if we distinguish between "leftist" and "rightist" governments, it is expected that the former tend to exert a relatively higher level of effort in tax administration, and so obtain a higher level of tax revenues (see Franzese, 2002, for a recent and complete review of the main theories and empirical results concerning the partisan motivations of governments).

[12] For an introduction to the Spanish electoral system, see Astorkia (1998).

3. Empirical methodology and data

3.1. *Empirical methodology*

The methodology used to estimate [2] is based on that of Battese and Coelli (1995)[13]. This methodology enables a stochastic frontier of tax revenue, i.e. the maximum amount of tax revenues that could be collected given, in our case, the (marginal) statutory tax rate, *t*, the tax capacity, *B*, and the administrative inputs, *I,* to be estimated. The error term obtained from this estimation is decomposed into two parts, the error term of the econometric specification, and what is known as the (technical) inefficiency effect: thus, the technical inefficiency is the difference between the observation of a decision unit and the frontier. Crucially, in our case, the "inefficiency effect" is directly related to *S*, as has been shown in section 2.1, and so it is explained according to the hypothesis set up in section 2.2[14].

The estimated frontier is stochastic, as a decision unit is allowed to be below the frontier due either to a random shock or an error of measurement. However, deterministic techniques do not enable these two components to be distinguished, so biased measures of technical efficiency are usually obtained. Battese and Coelli's methodology is able to overcome the inconsistency that arises when one tries to explain inefficiency through two-step estimation methods (Kumbhakar et al., 1991; and Reifschneider and Stevenson, 1991, were the first to detect this inconsistency).

Briefly, Battese and Coelli's (1995) methodology proposes to estimate the following function for a panel of data[15]:

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[13] See also Coelli et al. (1997).

[14] In fact, although throughout the paper we do not distinguish between tax evasion and technical efficiency, the two measures are not completely identical. This is because technical efficiency measures the *relative* performance of tax administrations in closing the gap between the maximum amount of tax revenue that could be collected and the tax revenue collected, given a level of tax capacity, administrative inputs and statutory tax parameters. Therefore, it may be the case that all (comparable) tax administrations were performing equally badly, and their levels of efficiency were close to 1. In conclusion, other measures should be employed in order to obtain the absolute levels of tax evasion (see for such measures, e.g., Slemrod and Yitzhaki, 2000, pp. 21-23).

[15] The joint estimation of the stochastic tax revenue frontier and the explanatory equation of the inefficiency effects is performed using FRONTIER V. 4.1 software, Coelli (1996).

$$T_{it} = exp(x_{it}\beta + V_{it} - U_{it}) \quad [4]$$

where T_{it} is the amount of tax revenue collected by the tax administration *i* in the period *t;*

x_{it} is a vector of (k*1) values of inputs (in our case, tax capacity and administrative inputs, and the statutory tax rate) and other explanatory variables associated to the unit *i* in the period *t;*

β is a vector of (k*1) unknown values to be estimated;

V_{it} are assumed to be identically- and independently-distributed stochastic errors, with a normal distribution of zero average and an unknown variance, σ_V;

U_{it} are non-negative random variables, associated with technical inefficiency, and are assumed to be independently distributed, such that U_{it} is obtained by truncation (at zero) of the normal distribution with mean $z_{it}\delta$, and variance, σ^2;

z_{it} is a vector of (1*m) explanatory variables associated with the inefficiency of the decision unit over time, among which those variables identified in section 2.2. as potentially explaining the efforts made in the collection of taxes are included;

and, finally, δ is a vector of (1*m) unknown coefficients, to be estimated.

Therefore, from the previous assumptions, technical inefficiency can be specified in the following way:

$$U_{it} = z_{it}\delta + W_{it} \quad [5]$$

where the random variable W_{it} is defined by truncation of the normal distribution, $N(0,\sigma^2)$, at $-z_{it}\delta$, that is, $W_{it} \geq -z_{it}\delta$.

By means of the definition of γ (Battese and Corra, 1977), such that $\gamma = \sigma_u^2 / (\sigma_u^2 + \sigma_v^2)$

and $0 \leq \gamma \leq 1$, it is possible to discern the relative importance of the inefficiency effects versus the estimation error of the stochastic frontier. Hence, if $\gamma = 0$ the observed deviations from the frontier are exclusively due to an error of estimation, and the explanatory variables included in the inefficiency effects model should be included in the estimation of the stochastic frontier; therefore, a traditional panel data analysis is the most adequate econometric technique, not a stochastic frontier model[16].

In the estimation of the stochastic frontier a set of fixed and time effects are also included. The fixed effects aim to pick up certain structural factors concerning the tax capacity of a decision unit, or institutional factors that condition the composition of the administrative inputs, *I*[17]. As long as such structural or institutional factors are correlated with *I*, the exclusion of the fixed effects will produce inconsistent measures of the $\beta' s$ (Mundlak, 1961). The time effects have been included to control for common changes in the statutory tax rates over the period of analysis since, as has been already been pointed out, there were no differences among the CA's with respect to the setting of statutory tax rates during this period. The time effects also control for the existence of common macroeconomic shocks that may have affected the tax capacity of all the decision units, and which have not been precisely captured by the variables being used to measure tax capacity.

In order to control for the effect of statutory tax rates on the decision to evade taxes and on the efforts made by the tax administration (see section 2.1), a set of time effects was also included in the equation of the "inefficiency effects model". Moreover, given that one potentially explanatory variable for technical inefficiency is the (expected) public deficit (see section 2.2., point (i.1)), the time effects may also help to alleviate the likely endogeneity of this variable. Public deficit was not used as an explanatory variable, since the simultaneous relationship is obvious: *ceteris paribus*, the greater the inefficiency, the greater the public deficit, while it is precisely the reverse causality which we want to test. However, having instead included the expected public deficit, there could still be a

[16] The value of γ is obtained through the resolution of an iterative process, like the one generated by the Davidon-Fletcher-Powell algorithm. Thus, given an initial value (where, with the exception of β_0 and σ, the estimates by OLS of β are employed), the iteration process is solved for that value of γ which maximises the likelihood function (Coelli, 1996, pp. 11-12).

