COMPETITION IN TAX AUDITING POLICIES: AN EMPIRICAL ANALYSIS

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Abstract:

Preliminary version

1. Introduction

Previous theoretical studies: Janeba and Peters (1999), Cremer and Gahvari (2000), Gándelman and Hernández-Murillo (2004), Wang (2004), Stöwhase and Traxler (2005). But, to our knowledge, there is not any empirical study estimating tax competition in tax auditing. Probably, this is mainly due to the difficulties in obtaining a synthetic measure of "tax enforcement". Relevant empirical studies of taxpayers' mobility for estate taxation in the US: Bakija and Slemrod (2004), Conway and Rork (2006).

Good field of research: institutional context in Spain. Autonomous Communities (AC's, from now on) have power to administer taxes since mid eighties. In particular, they administer IP, ISD & ITPAJD. Común *vs.* Foral. Currently, there is a "race-to-the-bottom" in ISD, especially since they got power to change statutory tax parameters in 1997 (Durán and Esteller, 2006). Therefore, to a certain extent, we would expect that before that date when they did not have that legal power, but only administered taxes, some kind of competition were also present. That is what we aim at testing.

Main results (still to be obtained)….

Structure of the rest of the paper…

2. Regional Tax Administration in Spain

The 1978 Spanish Constitution set up the so-called autonomous communities (ACs), a new level of subcentral government between the state and municipalities. 17 ACs were created and a quick process of decentralization started. On the expenditure side, education, health and social services, among other policies, are currently under the ACs responsible. Regional expenditure already accounts for about 35% of total public expenditure, a higher level than traditional federal countries (Bosch and Durán, 2008). On the revenue side, the regional financing system must provide enough resources to finance expenditure needs. The system lays in two basic sources, taxes and equalization grants.

At the beginning ACs depended much on grants, but subsequent reforms enhanced the weight of taxes, which on average currently accounts for 55% of all regional revenues, while equalization grants are 25%. Tax revenues come basically from state taxes which have been ceded to ACs. That means the basic rule is fixed by the State and all or a part of the revenues go for the regions. However, the tax power given to ACs may vary considerably. Thus, in certain taxes, such as VAT or excises, ACs receive a percentage of raised revenues, 35 % and 40% respectively, but they do not have any kind of tax power. In other taxes, as the personal income tax or the car registration tax, apart from receiving the revenues, 33% and 100% respectively, ACs have legal power, although subject to certain constrains. For instance, they may modify the tax rates or introduce some new tax credits. Finally, in other taxes, ACs receive all revenue raised and have a very wide tax power to introduce legal changes, and furthermore they also are responsible for the administration of the taxes. This is the case, for instance, in the Inheritance and Gift Tax (IGT), Annual Wealth Tax (WT), Capital Transfer Tax (CTT) or Stamp Duty (SD).

ACs are responsible for the management, assessment, auditing and collection of the last group of taxes, that is, for any task related to administration. For instance, an AC can decide the staff engaged in tax issues, how they check the proper assessment of assets or how many tax audits are carried out. This latter group of taxes is known as the traditional ceded taxes, since they were the sole ceded taxes in the first stages of the regional financing system. Since the eighties ACs obtain all revenue raised and they are responsible for the administration. Later on, since 1997 they were given tax power, which was further enhanced since 2002. To sum up, ACs have administered traditional ceded taxes for more than twenty years, while they have only had tax power for the last ten years.

Increasing or reducing the statutory tax rates or introducing a new tax credit is much more visible than changing the assessment procedures of assets or rising the number of tax audits. Administration issues have much less public impact than legal changes, although even the former can finally have a greater revenue effect than the latter. For that reason, although the economic literature and the general opinion have not bothered much about administration issues, we believe it is interesting to analyze what Spanish regions have been doing for the last twenty years in the administration grounds and how they have employed their power.

However, decisions about how to administrate taxes can be conditioned by issues far from the control of ACs. For instance, the way the financing system calculates the equalization grants or the level of fiscal equalization are important. If the real revenue raised from a tax is deducted from the equalization grant to receive, the AC does not have any incentive to administer that tax efficiently. This effect is kwnon in the literature as a "tax on tax revenue" (Baretti *et al.* (2002) and it happened in the Spanish system of regional financing until 1988. Likewise, if the State changes key parameters of the tax, such us thresholds, exemptions or tax rates, it is very likely that those changes have an effect on the administration of the tax. Besides, the facts levied in a tax also condition its administration, since they usually depend on external circumstances, for instance the number of transmissions in the housing market. As a consequence, there are external issues, not decided by the own ACs, which impact on the administration of taxes.

