THE POLITICS OF TAX ADMINISTRATION: EVIDENCE FROM SPAIN*

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Abstract: Does there exist a connection between the political power and the tax administration? In this paper, we offer empirical evidence from Spain that there exists. First, the Spanish regional tax administration is not immune to the budgetary situation of the regional government, and tends to exert a greater (lower) effort in tax collection as the (expected) public deficit is greater (lower). At the same time, the system of unconditional grants provokes an "income effect" that disincentives the efforts carried out by the tax administration. Second, when the margin to lose a parliamentary seat in an electoral district decreases, the efforts also diminish, though this disincentive is lessened according to the parliamentary strength of the incumbent (evidence of *electoral competition*).

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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 Slemrod and Yitzhaki, 2000, for a recent review on these issues). The most common way of characterising it is as a public agency that maximises the amount of gross tax revenue collected[1]. However, several empirical papers have suggested and shown that the efforts carried out by a tax administration are also guided by electoral concerns (Toma and Toma, 1986; Hunter and Nelson, 1995; or more recently, Young et al., 2001), and conditioned by the system of unconditional grants in the case of the sub-central tax administrations (Jha et al., 1999; Baretti et al., 2002). In this paper, we aim at testing several hypothesis concerning the political determinants of the activities carried out by the regional tax administration in Spain.

First, we will check whether there exists a nexus between the tax administration and the public budget, or instead the tax administration is simply a "black box" that - independently of the "health" of the public finances, which are under the direct control of politicians (i.e., the Ministry of Finances) - aims at obtaining as much tax revenue as possible from the taxpayers[2]. That is, for instance, we will test whether the tax administration exerts a greater effort when the (expected) public deficit is greater, and vice versa. Second, we will analyse whether those efforts depend on the political strength of the government *and* the electoral competitiveness in each electoral district (or province). Thus, according to this hypothesis of "electoral competition", we expect a lower effort in those

[1] According to Slemrod and Yitzhaki (1987), this rule – that implies in equilibrium the equality between marginal cost and marginal benefit - will not be optimal, since while the marginal cost is a real cost, the marginal revenue 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 our analysis is very close to Toma and Toma (1986)'s 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, in Toma and Toma, the reaction is only caused by the variation in the 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 the influence of the politicians on the bureaucrats is only due to an appropriation process by the latter, while we do not make explicit the source of connection between both actors.

electoral districts where the margin for winning or losing a parliamentary seat is smaller, though a priori such incentive should be lower the greater the parliamentary strength of the incumbent (e.g., measured through the percentage of seats in the regional parliament)[3].

The empirical validation of any one of those two hypothesis would confirm the connection between the tax administration and the political power, though they both embody totally different normative implications. In the first case, the tax administration becomes an extra tax instrument for the government - apart from the statutory tax parameters - in order to obtain additional tax revenues (and so meet the constituency expenditure needs), which must produce a greater global efficiency of the tax system (Slemrod, 1990). In the second case, on the contrary, there would be a lower level of global efficiency (and of inter-provincial equity), since the efforts carried out by the tax administration are simply guided by electoral motives.

In order to test such hypothesis, we will perform an empirical analysis based on the estimation of stochastic frontiers (Aigner et al., 1977; Meeusen and van den Broeck, 1977). From the estimation of a tax revenue function, we will obtain a frontier function. The fact that certain observations lie below the frontier can be due either to an estimation error or to inefficiency (i.e., lower efforts in tax administration). This technique disentangles both effects. Given this, we will be interested in identifying which factors explain the distance of each decision unit to the frontier (this is the so-called *inefficiency effects model*). The methodology developed by Battese and Coelli (1995) applied to a panel of data will permit

[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 levels 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 papers showing that the responsiveness of the 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 the electoral motives for the design of public policies, though the measurement of "political competition" differs in each case according to the system of election of the regional representatives in the national assembly. This will have to be appropriately dealt with in our analysis, given the multi-party system prevailing in Spain (e.g., different to 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 national parliament.

us to carry out such identification. In fact, this methodology has already been applied by other papers to study the behaviour of the tax administration (Jha et al., 1999; and Maekawa and Atoda, 2001).