[17] Usually, in the literature on the estimation of technical efficiency, the fixed effects are also interpreted as a "management index".

simultaneous relationship if budgetary decisions and decisions about the efforts of the tax administration are simultaneously adopted - which can be rejected if we assume that expectation about the public deficit has been previously taken to the decision over the effort in collecting tax revenue - or if both decisions are affected by the economic cycle (i.e., the expected deficit is negatively affected by the downturn phase of the economic cycle, although it might also be more difficult to collect tax revenue at that moment; see, for a possible justification of this argument, Andreoni, 1992). Especially with respect to this latter situation, the inclusion of time effects becomes a useful instrument for controlling this potential source of simultaneity bias.

Finally, it should be pointed out that the structure of the stochastic frontier used here is similar to that of Hunter and Nelson (1996). They only include administrative inputs (personnel and capital stock) and consider the tax revenue collected from the audit processes as the only output of a tax administration. However, having chosen that input would, in our case, have made it difficult to evaluate the relative efficiency of each decision unit unless we had very accurately controlled for the voluntary compliance of taxpayers. Failure to do so could have meant that a decision unit obtained no flow of revenue from the tax audit processes, and in consequence was negatively evaluated in terms of technical efficiency, while voluntary compliance was close to 100%. This, among other reasons, is why total revenue collected was chosen as the input of the tax administration.

3.2. *Data*

Most of the data employed in the analysis have been obtained from the information that appears annually in the Spanish National Budget (*Presupuestos Generales del Estado*, PGE) as an appendix, under the title "Report on the cession of taxes to the CA's". The production of these reports is mandatory under Act 14/1996, 30th December, which regulates the cession of taxes from central government to the CA's[18]. In particular, the information obtained from such reports was as follows:

[18] The taxes administered by the CA's are known as "ceded" as they originally belong to central government, but were then ceded to the CA's (the first cession occurred in 1982, for Catalonia).

• *Tax revenue collected from the taxes administered by each CA*: Net Wealth Tax; Wealth Transmission Tax (intervivos and mortis causa); a tax on certain business operations ("Impuesto sobre Transmisiones Patrimoniales y Actos Jurídicos Documentados"); and taxes on gambling (except in the Balearic Islands and Cantabria, to whom such competence has not been transferred[19]). During the period of analysis, these taxes represented slightly less than 15% of all the budgetary revenues of the CA's. Table 1 shows the relative importance of each one of these taxes for the fiscal year 1998. The amount of collected tax revenue corresponds to effective collected tax revenue, not provisional or forecasted, and includes both the revenue collected through the CA's own offices ("oficinas gestoras") and through offices that do not directly depend on each CA ("oficinas liquidadoras"). From now on, we will call this latter type of office "external offices".

[INSERT TABLE 1]

• *Inputs of the Tax Administration*: number of personnel (tax inspectors and other staff); stock of computers; and m^2 of offices exclusively given over to the tasks of tax administration.

• *Explanatory variables of the inefficiency of the Tax Administration*: percentage of returns submitted through the "external offices"; and, secondly, concentration of tax bases (calculated as the total amount of collected tax revenue divided by the total number of tax returns, excluding taxes on gambling). In the former, this variable was included in order to control for this institutional factor which might affect the level of efficiency, without any previous idea about its sign. In any case, there is a suggestion that the high turnover of managers in these "external offices" and their low incentives to collect tax revenue might cause some inefficiency in the process of tax collection. In the latter, it would be expected that the greater the concentration of tax bases, the greater the level of efficiency, due to the greater profitability by tax return.

The reports are published with a delay of two years: for instance, the budget for the year 2000 contained the report for the fiscal year 1998. The reports used to construct our

[19] Therefore, this is a typical institutional factor that must be controlled for by the fixed effects.

database correspond to the years 2000 (1998), 1999 (1997), 1998 (1996), 1997 (1995) and 1994 (1992). Thus, the analysis consists of 225 observations (45 provinces were included in the database, while Madrid was excluded from the analysis as it has only very recently started to administer its ceded taxes, and still does not administer the Net Wealth Tax).

The remaining variables were obtained from the following statistical sources:

• *Gross Domestic Product* (GDP) and *Capitalisation of the Returns of Capital* (W)*:* from *National Income of Spain and its Provincial Distribution* (Volume II), BBV, for all the years. As there are no official statistics about the wealth of a region/province (apart from real state property, what is known as the "valor catastral" (VC), which is measured by a National Agency), an approximation to the wealth of each province was calculated by capitalising the provincial returns on capital according to the national interest rate of the corresponding year (source: Bank of Spain).

• *Amount of unconditional transfers received by the CA as a percentage of total expenditure:* this amount of funds consists of a share in the total amount of national tax revenue based on expenditure needs ("Participación en los Impuestos del Estado", PIE), and a territorial share in personal income tax (since 1995), both of these being sources of tax revenue collected by central government. This information was obtained from the *Informe Económico-Financiero de las Administraciones Territoriales* (a report produced by the Ministry of Public Administration), for several years.

• *Public deficit:* the public deficit was calculated as a percentage of the regional GDP, and is the expected deficit that appears in the regional budget at the beginning of the fiscal year. This information was also obtained from the *Informe Económico-Financiero de las Administraciones Territoriales*, op. cit. Note that both this variable and the amount of unconditional transfers are common to all the provinces of a region.