Nonetheless, other factors do depend on regions and on how each one employs its administrative power. Then, what are the reasons behind their policies? Do they follow a common pattern or there are important differences? These are some of the questions we can make and we would like to investigate. A starting point from the knowledge of the Spanish situation is wonder what results can be expected. One possibility is that there are important differences in administration that provokes different levels of tax enforcement. Since 2002, when the regional tax power on the traditional ceded taxes was enlarged, a "race to the bottom" process seems clearly to have started as far as IGT is concerned. Indeed, transmissions from the deceased to the consort or the direct decedents were taxed before in fifteen ACs, that is in all ones except two that have a special financing system[1]. In five years, seven more communities do not either levied them, by far the most common case, about 85% over all taxed transmissions. Therefore nine out of the seventeen communities do not levy most transmissions. Given that, there could be a suspicious that before 2002 the competence took place in a less visible way, on the administration of the tax. This hide competence, if any, would be provoked by important differences in the administrative performance, mainly in the auditing process.

Another possibility is that not all ACs make the same, and while some are very active, introducing, for instance, new practices or new auditing schedules, the others are more passive. It is important to bear in mind that when Spain was divided into seventeen ACs, the will of self-governance was strong in a few communities, while in the others that will was not a strong. For that reason, the process of decentralization took two alternative ways, a quicker one for the former and a slower one for the latter. Only since 2002 all ACs almost have the same level of responsibilities. Furthermore, the economic weight and the size of ACs present significant differences, which in turn may affect how they administer the taxes. It is also known that the general managers of the regional tax administrations hold informal meetings among them to exchange experiences and opinions about tax issues.

3. Theoretical Framework

The model consists of three stages:

1. Tax administrations announce their tax auditing policies[2]
2. Each individual reassesses the convenience of his location in the federation according to the relative tax burden

3. Once the (re)location has been made, taxpayers decide their level of tax compliance

[1] Spain is divided in 17 AC, but two of them, Basque Country and Navarre, have a completely different financing system due to historical reasons. Broadly speaking, they levy their own taxes and pay to the State for the public services provided to the whole country. In this paper, we only analyze the role of the other 15 AC, subject to the common financing system. The absence of available data takes us not to consider these two ACs, the so called foral communities.

[2] At least in Spain, the tax administration of each AC is obliged by law to prepare a general tax auditing project for each fiscal year, which is publicized. Obviously, taxpayers might not be aware of it, and/or might not even be able to fully understand its contents. Then, they might under or overestimate the tax auditing probabilities. In any case, we suppose they base their beliefs on the announced policy. Therefore, we suppose that stage 1 is still informative for taxpayers, and moreover there is full commitment by the tax administration.

In order to simplify the model, we will suppose the federation consists of two regions, *i* and *j*. We will solve the model by backwards induction. Then, we first solve the problem of the (representative) taxpayer in region *i* regarding the level of tax compliance.

(i) *The decision about the level of tax compliance*

Basic assumptions:

- Neutral risk averse taxpayers (so, we leave aside "income effects")
- In order to obtain interior solutions, we consider the (reasonable) presence of tax evasion costs
- The taxpayer is predisposed to dishonesty (he aims at minimising the payment of taxes independently of its consequences on public good provision)
- The amount of real tax base is exogenous

Analytically:

$$\underset{B_i}{Min} \quad [t_i \times B_i] + [t_i \times \theta_i \times (\overline{B} - B_i)] + \beta(\overline{B} - B_i)$$

In order to avoid excessive notation, and given that our focus is on tax auditing policies, by now we abstract from the role of taxes, and will assume the tax rate, t_i, is equal to 1. B_i is the tax base voluntarily declared by the individual, but given that t_i=1, B_i is also equal to the amount of tax revenues voluntarily paid by the individual. The real tax base is $\overline{B}$. Hence, $(\overline{B} - B_i)$ is the (absolute) level of tax evasion. However, the individual might be caught evading taxes and then should made an extra payment $(\overline{B} - B_i) \times \theta_i$, where $\theta_i = p_i F_i$, being p_i the tax auditing probability and F_i the fine per unit of tax evaded. In general, the tax administration has control over *p*, but not over *F*; where $0 \leq p \leq 1$ and $F \geq 1$[3]. Tax evasion, though, implies some pecuniary cost (probably, mainly professional advising) and/or moral costs for the taxpayer, β, which we assume are strictly convex in the level of tax evasion, that is, $\beta', \beta'' > 0$[4].