Our empirical analysis will be based on the behaviour of the Spanish tax administration at the regional level (in Spanish, *Comunidades Autónomas*, CCAA). Nevertheless, in order to enlarge the database, each province (or in political terminology, electoral district) of a CA will be considered as a decision unit in the analysis. In Spain, the CCAA have the power to administer certain taxes ceded by the central government since the beginning of the 80's, while the tax autonomy to vary their statutory tax parameters has been null, at least until 1997. This will be the institutional context that we will have to deal with. Interestingly enough, this context will permit us to test to what extent the relative importance of the unconditional grants in the regional budgets influences the efficiency in tax administration (in our case, exclusively through an "income effect"), like Jha et al. (1999) and Baretti et al. (2002) have shown for India and Germany, respectively.

The results obtained from our analysis point out in the direction of a close connection between the political power and the tax administration. Thus, first, we find 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 the central government is high enough (approximately, 41% with respect to public expenditure, above the average during the period of analysis), efficiency diminishes. Second, the tax administration is also guided by electoral concerns, since tends to decrease its level of efficiency (with the aim of increasing the level of popularity of the incumbent) when the margin for *losing* a parliamentary seat is low, while this decrease is lower the higher is the political strength of the incumbent in the regional parliament. Both results are quite robust to different specifications of the model as we will show.

The remainder of the paper is organised as follows. In the next section, we set up the basic hypothesis concerning the empirical analysis, first, with respect to the tax revenue function and, second, with respect to the determinants of the efforts in tax administration. In the third section, we will describe the empirical methodology and the database constructed for the analysis. In section four, we will present the results of the empirical estimation, while section five contains some concluding remarks.

2. Tax Administration and Politics

2.1. *The tax revenue technology*

In this section, we will define the tax technology, since it will permit us to identify the motives that guide the efforts of the tax administration. The tax technology - which will be later 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 that variables, not all the 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 with the function originally proposed by Mayshar is that, on the one hand, we have distinguished between the inputs of the tax administration and the statutory tax rate, while he includes both factors into just one variable, $\boldsymbol{q}$. On the other hand, Mayshar names S as "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 that might explain tax evasion. Following Andreoni et al. (1998), these can be mainly classified into three groups: (i) income and tax rates; (ii) demographic and social factors; and (iii) penalties and audit probabilities. Nevertheless, 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 on these issues). The classical theoretical models of tax evasion (Allingham and Sandmo, 1972) predict that the greater the audit probability, 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 less tax compliance). However, if the penalty is proportional to the amount of tax evaded, the "substitution"

[4] See, e.g., Slemrod and Yitzhaki (2000) for an extensive explanation of the definitions of each one of those two concepts, though they both have the same consequence: a reduction in the potential amount of tax revenue collected.

effect disappears, and so an increase in t always promotes more tax compliance (Yitzhaki, 1974). Due to the multiplicity of factors that might exert some influence on the decision to evade taxes, the empirical (and experimental) analysis have also included socio-economic variables like the level of education, the age, the race or the occupation of the taxpayer (see Andreoni et al., 1998, pp. 840-1).

Therefore, we can express the level of tax evasion as follows:

$$S = S(Y, t, p, F, X) \qquad [1]$$
$$\quad + - - - \ ?$$

where Y is the level of income, p is the audit probability, F is the penalty proportional to the amount of evaded tax, and X is a vector of socio-economic variables. Below each variable in expression [1], it is indicated 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 variable that will be at the disposal of the tax administration, since t and F are established by law[5], while the rest of variables are exogenous. Finally, note that S could be interpreted more broadly. For example, it could be that $S<1$ just 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 it has not administered diligently enough the tax returns submitted by the taxpayers, which would cause a delay in the 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 tax instruments at disposal of the tax administration - apart from p - can be included in [1]. All these instruments -including p- can be summarized into E, which from now on will be called as the efforts put by the tax administration into the reduction of S.

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

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

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

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 disposal of the tax administration, E. However, in our paper, such difference becomes crucial to understand our empirical framework. Such difference 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 audit budget, or more generally, the tax administration budget (which includes the number of personnel and the stock of capital at disposal of the tax administration). Therefore, the social planner has chosen t and I, but also F (see fn. 5).

2nd. The tax administration is delegated the responsibility to enforce the tax obligations through a diligent administration of the tax returns, the realisation of tax audits or the proper assessment of the tax bases, among other tasks. Hence, the tax administration, given the budget at its disposal, chooses E (being this variable difficult to measure or to concrete into one single measure given the wide range of actions that can be carried out by a tax administration as we have justified).