• *Political variables:* using the *Anuario de El País*, for several years, we differentiated - by means of a dummy variable - between regional leftist governments (=1) and rightist ones (=0); all the data necessary to construct the variable “electoral competition” were also obtained from this source (see Appendix).

All the monetary magnitudes were transformed into constant prices of the year 1995 using the national consumer price index (source: National Institute of Statistics, INE). Table 2 provides some descriptive statistics of all the data.

[INSERT TABLE 2]

In addition to the political variables described in section 2.2., which aim to explain *E*, the following variables were also included: the GDP p.c. to control for its supposedly positive relationship with *S* according to the traditional theoretical models of tax evasion (see section 2.1), the "concentration of tax bases", the percentage of tax returns submitted through the "external offices", and the time effects. According to the literature cited in section 2.1, some "socio-economic variables" could also have been included. However, given that the ceded taxes do not affect all citizens (e.g., the transmission of wealth is clearly a non-periodical tax, while wealth tax only affects very rich people), the inclusion of socio-economic variables (such as level of education or age) might have given a misleading picture of the group of taxpayers. Furthermore, other types of variable, such as the composition of the tax bases (e.g., percentage of the tax bases that are financial capital or real state property), are simply not available. In any case, we do not believe that the exclusion of these variables biases the estimates of the other variables, provided we do not expect a serious correlation between the variables included and those omitted. The paper by Jha et al. (1999) – which employs the same econometric technique - did not include this group of variables either.

Before describing the empirical results, let us consider the equations to be empirically estimated:

$$ln(T_{it}) = \beta_1\, ln(Offices_{it}) + \beta_2\, ln(Computers_{it}) + \beta_3\, ln(Tax\ Inspectors_{it}) + \beta_4\, ln(General\ Staff_{it}) +$$

$$+ \beta_5\, ln(GDP_{it}) + \beta_6\, ln(W_{it}) + \beta_7\, ln(VC_{it}) + F_i + z_t + (v_{it} - u_{it}) \qquad [6]$$

This is the equation of the stochastic frontier (equation [4]), where the endogenous variable is the amount of tax revenue collected by the province *i* in *t*, T_{it}. The first row includes the four administrative inputs, while the second shows the variables picking up tax capacity

(GDP, W and VC), the fixed and time effects, F_i and z_t, respectively, v_{it}, the estimation error and finally u_{it}, the technical inefficiency. From this basic equation, the elasticities of the inputs are allowed to vary over time, and so an interaction between each explanatory variable and a time trend is included.

The equation attempting to explain technical inefficiency (equation [5]) is as follows:

$$u_{it} = (\alpha_1 Def_{it} + \alpha_2 Def_{it}^2) + (\alpha_3 Transfers_{it} + \alpha_4 Transfers_{it}^2) +$$
$$+\alpha_5 Votes(L)_{it} + \alpha_6 \left[Votes(L) * \%Seats\right]_{it} + \alpha_7 Votes(W)_{it} + \alpha_8 \left[Votes(W) * \%Seats\right]_{it} + \alpha_9 Left_{it} +$$
$$+\alpha_{10} GDPp.c._{it} + \alpha_{11} (Tax\ Base\ Concentration)_{it} + \alpha_{12} (External\ Offices)_{it} + z_t + \alpha_0 + w_{it} \quad [7]$$

The first row includes the variables concerning the "budget connection", that is, the (expected) public deficit in relation to the regional GDP and the amount of unconditional grants in relation to regional public expenditure. They were both introduced squared in order to test whether their relationship with technical inefficiency is non-linear. The second row contains the variables included in order to check the empirical relevance of the "electoral competition" hypothesis, and partisan preferences. Finally, the third row includes the GDP p.c., the tax base concentration, the percentage of tax returns administered by the "external offices", a set of time effects, α_0 is a constant and w_{it} is the estimation error of the technical inefficiency effects[20].

4. Empirical results

4.1. *Basic results*

The results of the basic econometric estimations are reported in Table 3. The most complete specification is Model 3, which includes both administrative and tax capacity inputs – also interacted with a time trend - and all the potentially explanatory variables of

[20] In equation [7] the endogenous variable is "technical inefficiency", and so a positive (negative) estimate means that a positive variation in that particular variable increases (decreases) technical inefficiency.

the inefficiency effects. The estimates of Model 3 suggest that the only administrative input which positively contributes to increase the amount of collected tax revenue is the number of tax inspectors, although with a very low elasticity (1.5%). With respect to the inputs of tax capacity, those picking up the level of wealth (*W* and *VC*) are only significant when they are interacted with a time trend, while the impact of *GDP* is significant both with and without such interaction. In order to check the empirical relevance of other alternative specifications of the stochastic frontier, we tested, in Model 1, the hypothesis that the inclusion of the administrative inputs can be rejected; this hypothesis was not accepted. In Model 2, the significance of the interaction of all the inputs with a time trend was tested, and this was accepted (i.e., Model 3 is preferable to Model 2). Table 4 shows the generalized likelihood ratio tests carried out comparing Model 3 with Model 1 and with Model 2, and also tests the inclusion of the time and fixed effects in Model 3, which is accepted. Thus, the specification of the stochastic frontier in Model 3 seems to be robust to alternative specifications.

[INSERT TABLE 3]

[INSERT TABLE 4]

Thus, following the estimates obtained in Model 3, with respect to the inefficiency effects model, the percentage of tax returns administered in "external offices" clearly increases the inefficiency of the tax administration. As expected, the greater the concentration of tax revenue in fewer tax returns, the lower the level of inefficiency. It was also expected that a greater level of income p.c. (measured by the GDP) would imply a greater level of inefficiency, given the traditionally supposed positive relationship between income and tax evasion, although in Model 3 this estimate is not statistically different from zero. With respect to the political variables the estimates suggest a powerful connection between the public budget and the tax administration (all the estimates being significant): provided the relative importance of the unconditional grants in the regional budget is greater than 31.71%, the efforts in tax administration tend to diminish; however, when the (expected) public deficit is greater than 1.55%, the efforts tend to increase.