The solution of this problem with respect to B_i is trivial. The FOC is the following:

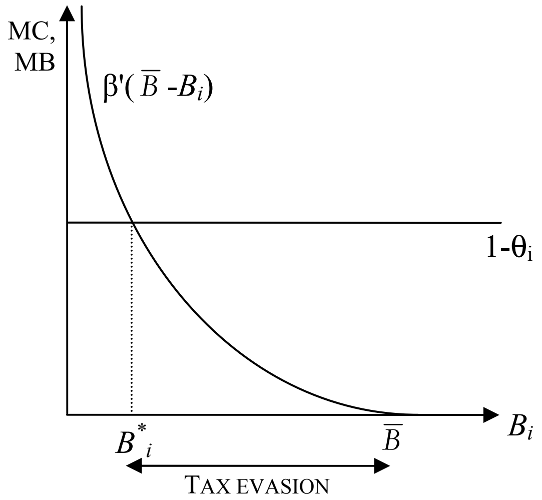
[3] Throughout the model, we will implicitly consider *F* as fixed, since we are interested in the behaviour of the tax administration, in particular, regarding *p*. That is why, although θ is *a* "tax enforcement" parameter that embodies both *F* and *p*, in our context we are only interested in *p*. Hence, we will indistinctly use the concept "tax enforcement" policy or "tax auditing" policy, although the latter is the most appropriate one in our context.

[4] For functions of a single variable, differentiation is indicated by a prime.

$$1-\theta_i = \beta'$$ [1]

The LHS is the marginal benefit (MB) of tax evasion, and the RHS is the marginal cost (MC) of tax evasion. Graphically,

Figure 1: Optimal level of tax compliance



where B_i^* is the optimal level of tax base declared. In order to guarantee an interior solution, we have to assume that 1-θ_i>0[5]. Additionally, we also have to suppose that $\beta'(\overline{B}) \rightarrow \infty$ (*i.e.*, the individual still has some "moral" regarding the payment of taxes, such that even if $\theta_i = 0$, there would still be tax compliance[6], or it is simply impossible to become fully invisible to the tax administration) and $\beta'(0) = 0$ (*i.e.*, the first amounts of tax evasion have a negligible cost, such there is no even need of professional advising; or some small amount of tax evasion is generalized, and so the taxpayer does not feel bad from a moral point of view when he evades some small amount of taxes). Thus, $0 < B_i^* < \overline{B}$.

We perform some basic comparative statics that will be useful for the tax administration's maximisation problem. From the FOC [1], it is easy to verify that: $dB_i / d\theta_i = t_i / \beta'' \geq 0$, that is, the level of tax compliance increases as the tax enforcement policy becomes more severe. Although we have implicitly assumed that the fine is established per unit of tax evaded, a higher tax rate promotes lower tax compliance: $dB_i / dt_i = -(1-\theta_i)/\beta'' \leq 0$. In contrast with Yitzhaki (1974), in our model when the tax rate goes up profitability of evading taxes also increases because we are supposing the

[5] This condition is the standard one in tax evasion theory: 1>*pF*.

[6] This reasoning is consistent with the flourishing literature on tax morale. See, *e.g.*, Andreoni *et al.* (1998), section 8, for a review, and Sandmo (2006) for a attempt of reconciliation between this strand of literature and the neoclassical economic theory approach started by himself (Allingham and Sandmo, 1972).

costs of tax evasion do not depend on the amount of taxes evaded, but on the amount of tax base evaded, and so this substitution effect does not cancel out. Finally, despite of neutral risk aversion, $dB_i / d\overline{B} = 1$. Again, this result arises because of the functional form of the tax evasion costs. Keeping the marginal benefit of tax evasion constant, $1-\theta_i$, in front of an increase in 1 unit of $\overline{B}$, B_i will increase in the same amount in order to maintain constant the marginal cost of tax evasion in the optimum. Hence, although the absolute level of tax compliance will remain unchanged, the percentage level of tax compliance, $B_i / \overline{B}$, will increase.

(ii) *The decision to move*

The individual will be indifferent between location *i* and location *j* when the following condition holds:

$$B_i^*(\theta_i) + \left[\overline{B} - B_i^*(\theta_i)\right] \times \theta_i + \beta(\overline{B} - B_i^*(\theta_i)) = B_j^*(\theta_j) + \left[\overline{B} - B_j^*(\theta_j)\right] \times \theta_j + \beta(\overline{B} - B_j^*(\theta_j)) + \gamma_{ij} \qquad [2a]$$

The subscript * indicates optimal decision in previous stage by the taxpayer, while the parameter γ_{ij} represents the costs of moving from *i* to *j*, which we suppose are fixed[7]. Note we are also assuming that the individual obtains the same real tax base independently of his place of residence[8]. As we will argue next, it is better to rewrite the above condition as follows:

$$B_i^*(\theta_i) + \left[\overline{B} - B_i^*(\theta_i)\right] \times \theta_i + \beta(\overline{B} - B_i^*(\theta_i)) - B_j^*(\theta_j) - \left[\overline{B} - B_j^*(\theta_j)\right] \times \theta_j - \beta(\overline{B} - B_j^*(\theta_j)) \equiv \Delta_{ij} = \gamma_{ij} \qquad [2b]$$

Thus, Δ_{ij} are the (gross) tax savings from moving from jurisdiction *i* to jurisdiction *j*. We suppose within a jurisdiction all individuals are equal except regarding their mobility parameter picked up by γ. Thus, the LHS of expression [2b], Δ_{ij}, is constant for any individual living in *i*, while the RHS varies among individuals according to their degree of mobility.