Precisely, it is important to bear in mind that the main aim of the paper is finding the variables that explain the behaviour of the tax administration, i.e., those variables that guide the selection of E. According to the empirical methodology - which will be explained in detail in section 3.1. - we will (consistently) estimate both T and S. Then, given the supposedly positive relationship between S and E (e.g., higher p) and given the rest of variables included in [1], as long as we find a positive relationship between the potentially explanatory variables of E, on the one hand, and S, on the other, we will have indirectly shown the influence of the former group of variables on the choice of E[6]. That is why, it is crucial for our empirical analysis to set up certain basic hypothesis concerning

[6] E.g., this approach has also been followed by Grossman et al. (1999) in estimating the efficiency of US local governments in "producing" local property value, also employing 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” corresponds to S, while those "observable characteristics" are precisely those included as explanatory variables of S.

the choice of *E*.

2.2. *The determinants of the efforts in tax administration*

All the variables that we will identify as potentially explanatory of *S* 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*), which responsibility is at hands of a political responsible, 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 in the intensity put into tax collection (*partisan preferences*).

The hypothesis concerning each one of these three groups of factors that could potentially affect the choice of *E* are the following:

(i) *Budget connection*. In the empirical analysis, we will test two different hypothesis with respect to the budget connection:

(i.1) First, we will test whether the government conditions the efforts carried out by the tax administration according to the "health" of the public finances. That is, in front of a negative (positive) shock in the public finances, does the tax administration – induced somehow by the political power- react increasing (reducing) its efforts in collecting taxes? Note that the negative (positive) shock could be due either to a demand of the citizens in favour of a higher (lower) level of public goods[7] or, alternatively, to a decrease (increase) in the level of tax bases, maintaining the statutory tax rates, or to a reduction (increase) of the latter established in the annual budget, maintaining the level of tax bases[8], or to a combination of all these causes. In order to test this hypothesis, we will use the (expected) public deficit at the beginning of the fiscal year as explanatory variable, and so it will not be possible to discern the cause(s) that has (or have) provoked the financial needs (or surplus).

[7] See Dušek (2002), who very appropriately calls this effect as 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" produced as a response to the "technological shock".

[8] See Toma and Toma (1986).

(i.2) Second, it might be the case that not only the "health" of the public finances affect the efforts of the tax administration, but also the composition of the public budget. In this sense, we will test whether the relative importance of the amount of unconditional grants received by a region from the central government provokes an "income effect" that lowers the marginal value of any additional tax revenue collected up to the extent to make unbeneficial carrying out any additional (costly) effort by the tax administration (see Jha et al., 1999, for India; and Baretti et al., 2002, for Germany, who are also able to detect a "substitution effect" that in addition to the "income effect" disincentives 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[9]. Thus, as long as voters dislike the burden of taxes, in order to minimise the risk of defeat in an electoral district (plurality system) or of losing a parliamentary seat assigned to a district (proportional system), the political power, through the tax administration, will be induced to reduce the efforts in collecting taxes in that district. Then, the key question to test this hypothesis is how to measure "electoral competition" (see for a review Holbrook and van Dunk, 1993, and their proposed index of measurement instead of the "Ranney index", the most commonly used)[10]. All of 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. However, it is self-evident that the way of measuring "electoral competition" depends on the electoral system.

In Spain, the selection of the regional representatives in the lower house is done according to a proportional system, in which the Hondt's Law is used to transform provincial votes into seats in the regional assembly[11]. Hence, in order to measure the electoral competition in an electoral district, the most natural way of doing it is calculating the minimum number of votes the incumbent should lose (win) in order to lose (obtain) one seat in the regional

[9] Among many others, see on this issue Holbrook and van Dunk (1993), Besley and Case (2002), and the references cited therein.

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

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

parliament (see the Annex for a description of this calculus). The lower the margin, the higher the electoral "district competition". Nevertheless, such marginal lose (win) will be relevant to the incumbent depending on her strength in the regional parliament. That is, e.g., if the margin to lose a seat in a certain electoral district is very low, but the government disposes of a "comfortable" majority in the regional parliament, such lose will be less important than in the case that such seat is crucial to obtain a majority in the parliament. On the whole, we propose to estimate "electoral competition" as follows:

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

Therefore, the measure of "electoral competition" is a combination of two factors, which tend to vanish with each other. Later on, in the empirical section, we will test other measures of "electoral competition", though in any case they all will be based on [3].

(iii) *Partisan preferences*. Given that the efforts in tax administration end up by affecting the effective tax burden borne by the citizens, it seems reasonable to assume that the governments – as long as they are connected with the tax administration, and given that the statutory tax parameters have already been established - 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 on the main theories and empirical results concerning the partisan motivations of the governments).