The alignment of the tax administration with the electoral concerns of the incumbent is less obvious, since whether or not the latter distorts the efforts of the former depends only on the narrowness of the margin to *lose* a parliamentary seat - though the importance of this influence decreases with the strength of the incumbent in the regional parliament (measured as the percentage of parliamentary seats). Hence, when the margin to lose a parliamentary seat has diminished in a certain electoral district (in the most recent electoral contest), the tax administration tends to diminish its efforts in collecting taxes in that district, although this disincentive disappears when the percentage of parliamentary seats held by the incumbent is greater than 52.50%. Curiously enough the impact of "electoral competition" on the efforts made by the tax administration does not hold with respect to the margin of winning a parliamentary seat[21]. Finally, there is also some evidence of partisan preferences (see Model 3), in the sense that leftist governments tend to exert a lower effort in tax administration[22].

In order to check the robustness of the results obtained from Model 3, some variables were omitted in Model 4 according to the generalized likelihood ratio test (see Table 4). In the inefficiency effects model, only the exclusion of the variable "Left" and of those variables related to the margin of winning a parliamentary seat were accepted, while none of the inputs included in the stochastic frontiers were excluded. In Model 4, not only the tax inspectors contribute to increase the amount of taxes collected, but also the general staff. Thus, the elasticity of all the staff is 11.10% (invariable over time). The elasticity of the capital stock of the tax administration in terms of square metres of offices is negative and also invariable over time (-5.20%), while the elasticity of the number of computers is not

[21] Alternative definitions of "district competition" were tried, which were always rejected by the better performance of the one that appears in Table 3. For example, instead of including the margin for losing or winning a parliamentary seat in absolute values, this was included as a percentage, or the smaller of the margin for losing and the margin for winning a parliamentary seat was chosen. Finally, the possibility of an electoral cycle (assigning a dummy equal to one for the electoral year, or even trying it for the electoral year and the year before) was also tested, and this was interacted with the margin for losing and winning a parliamentary seat. However, these hypotheses were also rejected.

[22] In a preliminary version of a paper by Besley and Preston (2002), p. 16, they find that "labour parties" tend to collect a relatively lower percentage of tax revenues. Although one would expect the reverse, in our case this result might make sense if leftist governments have set up a more important level of administrative inputs that rightist ones. Thus, given that the productivity of those inputs is relatively low (see Model 3), our result would suggest that leftist governments have expanded too much the material and personal means given to their tax administrations. That is, their efforts are low given their level of infrastructure in tax administration.

statistically different from zero, although its inclusion in Model 4 cannot be rejected[23]. The elasticity of the inputs of tax capacity is (slightly) variable over time and, for example, for t=5 this elasticity is 110.40%.

With respect to the variables included in the inefficiency effects model, the signs of the estimates do not vary from Model 3, and so the previous conclusions still apply. However, the thresholds of the political variables varied slightly. In Model 4, the percentage of parliamentary seats that eliminates the disincentives of the tax administration in the case that the margin to lose a parliamentary seat has narrowed in an electoral district is 53.27% (slightly greater than in Model 3). Now the (expected) level of public deficit has to be as high as 1.64% (during the period analysed, its average was 0.57%) in order to incite the tax administration to exert a higher level of effort, while the relative importance of the unconditional grants has to be greater than 40.84% (higher than in Model 3) in order for an "income effect" to disincentivise the efforts in collecting taxes.

Finally, Table 5 shows the ranking of efficiency by province and year obtained from Model 4. The average of efficiency during the period analysed is 83.77%, though the level of efficiency tends to vary across it, reaching its maximum in 1992 (86.76%) and the minimum in 1998 (80.77%).

[INSERT TABLE 5]

4.2. *Additional Results*

In addition to the percentage of parliamentary seats, we also considered alternatives to the measurement of the incumbent's parliamentary strength. The results – for just the inefficiency effects model - are shown in Table 6. Two alternatives in particular were tried: first, in Model 5 the parliamentary strength was measured through the difference between the number of seats held by the incumbent and the main opposition party (as a percentage, though the results do not differ very much if such a difference is measured in absolute values). Second, in Model 6, the parliamentary strength was picked up by a dummy variable, whose value is 1 in the case that the incumbent holds a majority in the regional

[23] Cfr. Hunter and Nelson (1996), p. 112, who also find negative estimates of the variables included in the production frontier of the tax administration.

parliament (>50% of seats), and 0 otherwise. Table 6 shows how the main results obtained from Model 3 do not vary. That is, the tax administration only becomes an important electoral instrument for the incumbent as long as the margin of votes for losing a parliamentary seat in a certain electoral district has shrunk. Thus, for instance, if the incumbent holds a majority of seats (Model 6), such an effect almost completely vanishes (-0.067+0.072=0.005). However, it seems that parliamentary strength is not so accurately measured if we just consider the distance with respect to the main party in opposition, since in that case the estimates are only significant at the 10% level (see Model 5). In neither Model 5 nor Model 6 does the sign or the magnitude of the remaining estimates change substantially.

In Model 7, the parliamentary strength of the incumbent is included without interaction. Although the variable has the expected sign – the greater the parliamentary strength, the more secure is the incumbent in power, and so the greater effort made in collecting taxes all over the region – it is not statistically different from zero, and its inclusion is rejected according to the generalized likelihood ratio test (see Table 7).