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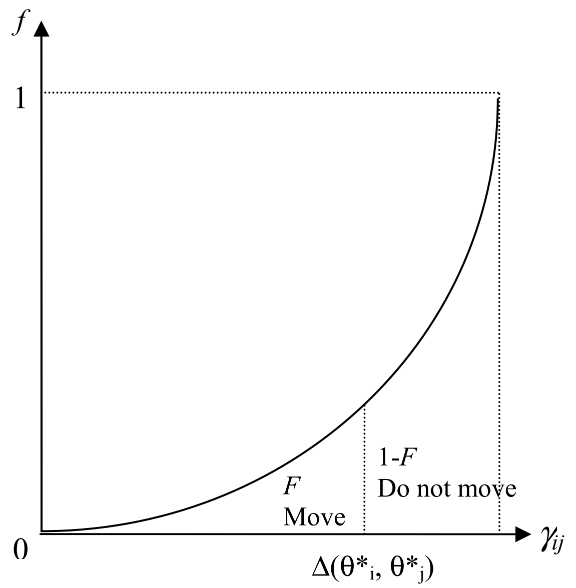
[7] For instance, these costs could be interpreted as the price of housing in region *j* with respect to prices in *i* including transaction costs. If the location decision were made in an intertemporal context, those relocation costs would tend to zero, although that tendency would not be equal for all taxpayers (among others, it would depend on the expectancy of life of each taxpayer). The parameter γ could also be interpreted as information costs regarding tax auditing differentials, which might be important given what we said in fn. 1. That is, for some taxpayers, γ=0, which in absence of physical costs of mobility, would mean they have full information regarding tax auditing differentials among territories. In any case, differences in γ among taxpayers are crucial for our model as we will see next.

[8] This is consistent with our empirical analysis, since the most likely taxpayers that may move because of tax differentials in the inheritance and gift tax are retired owners of capital. Their pension is guaranteed independently of their residence, while their capital return we can reasonably suppose is given.

While the different degree of mobility among taxpayers guarantees that both region *i* and region *j* are populated, the very existence of costs of mobility permits that at equilibrium $\theta_i, \theta_j \geq 0$, and similarly for the case of region *j*. Otherwise, if taxpayers were fully mobile (or according to a wider interpretation of γ, if they were fully aware of tax auditing differentials; see fn. 6), $\theta_i = \theta_j = 0$.[9]

Figure 2: Distribution of taxpayers according to their mobility costs



Individuals might graphically be distributed along γ_{ij} as Figure 2 shows. In the vertical axis, we have the density function, *f*. Above a given difference in expected tax payments due to different tax auditing policies, say Δ^*_{ij}, we have all those taxpayers that remain in region *i* (*i.e.*, those who have high mobility costs), while below Δ^*_{ij}, there are all those taxpayers that move to region *j* (*i.e.*, those who have relatively low mobility costs). The respective shares of each group are 1-*F* and *F*. If $\Delta<0$, then $F\leq 0$, that is, the number of taxpayers in region *i* would increase due to the mobile taxpayers coming from *j*.

(iii) *The decision about the level of tax enforcement*

[9] We will see next that because of the fear of taxpayers' mobility, tax enforcement policies become more costly at the decentralized level and so tax evasion will be higher than if tax administration were centralized. If we interpret a high level of mobility costs as lack of information about what other tax administrations are doing (see fn. 6), tax evasion could be reduced if tax auditing policies were somewhat opaque to the taxpayers. Thus, somewhat paradoxically, and in contrast with recent political economy models, in our context decentralized outcomes would tend to be better, the lower the degree of transparency of tax auditing policies.

We suppose each tax administration (TA) operates given a fixed budget, which is big enough. In this case, maximization of net tax revenue collected is the socially optimal strategy for the administration (Slemrod and Yitzhaki, 1987). Without loss of generality, we assume that in absence of mobility the number of *i*-residents is equal to 1, and equally for region *j*. Therefore, the total number of taxpayers in the federation is equal to 2.

The maximization problem of the *i*-TA is the following:

$$\underset{\theta_i}{Max} \quad \left(1 - F\left(\Delta(\theta_i, \theta_j)\right)\right) \times \left\{T\left(B_i(\theta_i), \theta_i\right) - C(\theta_i)\right\}$$

where *C* are the tax administration costs, which we suppose are strictly convex in θ_i (*i.e.*, in p_i). Again, we are not interested in *F*, but in *p*. Thus, when the TA is maximising with respect to θ_i, implicitly we must assume that it is deciding the optimal level of p_i. Gross tax revenues per taxpayer, T_i, are $B_i + (\overline{B} - B_i) \times \theta_i$, while 1-*F* is the number of taxpayers in region *i*, which can be greater than one (immigration) or less than one (outmigration).