3. Empirical methodology and data

3.1. *Empirical methodology*

The methodology that we will employ to estimate [2] is based on Battese and Coelli (1995)[12]. This methodology permits estimating a stochastic frontier of tax revenue, i.e. the maximum amount of tax revenues that could be collected given, in our case, the (marginal)

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

statutory tax rate, *t*, the tax capacity, *B*, and the administrative inputs, *I*. The error term obtained from this estimation is decomposed into two parts: one is the error term of the econometric specification, and the other one is the so-called (technical) inefficiency effect. That is, 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 with *S*, as we have shown in section 2.1, and so we will explain it according to the hypothesis set up in section 2.2[13].

The estimated frontier is stochastic, since we allow that a decision unit is out of the frontier either due to a random shock or to an error of measurement. Instead, the deterministic techniques do not permit to distinguish between those two components, so biased measures of technical efficiency are usually obtained. Moreover, Battese and Coelli's methodology permits to overcome the inconsistency that arises when one tries to explain inefficiency through methods of estimation in two steps.

Briefly, Battese and Coelli (1995)'s methodology proposes to estimate the following function for a panel of data[14]:

$$T_{it} = exp\left(x_{it}\boldsymbol{b} + V_{it} - U_{it}\right),$$

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;*

[13] In fact, though throughout the paper we will not distinguish between tax evasion (*S*) and technical efficiency, both measures are not fully identical. The reason is that technical efficiency is measuring the relative performance of the 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 could be the case that all tax administration were performing equally bad (or that the level of the tax administration budget were still low, given its productivity), and all the levels of efficiency – as they are obtained from the comparison of the observed performances - were close to 100%. 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).

[14] The joint estimation of the stochastic tax revenue frontier and the explanatory equation of the inefficiency effects will be performed with the software FRONTIER V. 4.1, Coelli (1996).

$\boldsymbol{b}$ is a vector of (k*1) unknown values to be estimated;

V_{it} are assumed to be stochastic errors identically and independently distributed, with a normal distribution with zero average and an unknown variance, $\boldsymbol{s}_V$;

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

z_{it} is a vector of (1*m) explanatory variables associated to the inefficiency of the decision unit along time, among which those variables identified in section 2.2. as potentially explanatory of the efforts carried out in the collection of taxes will be included; and, finally, $\boldsymbol{d}$ is a vector of (1*m) unknown coefficients, to be estimated.

Therefore, from the previous assumptions, technical inefficiency (i.e., S) can be specified in the following way:

$U_{it} = z_{it}\boldsymbol{d} + W_{it}$, where the random variable W_{it} is defined by truncation of the normal distribution, $N(o, \boldsymbol{s}^2)$, at $-z_{it}\boldsymbol{d}$, that is, $W_{it} \geq -z_{it}\boldsymbol{d}$.

By means of the definition of $\boldsymbol{g}$ (Battese and Corra, 1977), such that $\boldsymbol{g} = \boldsymbol{s}_u^2 / (\boldsymbol{s}_u^2 + \boldsymbol{s}_v^2)$ and $0 \leq \boldsymbol{g} \leq 1$, it is possible to discern the relative importance of the inefficiency effects versus the estimation error of the stochastic frontier. Hence, e.g., if $\boldsymbol{g} = 0$, 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, and a traditional panel data analysis is the adequate econometric technique instead of the stochastic frontier models[15].

[15] The value of g is obtained through the resolution of an iterative process, like the one generated by the Davidon-Fletcher-Powell's algorithm. Thus, given an initial value (where, with the exception of b_0 and s, the estimates by OLS of b are employed), the iteration process is solved for that value of g that maximises the likelihood-function (Coelli, 1996, pp. 11-12).

In the estimation of the stochastic frontier, we will also include a set of fixed and time effects. The fixed effects aim at picking up certain structural factors concerning the tax capacity of a decision unit or institutional factors that condition the composition of the administrative inputs, I[16]. As long as such structural or institutional factors were correlated with I, the exclusion of the fixed effects would cause inconsistent measures of the $\boldsymbol{b}'s$ (Mundlak, 1961). With respect to the time effects, they have been included to control for common changes in the statutory tax rates along the period of analysis, since as we have already said, during this period there have not been differences among CCAA in the setting of the statutory tax rates, though since 1997, the CCAA have gained an increasing tax autonomy. The time effects also control for the existence of common macroeconomic shocks that could have affected the tax capacity of all the decision units, and which had not been precisely captured by the variables that already measure the tax capacity.