[INSERT TABLE 6]

Table 7 shows the tests carried out in order to check the empirical relevance of each of the alternative hypotheses regarding parliamentary strength. In the table, each of the alternative definitions of parliamentary strength described above is indicated by ϕ. Leaving aside Model 7 - since Model 3 is clearly preferable to it - the inclusion of all the variables relating to political competition is only rejected in Model 5.

[INSERT TABLE 7]

5. Conclusions

This paper has empirically analysed the behaviour of the Spanish regional tax administration. In particular, it has shown the close connection between the political power and the tax administration itself. Such a connection implies that the tax administration reacts to the budgetary situation of the regional government. In addition, however, the incumbent also takes advantage of the tax administration in order to gain electoral popularity in those electoral districts where the margin to lose a parliamentary seat is small

- although at a decreasing rate according to its strength in the regional parliament. The empirical relevance of both results has been shown from the estimation of a stochastic frontier tax revenue function following the methodology proposed by Battese and Coelli (1995) for panel data.

As was stated in the introduction, the normative implication of each of these sources of connection is totally different. The question is whether it is possible to ascertain if the connection is, on the whole, efficiency-enhancing. The answer obviously depends on the individual characteristics of each regional government, though the particular analysis of the budgetary connection might offer some hints about its net impact. While the (expected) public deficit has to be as high as 1.64% of the regional GDP in order to produce an increase in the effort in tax revenue collection (the average for the period analysed is 0.57%), provided the relative importance of the unconditional transfers in the regional budget is higher than 40.84% (the average for the period is 28.86%), the efforts diminish. Therefore, it seems that the impact of the budgetary connection in favour of a greater effort in tax collection tends to be modest, or even negative given the importance of the unconditional grant system, and so it probably does not compensate for the negative impact of the electoral motives.

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Appendix: *How electoral district competition was measured*

In order to explain how we calculated the "district competition", there follows a brief explanation of the functioning of Hondt's Law through an example that appears in Spanish Electoral Law. Thus, it is supposed that there have been 480,000 valid votes in an electoral district shared among 6 political parties (A: 168,000 votes; B: 104,000 votes; C: 72,000 votes; D: 64,000 votes; E: 40,000 votes; and F: 32,000 votes). This electoral district has been assigned by law 8 seats in the regional parliament.

	1	2	3	4	5	6	7	8	*Seats*
A	**168,000**	**84,000**	**56,000**	**42,000**	33,600	28,000	24,000	21,000	4
B	**104,000**	**52,000**	34,666	26,000	20,800	17,333	14,857	13,000	2
C	**72,000**	36,000	24,000	18,000	14,400	12,000	10,285	9,000	1
D	**64,000**	32,000	21,333	16,000	12,800	10,666	9,142	8,000	1
E	40,000	20,000	13,333	10,000	8,000	6,666	5,714	5,000	0
F	32,000	16,000	10,666	8,000	6,400	5,333	4,571	4,000	0

Given this information, the number of votes obtained by each political party is divided by 1,2,3 and so on, up to a number equal to the number of parliamentary seats assigned to the electoral district (see the table above). The parliamentary seats are then distributed to the political parties which obtain the highest ratios in a decreasing way (i.e., the first parliamentary seat is assigned to party A (168,000), the next one to B (104,000), and so on, the last one being assigned to A (42,000)).

Hence, in order to calculate the margin for losing a parliamentary seat in electoral district, *L*, for the governing party in the region (note that it might not be the same party as A, although in the example we assume that it is), we have to suppose how the number of votes is distributed among the other parties. We assume that the number of votes lost by the incumbent party is allocated to the other parties according to the percentage of votes obtained by each party in that electoral district. The same assumption is made in the case of winning a marginal parliamentary seat. In the example above, for each party in opposition, we set up an inequality, e.g., in the case of party B:

$$\frac{168.000 - L}{4} < \frac{104.000 + \alpha_B L}{3}$$

where α_B : percentage of votes obtained by B among all the parties with the exception of A. Once all these inequalities are set up, we select the smallest one. Therefore, we obtain the following general formula:

$$L \equiv Min\left\{\frac{V_I * \left(\frac{N_{-1}+1}{N_I}\right) - V_{-1}}{\left(\frac{N_{-1}+1}{N_I}\right) + \alpha_{-1}}\right\}$$; where the subscript *I* indicates the incumbent in the region,

and *–1* the other parties, *N* being the number of parliamentary seats and *V* the number of votes.

Similarly, in the case of winning a marginal parliamentary seat in the electoral district, *W*, we obtain the following formula:

$$W \equiv Min\left\{ \frac{V_{-1} * \left(\frac{N_I + 1}{N_{-1}} \right) - V_I}{\alpha_{-1} * \left(\frac{N_I + 1}{N_{-1}} \right) + 1} \right\}$$

Table 1: *Importance of the Ceded Taxes* (1998)

	% Ceded Taxes	*% Regional GDP*
Net Wealth Tax (IP)	9.915%	0.131%
Wealth Transmission Tax (ISD)	13.632%	0.180%
Tax on Business Operations (ITPAJD)	58.584%	0.773%
Gambling Taxes	17.869%	0.236%
Total	100%	1.32%