The FOC of the maximisation problem is the following:

$$-\frac{\partial F}{\partial \Delta} \times \frac{\partial \Delta}{\partial \theta_i} \times (T - C) + (1 - F) \times \left(\frac{\partial T}{\partial \theta_i} - \frac{\partial C}{\partial \theta_i}\right) = 0 \qquad [3a]$$

where $\partial F / \partial \Delta \geq 0$ is the density function, *f.* Applying the envelope theorem we have that $\partial \Delta / \partial \theta_i = (\overline{B} - B_i) > 0$, and also from the taxpayer's maximization problem, $\partial T / \partial \theta_i = \overline{B} - B_i + \left((1 - \theta_i) / \beta''\right) > 0$. Then, substituting these derivatives in the above expression, we have:

$$f \times (\overline{B} - B_i) \times (T - C) = (1 - F) \times (T' - C') \qquad [3b]$$

The LHS is the marginal cost of rising θ_i due to the mobility of individuals, while the RHS is the (net) marginal benefit of rising θ_i keeping the number of taxpayers in jurisdiction *i* constant. We define the "hazard rate", $H \equiv f / (1 - F)$, which is the risk of losing additional taxpayers if Δ increases given that till that point there are 1-*F* taxpayers in region *i*. Then,

$$H \times (\overline{B} - B_i) \times (T - C) = (T' - C') \qquad [3c]$$

The expected loss in the number of taxpayers due to an increase in θ_i is $H \times (\overline{B} - B_i)$, while in terms of net tax revenue that implies a loss reflected by the LHS of expression [3c].

Note that as long as *H*=0, we are back to the traditional case where tax auditing policies are centralized (or, in our decentralized context, mobility costs are extremely high), and then at the optimum $T' = C'$. Otherwise, **as long as *H*>0, in equilibrium, $T' > C'$, and so the tax auditing policies in the decentralized case will be less severe than in the centralized case**[10]. Because of the (real or perceived) mobility of tax bases, tax enforcement policies are more costly at the decentralized level.

Empirical prediction

However, for our empirical purposes, we are only interested in the slope of the reaction function, that is, in $\partial\theta_i / \partial\theta_j$. From total differentiation of the FOC, we obtain that: $sign(\partial\theta_i / \partial\theta_j) = sign(\partial H / \partial\Delta)$.

Then, **as long as** $\partial H / \partial\Delta > 0$, as can be reasonably assumed for most distribution functions (see Bagnoli and Bergstrom, 2005)[11]**, tax auditing policies of region *i* and region *j* are strategic complements.** In any case, independently of the sign, the fact that $\partial\theta_i / \partial\theta_j \neq 0$ would be indirect evidence that (real or perceived) mobility of tax bases affects tax enforcement policies when these policies are decentralized[12].

In absence of taxpayers' mobility or if the tax administration is centralized, it is easy to show that: $\partial\theta_i / \partial\overline{B} = 0$ and $\partial\theta_i / \partial t_i > 0$. That is, the tax rate and tax enforcement parameters are complement; while the sign of the former partial derivative is congruent with the fact that $\partial B_i / \partial\overline{B}_i = 1$, and so the profitability of increasing θ_i does not change as the absolute level of tax compliance remains unchanged. However, in the presence of mobility, those results do not necessarily hold[13]:

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[10] It is very easy to show that as long there is a full (gross) equalization grant system, the incentives to carry out tax auditing tax policies are null, and so θ_i=0. See also Stöwhase and Traxler (2005).

[11] If the density function is log-concave, the hazard function is monotone increasing. For instance, for Figure 2, that holds since we have used a power distribution function. In contrast, that would not hold for an exponential distribution (constant hazard rate), or a Pareto distribution (monotone decreasing hazard rate). Other distributions like uniform, normal, logistic, chi-squared, Laplace, and under some restrictions on the parameters, Weibull, gamma or beta aso produce a monotone increasing hazard function. In numerical simulations we will carry out in the Appendix, for simplicity of calculus, we will employ a uniform distribution.

[12] As Brueckner notes: "It is important to realize that for strategic interactions to materialize, all that is required is a perception on the part of state governments that generous benefits attract welfare immigrants" (Brueckner, 2000, p. 508). In our case, instead of generous benefits, it is lax tax auditing policies that might attract taxpayers, or at least it is perceived in this way by the tax administration.

[13] We have supposed f'=0 and β'''=0, which is also congruous with the functional forms employed in the Appendix.