In order to control for the effect of the statutory tax rates on S, we have also included a set of time effects in the equation of the "inefficiency effects model". Moreover, given that one potentially explanatory variable of the inefficiency is the (expected) public deficit (see section 2.2., point (i.1)), the time effects could also help to alleviate the likely endogeneity of the (expected) public deficit. Thus, we have not employed the public deficit as explanatory variable, since the simultaneous relation is obvious: *ceteris paribus*, the greater the inefficiency, the greater the public deficit, while we precisely want to test the reverse causality. However, having included instead the (expected) public deficit, there could still exist a simultaneous relationship if the budgetary decisions and the decisions about the efforts of the tax administration are simultaneously adopted - which does not seem too much realistic- or both decisions are affected by the economic cycle (the expected deficit is negatively affected by the downturn phase of the cycle, but it might also be more difficult to collect tax revenue at that moment; see for a possible justification of this argument, Andreoni, 1992). In this latter case, the inclusion of the time effects becomes an useful instrument for controlling that potential source of simultaneity bias.

Finally, we have to say that the structure of our stochastic frontier is very similar to Hunter and Nelson (1996), since they only include inputs in the way we have defined I (personnel

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

and capital stock), though they treat the tax revenue collected from the audit processes as the only output of a tax administration. However, in order to perform an analysis of efficiency, as we will do, it is difficult then to evaluate the relative efficiency of each decision unit, unless the researcher has very precisely controlled for the voluntary compliance of the taxpayers. Otherwise, it could be the case that a decision unit has not obtained any flow of revenue from the tax audit processes, and in consequence were negatively evaluated, while voluntary compliance was close to 100%.

3.2. *Data*

Most of the data employed in the analysis have been obtained from the information that annually appears in the National Budget (*Presupuestos Generales del Estado*, PGE) as an Annex, under the title "Report on the cession of taxes to the Autonomous Communities". The realization of these reports is obliged by the Act 14/1996, 30th December, which regulates the cession of taxes from the central government to the CCAA[17]. In particular, the information that we have obtained form such reports has been the following:

- *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 Baleares and Cantabria, to which such competence has not been transferred[18]). During the period of analysis, these taxes have represented around the 12% of all the budgetary revenues of the CCAA. Table 1 shows the relative importance of each one of these taxes. The amount of collected tax revenue corresponds to effective collected tax revenue, not provisional or forecasted, and includes both the revenue collected through the own offices of the CA ("oficinas gestoras") and through offices that do not directly depend on each CA ("oficinas liquidadoras"). From now on, we will name this latter type of offices as "external offices".

[17] The taxes administered by the CCAA are so-called "ceded", since they originally belong to the central government, but they were ceded to the CCAA (the first cession occurred in 1982, for Catalonia). However, though the CCAA are entitled to maintain all the collected tax revenues, until 1997 they were not entitled to perform tax reforms on this set of taxes.

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

[INSERT TABLE 1]

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

• *Explanatory variables of the inefficiency of the Tax Administration*: percentage of returns submitted through the "external offices"; and concentration of tax bases (calculated as the total amount of collected tax revenue divided by the total number of tax returns, excluding the taxes on gambling). In the first case, this variable has been included in order to control for this institutional factor that might affect the level of efficiency, without any previous expectancy about its sign. In any case, there exists the suspect that the great mobility of the responsibles of those "external offices" and their low incentives to collect tax revenue might cause some inefficiency in the process of tax collection. In the second case, we expect that the greater the concentration of tax bases (in the way it has been measured), the greater the level of efficiency, since we would expect a greater profitability by tax return of a marginal effort of the tax administration.

The reports present a delay of two years, that is, for instance, in the budget of the year 2000, there appeared the report of the fiscal year 1998. The reports employed to construct our database have been those that correspond to the years 2000 (1998), 1999 (1997), 1998 (1996), 1997 (1995) and 1994 (1992). Thus, the analysis consists of 225 observations (since 45 provinces have been included in the database, and Madrid has been excluded from the analysis, since it has only very recently started to administer its ceded taxes, and still does not administer the Net Wealth Tax).