Table 2: *Descriptive statistics*

	Average	*Standard Deviation*	*Minimum*	*Maximum*
Stochastic Frontier				
Revenue Tax Collected ($*10^6$ ptas.)	15,852.78	26,377.49	1,231.37	201,486.02
Offices (m^2)	1,464.90	1,288.74	150	7,502
Computers	39.86	32.88	0	210
Tax Inspectors	4.93	2.83	0	25
General Staff	56.013	36.121	13	234
GDP ($*10^3$ ptas.)	1,490.16	2,184.75	151.73	1,3514.98
VC ($*10^3$ ptas.)	1,699.93	2,017.84	224.75	14,501.39
W ($*10^3$ ptas.)	2,787.20	1,562.22	754.23	9,483.93
Inefficiency Effects				
% (Tax Returns in External Offices)	28.15	16.04	0.74	86.52
Tax Base Concentration	102.74	29.53	59.80	257.05
GDP p.c.	1,802,090	414,095	924,008	3,346,540
% (Uncond. Transfers/ Expenditure)	28.86	8.59	10.12	69.97
% (Deficit (E) / GDP)	0.57	0.53	0.002	2.38
Leftist Government	0.39	0.49	0	1
Votes (L)	12,650	10,286	155	45,902
Votes (W)	11,942	11,720	142	57,343
% Seats	45.43	5.71	32.50	54.15
Majority	0.33	0.47	0	1
ΔSeats (Incumbent-Opposition) (%)	0.3284	0.1566	0.0625	0.6956

Notes: Statistics based on pooled cross-sections for the 45 provinces during the period 1992, 1995-1998.

Table 3: *Dependent Variable: Tax Revenue Collected by Province (1992, 1995-98)*

	Model 1	*Model 2*	*Model 3*	*Model 4*
ln (Offices)	-.-	-0.019 (-0.798)	-0.045 (-1.314)	-0.052 (-3.320)***
ln (Offices)	-.-	-.-	0.002 (0.367)	-0.001 (-0.152)
ln (General Staff)	-.-	-0.021 (-0.498)	0.056 (1.047)	0.100 (3.259)***
*ln (General Staff)*t*	-.-	-.-	0.001 (0.109)	0.001 (0.188)
ln (Tax Inspectors)	-.-	0.003 (0.514)	0.015 (2.304)**	0.011 (1.687)*
*ln (Tax Inspectors)*t*	-.-	-.-	-0.001 (-0.533)	0.0003 (0.221)
ln (Computers)	-.-	0.007 (0.889)	0.003 (0.224)	0.012 (1.182)
*ln (Computers)*t*	-.-	-.-	-0.0005 (-0.103)	-0.006 (-1.635)
ln (W)	-0.056 (-0.393)	0.207 (1.566)	-0.143 (-1.153)	-0.220 (-2.905)***
*ln (W)*t*	0.036 (1.686)*	-.-	0.054 (2.932)* **	0.070 (7.313)***
ln (VC)	0.076 (0.931)	0.359 (6.254)***	0.034 (0.528)	0.142 (4.506)***
*ln (VC)*t*	0.044 (2.646)***	-.-	0.043 (2.904)***	0.022 (3.272)***
ln (GDP)	1.142 (7.049)***	0.573 (3.940)***	1.275 (10.124)***	1,207 (14.694)***
*ln (GDP)*t*	-0.085 (-3.426)***	-.-	-0.108 (-4.823)***	-0.097 (-8.751)***
FIXED EFFECTS	YES	YES	YES	YES
TIME EFFECTS	YES	YES	YES	YES
		Inefficiency Effects		
Constant	0.416 (3.599)***	0.386 (3.129)***	0.530 (3.083)***	0.757 (5.694)***
External Offices	0.004 (4.585)***	0.004 (3.284)***	0.004 (3.623)***	0.004 (3.461)***
Tax Base Concentration	-0.006 (-9.292)***	-0.005 (-5.379)***	-0.005 (-4.424)***	-0.006 (-8.761)***
GDP p.c. $*10^6$	0.177 (4.787)***	0.188 (3.953)***	0.077 (1.337)	0.068 (1.603)
% (Transfers/EXP) $*10^2$	-0.618 (-1.347)	-0.874 (-1.648)*	-1.110 (-2.074)**	-1.333 (-2.590)***
% (Transfers/EXP) $^2*10^4$	0.757 (1.070)	1.188 (1.403)	1.750 (2.215)**	1.632 (1.980)**
% (Deficit (E) / GDP)	0.168 (1.929)*	0.142 (1.555)	0.319 (2.708)***	0.427 (4.089)***
% (Deficit (E) / GDP) ^{2}	-0.049 (1.480)	-0.064 (-1.749)*	-0.103 (-2.052)**	-0.130 (-2.994)***
Left	0.025 (0.654)	-0.039 (-0.791)	0.091 (1.852)*	-.-
Votes (L) $*10^4$	-0.185 (-2.104)**	-0.157 (-1.600)	-0.262 (-2.188)**	-0.228 (-2.465)***
Votes (L)%Seats* $*10^4$	0.369 (1.980)**	0.302 (1.488)	0.499 (2.012)**	0.428 (2.205)**
Votes (W)	0.110 (0.655)	0.082 (0.904)	0.073 (0.578)	-.-
Votes (W) %Seats* $*10^4$	-0.198 (-1.156)	-0.161 (-0.772)	-0.160 (-0.562)	-.-
TIME EFFECTS	YES	YES	YES	YES
Log-likelihood	226.072	221.537	235.819	238.757
γ	0.7672	0.4643	0.9999	0.9999
Average Efficiency	0.8502	0.8410	0.8273	0.8377

Notes: *t*-statistics in parentheses; asterisks indicate significance at the 1% (***), 5% (**) and 10% (*) levels.