If $H > 0$, $\partial\theta_i / \partial t_i > 0 \Leftrightarrow 1 + 3\varepsilon_{\overline{B}-B,t} > H \times \left\{ \frac{(T-C)[3HT+2]-(t+2T)}{3-H(T-C)-H(T-t)} \right\}$ [4]

If $H > 0$, $\partial\theta_i / \partial\overline{B} < 0 \Leftrightarrow \frac{t_j}{t_i} < 1 + \frac{1}{H(T-C)}$ [5]

Therefore, on the one hand, in the presence of mobility, when $\overline{B}$ increases there is "more at stake", since $\partial T / \partial\overline{B} = t$, and so the risk of losing taxpayers is more costly. This forces the tax administration to reduce its tax enforcement policy. However, the hazard rate itself might decrease if $t_i < t_j$, since $\partial\Delta / \partial\overline{B} = (t_i - t_j)$, and then although it is quite unlikely since differences in tax rates should be very big, it could be the case that $\partial\theta_i / \partial\overline{B} > 0$. A sufficient condition for $\partial\theta_i / \partial\overline{B} < 0$ is simply $t_i > t_j$. On the other hand, the result regarding a variation in the tax rate is not clear-cut. In general, the sign will still be positive if mobility is not great and tax rates are relatively low[14]. Finally, if $H>0$, $\partial\theta_i / \partial t_j > 0$, since the rise of tax rates in region *j* creates a positive externality in region *i* making mobility of *i*-residents less attractive, $\partial\Delta / \partial t_j < 0$.

4. Empirical Analysis

4.1. *Empirical Model*

According to the theoretical framework, the basic empirical specification to be estimated is the following:

$$\begin{aligned} \theta_{it} = {} & \beta_0 + \beta_1 t_{it-1} + \beta_2 K_{it-1} + \beta_3 \overline{B}_{it-1} + \\ & + \beta_4 \sum_{j \neq i} w_{ij} \theta_{jt-1} + \beta_5 \sum_{j \neq i} w_{ij} t_{jt} + F_i + T_t + u_{it} \end{aligned} \qquad [5a]$$

where β_4 and β_5 are the spatial autoregressive coefficients, which measure the overall strength of interdependence among AC's in tax enforcement policy, θ_{it} , and tax rates, t_{it} , respectively, while w_{ij} accounts for the relative interdependence relation among the respective AC's, or in matrix terms *W* ("spatial weighting matrix"). The predetermined variables included are congruous with the theoretical framework. Apart from the tax enforcement parameter and the tax rate, we have included K_{it} as a variable that aims at picking up the level of "tax morale", which supposedly increases the costs of tax evasion, and a proxy of the real tax base, $\overline{B}_{it}$. The expected signs of the

[14] According to the numerical simulations carried out in the Appendix, given a high degree of mobility (*i.e.*, Z=2,5), it can be shown that in order $\partial\theta_i / \partial t_i < 0$, the tax rate has to be abnormally high (61,5%). For higher values of *Z*, that threshold diminishes, but at the optimum that is only compatible with fully lax tax enforcement policies (*i.e.*, $\theta_i = \theta_j = 0$).

estimates are: $\beta_2 \leq 0$, $\beta_4, \beta_5 \geq 0$, while under "normal conditions" $\beta_1 \geq 0$ and $\beta_3 \leq 0$ (see [4] and [5], respectively). In order to avoid obtaining biased estimates, we aim at controlling for unobserved should that might correlated with the rest of predetermined variables including a set of time and fixed effects, T_t and F_i, respectively.

We will suppose different sources of interdependence among AC's, and so will define different alternative spatial weights matrices. First, we will suppose that those AC's that will most likely compete with each other are those which are geographically contiguous (*contiguity*), while second, will also consider the possibility that all AC's compete with each other (*uniformity*). In this latter case, it is not possible then to include the set of time effects.

The above basic specification will be widened in order to take into account other factors – *political* and *budgetary* – that might affect the objectives of the tax administration (*vid.* Esteller, 2005):

$$\theta_{it} = (...) + \beta_6 Elec_{it} + \beta_7 Izq_{it} + \beta_8 Transfers_{it} \qquad [5b]$$

where *a priori* we expect: $\beta_6, \beta_8 \leq 0$ and $\beta_7 \geq 0$

4.2. *Data*

Table ?: Data description

	Mean	Standard deviation	Max	Min
TAX VARIABLES				
Tax auditing				
Tax rate				
OTHER VARIABLES				
Tax morale				
Real tax base				
Election year				
Leftist gov.				
% Transfers				