The rest of variables have been obtained from the following statistic sources:

• *Gross Domestic Product* (GDP)*, 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 do not exist official statistics about the wealth of a region/province (apart from the real-state property, the so-called "valor catastral", VC, which is measured by a National Agency), an approximation to the wealth of each province has been calculated through the capitalisation of 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 is composed by a share based on expenditure needs in the total amount of National tax revenue ("Participación en los Impuestos del Estado", PIE), and a territorial share in the personal income tax (since 1995), being both sources of tax revenues collected by the central government. This information has been obtained from the *Informe Económico-Financiero de las Administraciones Territoriales*, several years, Ministry of Public Administrations.

• *Public deficit:* the public deficit has been calculated as a percentage of the regional GDP, and it is the expected deficit that appears in the regional budget at the beginning of the fiscal year. This information has also been obtained from the *Informe Económico-Financiero de las Administraciones Territoriales*, op. cit.

• *Political variables:* from the *Anuario de El País*, several years, we have differentiated through a dummy variable between the regional leftist governments (=1) from the rightist ones (=0); also from this source, all the data necessary to construct the variable "political competition" have been obtained (see Annex).

All the monetary magnitudes have been transformed into constant prices of the year 1995 through the national index of consumer prices (National Institute of Statistics, INE). Table 2 provides some descriptive statistics of all the data.

[INSERT TABLE 2]

Apart from the political variables of section 2.2. that aim at explaining *E*, the GDP p.c. in order 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, no other variable has been included in the inefficiency effects model. But according to expression [1], we could have also included some "socio-economic variables". However, given that, on the one hand, the ceded taxes do not affect all the citizenship (e.g., the

transmission of wealth is clearly a non-periodical tax, while the wealth tax only affects very rich people), the inclusion of socio-economic variables (like the level of education or age) might have given a misleading picture of the group of taxpayers. On the other hand, that group of variables might be correlated with the (expected) public deficit, as long as they measure expenditure needs, while other type of variables like the composition of the tax bases (e.g., percentage of the tax bases that are financial capital or real state property) are not available. In any case, we believe that the exclusion of that variables will not bias the estimates of the rest of variables as long as we do not expect a serious correlation of the variables included with those omitted.

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, in which we have included both administrative and tax capacity inputs - interacted with a time trend and without interaction - and all the potentially explanatory variables of the inefficiency effects. The estimates of Model 3 suggest that the only administrative input that positively contributes to increase the amount of collected tax revenue is the number of tax inspectors, though 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 with and without such interaction. In order to check the empirical relevance of other alternative specifications of the stochastic frontier, in Model 1 we test the hypothesis that the inclusion of the administrative inputs can be rejected, which result is negative. In Model 2, the significance of the interaction of all the inputs with a time trend is tested, and the result is again negative. In Table 4, there appear the Generalized Likelihood-Ratio Tests carried out confronting Model 3 with Model 1 and Model 2, and also testing 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]

Then, following with 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 less tax returns, the lower the level of inefficiency. It was also expected that a greater level of income p.c. (measured by the GDP) implies a greater level of inefficiency, given the normally supposed positive relation between income and tax evasion, though in Model 3 this estimate is not statistically different from zero[19]. With respect to the political variables, first, the estimates suggest a powerful connection between the public budget and the tax administration (being all the estimates statistically significant): as long as the relative importance of the unconditional grants in the regional budget is greater than 31,71%, the efforts in tax administration tend to diminish; while when the (expected) public deficit is greater than 1,55%, the efforts tend to increase.

Second, the alignment of the tax administration with the electoral concerns of the incumbent is less obvious, since the latter only distorts the efforts of the former depending on the narrowness of the margin to *lose* a parliamentary seat, though this influence is lowered according to 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 latest electoral contest), the tax administration tends to diminish its efforts in collecting taxes in that district, though this disincentive disappears when the percentage of parliamentary seats hold by the incumbent is greater than 52,50%. Curiously enough the impact of the "political competition" on the efforts carried out by the tax administration does not hold with respect to the margin of wining a parliamentary seat[20]. Finally, there is also some evidence of partisan preferences,

[19] Note that this variable – in conjunction with the (expected) public deficit – could also be picking up a "demand effect".

[20] We tried alternative definitions of "district competition", 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 wining a parliamentary seat in absolute values, we included it as a percentage, or chose the smallest one between the margin for losing and the margin for wining a parliamentary seat. Finally, we also tested the possibility of a electoral cycle (assigning a dummy equal to one for the electoral year, or even trying it for the electoral year and the year before), and interacted it with the margin for losing and wining a parliamentary seat. However, these hypotheses were rejected as well.

in the sense that leftist governments tend to exert a relatively lower effort in tax administration[21].