Table 4: *Model selection (Generalized Likelihood Ratio Tests)*

Null Hypothesis (*Ho*)	λ	$\chi^2_{0.95}$	Decision (at 5% level)
	Model 3		
H_0: *Fixed Effects*=0	108.046	21.742	RH_0
H_0: *Time Effects*=0	26.092	8.761	RH_0
H_0: *Fixed Effects= Time Effects*=0	107.982	26.983	RH_0
Model 3 vs. *Model 1*	19.494	14.853	RH_0
Model 3 vs. *Model 2*	28.564	13.401	RH_0
Model 3 vs. *Model 4*	-5.876	7.045	AH_0
	Model 4		
H_0: γ *= explanatory v. of inefficiency*=0	115.371	23.069	RH_0
H_0: *Offices = Offices*t* =0	27.314	5.318	RH_0
H_0: *Computers = Computers*t* =0	12.532	5.318	RH_0
H_0: *Tax Inspectors = Tax Inspectors *t = General Staff = General Staff*t*=0	30.114	8.761	RH_0
H_0: *Time Effects*=0 (*inefficiency effects*)	30.794	8.761	RH_0
H_0: *GDP p.c.*=0 (*inefficiency effects*)	26.116	2.706	RH_0
H_0: *% (Uncond. Transfers/ Expenditure)= % (Uncond. Transfers/ Expenditure)^2*=0	22.686	5.318	RH_0
H_0: *% (Deficit (E) / GDP)= % (Deficit (E) / GDP)^2*=0	14.428	5.318	RH_0
H_0: *Votes (L)= Votes (L)* %Seats* =0	13.306	5.318	RH_0

Note: λ: likelihood ratio test statistic, such that λ=-2{log[Likelihood(H_1)]-log[Likelihood(H_0)]}. It has an approximate chi-square distribution with degrees of freedom equal to the number of independent constraints. The asymptotic distribution of hypothesis tests involving a zero restriction on the parameter γ has a mixed chi-squared distribution, so the critical value for this test is taken from Kodde and Palm (1986).

Table 5: *Efficiency Ranking by Provinces*

1992		1995		1996		1997		1998	
Barcelona	0.9996	Barcelona	0.9984	Zamora	0.9977	Valladolid	0.9994	Cantabria	0.9990
Girona	0.9990	Pontevedra	0.9982	La Rioja	0.9970	Barcelona	0.9979	Málaga	0.9962
Zaragoza	0.9984	Las Palmas	0.9969	Valladolid	0.9951	Asturias	0.9978	Baleares	0.9943
Pontevedra	0.9983	Málaga	0.9738	Pontevedra	0.9893	Málaga	0.9965	Alicante	0.9928
La Rioja	0.9976	Asturias	0.9737	Salamanca	0.9665	Baleares	0.9892	Murcia	0.9581
Asturias	0.9967	La Rioja	0.9647	Barcelona	0.9613	Albacete	0.9829	Valladolid	0.9467
Cantabria	0.9961	Salamanca	0.9523	Albacete	0.9573	Segovia	0.9802	Almería	0.9326
Málaga	0.9958	Albacete	0.9282	Soria	0.9573	Salamanca	0.9769	Barcelona	0.9311
Salamanca	0.9933	Almería	0.9218	Almería	0.9344	Alicante	0.9757	Albacete	0.9267
Las Palmas	0.9930	Girona	0.9114	Las Palmas	0.9333	Cantabria	0.9715	Soria	0.9097
Albacete	0.9924	Alicante	0.9011	Málaga	0.9252	Las Palmas	0.9666	Segovia	0.9022
La Coruña	0.9884	Valladolid	0.8995	Baleares	0.9157	Soria	0.9578	Girona	0.8955
Segovia	0.9445	Baleares	0.8979	Cantabria	0.8903	Almería	0.9455	Asturias	0.8736
Cuenca	0.9329	Zaragoza	0.8967	Asturias	0.8782	Zaragoza	0.9295	León	0.8689
Tarragona	0.9296	Cantabria	0.8943	Murcia	0.8766	Murcia	0.9147	Las Palmas	0.8632
Alicante	0.9272	La Coruña	0.8898	Girona	0.8739	Palencia	0.9067	Salamanca	0.8532
Castellón	0.9208	Granada	0.8821	Palencia	0.8698	La Rioja	0.9018	La Rioja	0.8502
Soria	0.9091	Burgos	0.8820	Lugo	0.8575	Pontevedra	0.8928	Palencia	0.8459
Valladolid	0.8997	Soria	0.8813	Alicante	0.8528	Girona	0.8909	Pontevedra	0.8353
Huesca	0.8877	Córdoba	0.8722	Córdoba	0.8527	Burgos	0.8898	Orense	0.8321
Toledo	0.8839	Palencia	0.8698	León	0.8491	Córdoba	0.8852	Tarragona	0.8250
Tenerife	0.8740	Segovia	0.8551	Zaragoza	0.8455	La Coruña	0.8751	Zamora	0.8041
Murcia	0.8696	Lleida	0.8458	Granada	0.8430	Castellón	0.8550	Castellón	0.8030
Granada	0.8675	Lugo	0.8422	La Coruña	0.8426	León	0.8503	Zaragoza	0.8002
Almería	0.8660	Castellón	0.8377	Segovia	0.8328	Granada	0.8485	Lleida	0.7949
Lleida	0.8636	Murcia	0.8294	Burgos	0.8227	Zamora	0.8316	Granada	0.7918
Baleares	0.8554	Toledo	0.8081	Lleida	0.8006	Sevilla	0.8222	La Coruña	0.7789
Burgos	0.8373	Sevilla	0.7980	Valencia	0.7716	Lugo	0.8112	Toledo	0.7783
Zamora	0.8370	Huelva	0.7827	Castellón	0.7678	Toledo	0.8038	Cádiz	0.7594
Huelva	0.8340	Huesca	0.7820	Badajoz	0.7637	Lleida	0.8038	Valencia	0.7566
Cádiz	0.8268	Jaén	0.7808	Sevilla	0.7526	Tarragona	0.8037	Tenerife	0.7467
Córdoba	0.8178	Cuenca	0.7804	Toledo	0.7495	Huelva	0.7999	Sevilla	0.7437
Valencia	0.8157	Valencia	0.7755	Tarragona	0.7466	Valencia	0.7932	Lugo	0.7406
Orense	0.8052	Tarragona	0.7707	Cádiz	0.7431	Tenerife	0.7865	Córdoba	0.7401
Lugo	0.7980	Tenerife	0.7694	Ávila	0.7367	Badajoz	0.7827	Huelva	0.7260
Palencia	0.7930	Cádiz	0.7672	Orense	0.7272	Cádiz	0.7812	Burgos	0.7188
Ávila	0.7806	Badajoz	0.7652	Huesca	0.7259	Huesca	0.7694	Badajoz	0.7180
Badajoz	0.7506	León	0.7621	Cuenca	0.7193	Jaén	0.7566	Ciudad Real	0.6944
León	0.7468	Zamora	0.7583	Cáceres	0.7143	Cuenca	0.7434	Cuenca	0.6932
Guadalajara	0.7405	Orense	0.7522	Huelva	0.7095	Cáceres	0.7270	Huesca	0.6759
Ciudad Real	0.7186	Guadalajara	0.7288	Jaén	0.7060	Ávila	0.6911	Jaén	0.6666
Jaén	0.7161	Cáceres	0.6954	Tenerife	0.6985	Ciudad Real	0.6831	Cáceres	0.6596
Cáceres	0.7145	Ciudad Real	0.6832	Guadalajara	0.6611	Orense	0.6807	Ávila	0.6580
Sevilla	0.6725	Ávila	0.6311	Ciudad Real	0.6143	Guadalajara	0.6494	Guadalajara	0.6273
Teruel	0.4581	Teruel	0.4563	Teruel	0.4676	Teruel	0.4757	Teruel	0.4390
Average	0.8676		0.8365		0.8243		0.8528		0.8077
Standard deviation	0.1140		0.1061		0.1145		0.1146		0.1164
Max.-Min.	2.1822		2.1880		2.1338		2.1008		2.2758