4.3. *Results*

					(no CL)				
Log(auditm)$_{-1}$	0.7457** (2.22)	0.9888*** (2.67)	0.3571 (0.512)	0.4925** (2.02)	0.4634* (1.89)	2.900** (2.48)	1.3400*** (2.86)	1.7668** (2.36)	0.7783** (2.27)
Log(audit)$_{-1}$	-.-	-.-	-0.5490 (-1.20)	-.-	-.-	-.-	-.-	-.-	-.-
Log(auditm)$_{-1}$ $\times$ D(border PB or Navarre)	-.-	-.-	-.-	0.9381 (1.15)	1.3873 (1.35)	-.-	-.-	-.-	-.-
Log(auditm)$_{-1}$ $\times$ Transfers (%)	-.-	-.-	-.-	-.-	-.-	-0.0350** (-2.18)	-.-	-.-	-.-
Log(auditm)$_{-1}$ $\times$ D(High Expenditure)	-.-	-.-	-.-	-.-	-.-	-.-	-1.2527*** (-2.75)	-.-	-.-
Log(auditm)$_{-1}$ $\times$ Years of experience	-.-	-.-	-.-	-.-	-.-	-.-	-.-	-0.2243** (-2.03)	-.-
Log(auditm)$_{-1}$ $\times$ D(t<1997)	-.-	-.-	-.-	-.-	-.-	-.-	-.-	-.-	-0.1732*** (-3.24)
Mortality rate (%)	0.9333* (1.95)	-0.2071 (-0.554)	1.2102 (1.05)	0.8807* (1.74)	0.8320 (1.61)	0.8329* (1.68)	0.7595 (1.47)	1.0517** (2.41)	1.1100** (2.33)
Residential capital p.c.	0.00055 (1.51)	0.00044** (2.36)	0.00113 (1.37)	0.00065** (2.07)	0.00066** (2.14)	0.00040 (1.30)	0.00052* (1.73)	0.00054* (1.65)	0.00050 (1.39)
GPD p.c.	-0.0009** (-2.02)	0.00028 (0.911)	-0.002* (-1.71)	-0.0010** (-2.04)	-0.0010** (-2.01)	-0.00088* (-1.87)	-0.0009** (-1.98)	-0.0012*** (-2.61)	-0.00067 (-1.47)
Tax morale p.c.	-0.0021 (-0.125)	-0.0247** (-2.47)	0.0055 (0.291)	0.0008 (0.041)	0.0022 (0.115)	0.0024 (0.130)	0.0012 (0.0668)	-0.0035 (-0.207)	-0.0009 (-0.052)
Left govt.	0.7009 (1.41)	0.1030 (0.191)	0.6872 (1.05)	0.6358 (1.41)	0.5732 (1.34)	0.4910 (1.09)	0.6040 (1.32)	0.5856 (1.18)	0.7440 (1.54)
Transfers (%)	-0.0111 (-0.835)	-0.0179 (-0.889)	-0.0260 (-1.27)	-0.0095 (-0.665)	-0.011 (-0.759)	-0.1353** (-2.19)	-0.0062 (-0.447)	-0.0133 (-1.01)	-0.0091 (-0.685)
Individual time trends	YES	NO	YES	YES	YES	YES	YES	YES	YES
R2-adjusted	0.6839	0.3863	0.3652	0.6897	0.6958	0.7044	0.7021	0.6981	0.6863
# Observations	187	187	172	187	187	187	187	187	187
DW	1.4194	0.7683	-.-	1.4319	1.4449	1.4636	1.4789	1.4948	1.4310
AR(1)	2.224 [0.026]	1.968 [0.049]	1.032 [0.302]	2.385 [0.017]	2.393 [0.017]	2.171 [0.030]	2.108 [0.035]	2.278 [0.023]	2.297 [0.022]
AR(2)	-2.115 [0.034]	1.659 [0.097]	-1.771 [0.077]	-2.127 [0.033]	-2.122 [0.034]	-2.134 [0.033]	-2.138 [0.033]	-2.137 [0.033]	-2.152 [0.031]

	Average	Transfers		Level of competences		Years of experience		Degree of tax responsibility	
		% High	% Low	High	Low	# High	# Low	High (>1997)	Low (<1997)
Reaction	0.7457	-0.0143	1.9286	0.0873	1.34	-1.2863	0.7491	0.7783	0.6051
$\chi^2(1)=0$	4.9325 [0.026]	0.0032 [0.955]	6.8489 [0.009]	0.2513 [0.616]	8.164 [0.004]	2.7065 [0.100]	7.5006 [0.006]	5.1436 [0.023]	3.4502 [0.0632]
$\chi^2(1)=1$	-.-	-.-	1.5864 [0.208]	-.-	0.5256 [0.468]	-.-	-.-	-.-	--.-