In order to check the robustness of the results obtained from Model 3, in Model 4 we have omitted all the statistically insignificant variables according to the Generalized Likelihood-Ratio Test (see again Table 4). In the inefficiency effects model, only the exclusion of the variable "Left" and of those variables related with the margin of wining a parliamentary seat has been accepted, while none of the inputs included in the stochastic frontiers have been 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 along time). The elasticity of the capital stock of the tax administration in terms of square meters of offices is negative and also invariable along time (-5,20%), while the elasticity of the number of computers is not statistically significant from zero, though its inclusion in Model 4 cannot be rejected[22]. The elasticity of the inputs of tax capacity is (slightly) variable along 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 have slightly varied. 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 a 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, its average has been 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 an "income effect" disincentives the efforts in collecting taxes.

Finally, in Table 5, there appears the ranking of efficiency by province and year obtained from Model 4. The average of efficiency during the period is 83,77%, though the level of

[21] 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 (being this, according to their model, a measure of political accountability).

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

efficiency tends to vary across the period, having reached its maximum in 1992 (86,76%) and the minimum in 1998 (80,77%). From the ranking, it is also particularly remarkable the poor performance of Teruel (Aragón), which not only always remains in the last position of the ranking, but also presents a very bad performance in absolute values, being its maximum level of efficiency 47,57% in 1997.

[INSERT TABLE 5]

4.2. *Additional Results*

Apart from the percentage of parliamentary seats, we have tried other alternatives to the measurement of the parliamentary strength of the incumbent. The results – only of the inefficiency effects model - are shown in Table 6. In particular, we have tried two alternatives: first, in Model 5 the parliamentary strength has been measured through the difference between the number of seats hold by the incumbent and the main party of the opposition (in percentage, though the results do not differ very much if such difference is measured in absolute values). Second, in Model 6, the parliamentary strength is picked up by a dummy variable, which value is 1 in the case that the incumbent holds a majority in the regional parliament (>50% of seats), and 0 otherwise. From Table 6, it can be appreciated that 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 effect almost fully vanishes. However, it seems that the parliamentary strength is not so accurately measured if we just consider the distance with the main party in the opposition, since in that case the estimates are only significant at the 10% level (see Model 5). Both in Model 5 and Model 6, neither the sign nor the magnitude of the rest of estimates substantially change.

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 carries out 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]

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

[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 connection implies that, on the one hand, the tax administration reacts to the budgetary situation of the regional government. On the other hand, 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, though 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 we already stated in the introduction, the normative implication of each one of those sources of connection is totally different. But, is it possible to ascertain whether on the whole that connection is efficiency-enhancing? The answer to that question will obviously depend on the peculiar characteristics of each CA, though the particular analysis of the budgetary connection might offer us 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 of the period is 0,57%), as long as the relative importance of the unconditional transfers in the regional budget is higher than 40,84% (the average of 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 does not probably compensate the negative impact of the electoral motives as a rule that guides the efforts of the Spanish regional tax administration.

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Annex: *How electoral district competition has been measured*

In order to explain how we have calculated the "district competition", first, we offer a brief explanation of the working of Hondt's Law through an example that precisely appears in the 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 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 that information, the number of votes 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). Then, the parliamentary seats are distributed to the political parties that obtain the highest ratios in the table, but in a decreasing way (e.g., the first one is assigned to party A (168.000), the next one to B (104.000), and so on, being the latest one assigned to A (42.000)).

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

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

where a_{-1} *:* percentage of votes obtained by B among all the parties with the exception of A. Once all those inequalities have been set up, we select the smallest one. Therefore, we obtain the following general formula:

$$L \equiv Min\left\{ \frac{V_I * \left(\frac{N_{-1}+1}{N_I} \right) - V_{-1}}{\left(\frac{N_{-1}+1}{N_I} \right) + a_{-1}} \right\}$$; where the subscript *I* indicates incumbent in the region, and *–1* the rest of parties.