Table 6: *Inefficiency Effects Model: Alternative Hypothesis Concerning Electoral Competitiveness*

	Model 3	*Model 5*	*Model 6*	*Model 7*
Constant	0.530	0.645	0.555	1.020
	(3.083)***	(3.554)***	(3.318)***	(2.570)***
External Offices	0.004	0.005	0.005	0.004
	(3.623)***	(4.062)***	(4.405)***	(3.551)***
Tax Base Concentration	-0,005	-0.004	-0.005	-0.004
	(-4.424)***	(-4.080)***	(-5.853)***	(-4.124)***
GDP p.c.	0.077	0.028	0.099	0.052
	(1.337)	(0.467)	(1.770)*	(0.903)
% (Transfers/EXP)	-1.110	-1.300	-1.381	-1.024
	(-2.074)**	(-2.183)**	(-2.648)***	(-1.894)*
% (Transfers/EXP)^2	1.750	1.743	1.830	1.747
	(2.215)**	(1.813)*	(2.154)**	(2.015)**
% (Deficit (E) / GDP)	0.319	0.299	0.399	0.219
	(2.708)***	(2.662)***	(3.475)***	(1.618)
% (Deficit (E) / GDP)^2	-0.103	-0.092	-0.149	-0.079
	(-2.052)**	(-1.923)*	(-3.067)***	(-1.405)
Left	0.091	0.043	0.113	0.097
	(1.852)*	(0.880)	(2.093)**	(2.045)**
*% Seats*10^2*	-.-	-.-	-.-	-1.164
				(-1.443)
*Votes (L)*10^4*	-0.262	-0.079	-0.067	-0.422
	(-2.188)**	(-1.945)*	(-2.874)***	(-2.497)***
Votes (L)%Seats*10^4*	0.499	-.-	-.-	0.845
	(2.012)**			(2.387)***
*Votes (L)*ΔSeats(Opp.)*10^4*	-.-	0.140	-.-	-.-
		(1.801)*		
*Votes (L)*Majority*10^4*	-.-	-.-	0.072	-.-
			(2.551)***	
Votes (W)	0.073	0.014	-0.002	-0.091
	(0.578)	(0.525)	(-0.148)	(-0.559)
Votes (W) %Seats*10^4*	-0.160	-.-	-.-	0.219
	(-0.562)			(0.593)
*Votes (W)*ΔSeats(Opp.)*10^4*	-.-	-0.042	-.-	-.-
		(-0.544)		
*Votes (W)*Majority*10^4*	-.-	-.-	-0.040	-.-
			(-1.306)	
TIME EFFECTS	YES	YES	YES	YES
Log-likelihood	235.819	230.579	236.853	232.380
γ	0.9999	0.9995	0.9999	0.9994
Average Efficiency	0.8273	0.8385	0.8302	0.8268

Notes: See Table 3.

Table 7: *Alternative Hypothesis of Parliamentary Strength (Generalized Likelihood-Ratio Tests)*

	Model 3 (Log-likelihood value= 235,819)	*Model 5* (Log-likelihood value=232,676)	*Model 6* (Log-likelihood value=236,853)	*Model 7* (Log-likelihood value=232,380)
*Votes (L)= Votes (L)** ϕ = *Votes (W)= Votes (W)** ϕ =0	14.158***	3.678	16.226***	3.820
*Votes (L)= Votes (L)** ϕ =0	15.244***	6.430**	20.656***	4.894
*Votes (W)= Votes (W)** ϕ =0	0.636	7.340**	3.086	-5.002
*Votes (L)** ϕ = *Votes (W)** ϕ =0	17.690***	7.210**	7.316**	12.176***
% Seats=0	-.-	-.-	-.-	-6.878

Notes: See Table 3 and Table 4.