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

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

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
DSeats (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	-0,045	-0,052
		(-0,798)	(-1,314)	(-3,320)***
Ln (Offices)	-.-	-.-	0,002	-0,001
			(0,367)	(-0,152)
ln (General Staff)	-.-	-0,021	0,056	0,100
		(-0,498)	(1,047)	(3,259)***
*ln (General Staff)*t*	-.-	-.-	0,001	0,001
			(0,109)	(0,188)
ln (Tax Inspectors)	-.-	0,003	0,015	0,011
		(0,514)	(2,304)**	(1,687)*
*ln (Tax Inspectors)*t*	-.-	-.-	-0,001	0,0003
			(-0,533)	(0,221)
ln (Computers)	-.-	0,007	0,003	0,012
		(0,889)	(0,224)	(1,182)
*ln (Computers)*t*	-.-	-.-	-0,0005	-0,006
			(-0,103)	(-1,635)
ln (W)	-0,056	0,207	-0,143	-0,220
	(-0,393)	(1,566)	(-1,153)	(-2,905)***
*ln (W)*t*	0,036	-.-	0,054	0,070
	(1,686)*		(2,932)**	(7,313)***
ln (VC)	0,076	0,359	0,034	0,142
	(0,931)	(6,254)***	(0,528)	(4,506)***
*ln (VC)*t*	0,044	-.-	0,043	0,022
	(2,646)***		(2,904)***	(3,272)***
ln (GDP)	1,142	0,573	1,275	1,207
	(7,049)***	(3,940)***	(10,124)***	(14,694)***
*ln (GDP)*t*	-0,085	-.-	-0,108	-0,097
	(-3,426)***		(-4,823)***	(-8,751)***
FIXED EFFECTS	YES	YES	YES	YES
TIME EFFECTS	YES	YES	YES	YES
		Inefficiency Effects		
Constant	0,416	0,386	0,530	0,757
	(3,599)***	(3,129)***	(3,083)***	(5,694)***
External Offices	0,004	0,004	0,004	0,004
	(4,585)***	(3,284)***	(3,623)***	(3,461)***
Tax Base Concentration	-0,006	-0,005	-0,005	-0,006
	(-9,292)***	(-5,379)***	(-4,424)***	(-8,761)***
*GDP p.c. *10^{6}*	0,177	0,188	0,077	0,068
	(4,787)***	(3,953)***	(1,337)	(1,603)
*% (Transfers/EXP)*10^{2}*	-0,618	-0,874	-1,110	-1,333
	(-1,347)	(-1,648)*	(-2,074)**	(-2,590)***
*% (Transfers/EXP)^{2}*10^{4}*	0,757	1,188	1,750	1,632
	(1,070)	(1,403)	(2,215)**	(1,980)**
% (Deficit (E) / GDP)	0,168	0,142	0,319	0,427
	(1,929)*	(1,555)	(2,708)***	(4,089)***
% (Deficit (E) / GDP) ^{2}	-0,049	-0,064	-0,103	-0,130
	(1,480)	(-1,749)*	(-2,052)**	(-2,994)***
Left	0,025	-0,039	0,091	-.-
	(0,654)	(-0,791)	(1,852)*	
*Votes (L)*10^{4}*	-0,185	-0,157	-0,262	-0,228
	(-2,104)**	(-1,600)	(-2,188)**	(-2,465)***
Votes (L)%Seats*10^{4}*	0,369	0,302	0,499	0,428
	(1,980)**	(1,488)	(2,012)**	(2,205)**
Votes (W)	0,110	0,082	0,073	-.-
	(0,655)	(0,904)	(0,578)	
Votes (W) %Seats*10^{4}*	-0,198	-0,161	-0,160	-.-
	(-1,156)	(-0,772)	(-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 statistical significance at the 1% (***), 5% (**) and 10% (*) levels.

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

Null Hypothesis (*Ho*)	l	$c^2_{0.95}$	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: *g = explanatory v. of inefficiency*=0	115,371	23,069	RH_0
H_0: *Votes (L)= Votes (L)*%Seats*=0	13,306	5,318	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
H_0: *Votes (L)* %Seats* =0	27,644	2,706	RH_0

Note: λ: likelihood-ratio test statistic, such that $\lambda=-2\{\log[\text{Likelihood}(H_1)]-\log[\text{Likelihood}(H_0)]\}$. 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)*DSeats(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)*DSeats(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
g	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)* * f = *Votes (W)* = *Votes (W)* * f =0	14,158***	3,678	16,226***	3,820
Votes (L) = *Votes (L)* * f =0	15,244***	6,430**	20,656***	4,894
Votes (W) = *Votes (W)* * f =0	0,636	7,340**	3,086	-5,002
Votes (L) * f = *Votes (W)* * f =0	17,690***	7,210**	7,316**	12,176***
% Seats=0	-.-	-.-	-.-	-6,878

Notes: See Table 3 and Table 4.