Note: High=1.5*Average; Low=0.5*Average

	Uniform	Distance	Political color	Neighbors
ρ_{-1}	0.7457** (2.22)	0.5722** (2.04)	0.3623** (2.45)	0.2969* (1.77)
Mortality rate (%)	0.9333* (1.95)	0.9959** (2.04)	1.1041*** (2.51)	0.9996* (1.85)
Residential capital p.c.	0.00055 (1.51)	0.00061* (1.64)	0.00063 (1.63)	0.00073** (1.96)
GPD p.c.	-0.0009** (-2.02)	-0.0009** (-2.21)	-0.0010*** (-2.56)	-0.0010** (-2.51)
Tax morale p.c.	-0.0021 (-0.125)	-0.0010 (-0.0596)	0.0012 (0.0707)	-0.0015 (-0.0965)
Left govt.	0.7009 (1.41)	0.7386 (1.46)	0.8009 (1.53)	0.8025 (1.60)
Transfers (%)	-0.0111 (-0.835)	-0.0126 (-0.959)	-0.0141 (-1.08)	-0.0132 (-1.05)
Individual time trends	YES	YES	YES	YES
R2-adjusted	0.6839	0.6790	0.6722	0.6842
AIC	3.3205	3.3358	3.3568	3.3194
# Observations	187	187	187	187
DW	1.4194	1.4111	1.4246	1.4277
AR(1)	2.224 [0.026]	2.219 [0.027]	2.285 [0.022]	2.204 [0.028]
AR(2)	-2.115 [0.034]	-2.087 [0.037]	-2.001 [0.045]	-1.993 [0.046]

5. *Conclusions*

(to follow)

Appendix: Numerical exercise

In this Appendix, we provide a simple numerical exercise in order to obtain the Nash-Cournot equilibrium derived from competition in tax auditing policies, and derive some basic comparative statics. The functional forms are coherent with the basic assumptions set in section 2:

A1. Expected tax payment by the taxpayer in region *i* is: $T_i \equiv B_i + (\overline{B} - B_i) \times \theta_i$, where notation is the same than in section 2; from now on, we assume $\overline{B} = 1$, so $T_i \equiv B_i + (1 - B_i) \times \theta_i$.

A2. Taxpayers face a cost of tax evasion, which we assume strictly increasing in tax evasion: $CT_i = K \times (1-B_i)^2$. Thus, for a given level of tax evasion, CT_i is greater the greater the value of K. This value K will be useful to perform some basic comparative statics, and can be broadly interpreted as a generic increasing cost factor, or more narrowly, for example, as a greater level of tax morale.

From the combination of A1 and A2, we obtain the optimal level of tax compliance: $B_i^* = 1 - \left(\frac{1-\theta_i}{2K}\right)$. Hence, even if $\theta_i = 0$, there is tax compliance, unless $K \leq 0{,}5$.

A3. Taxpayers decide their location according to the tax auditing differential. Given A1 and A2, that differential is:

$$\Delta_{ij} \equiv \frac{1}{4K}\left\{(1-\theta_j)^2 - (1-\theta_i)^2\right\} \overset{\leq}{\underset{>}{}} 0$$

A positive (negative) value of Δ means that expected tax payments are relatively higher in region *i* (region *j*). Given the tax differential, those taxpayers with mobility costs lower than Δ will move, while the rest will not.

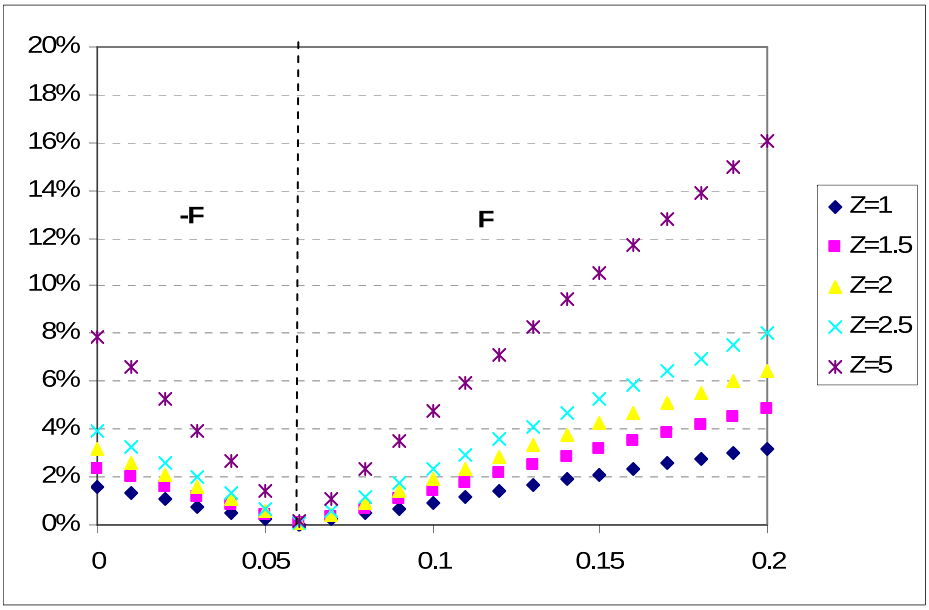
A4. Thus, a key aspect of the numerical simulation is how taxpayers distribute according to their mobility costs. We will assume a uniform distribution of taxpayers: $F = Z \times \Delta$. The density of this distribution function is (weakly) log-concave, and so its hazard rate is monotone increasing[15], a necessary condition in order to guarantee that tax auditing policies are strategic tax complements.
As we will see in the parameterization exercise, a (reasonable) equilibrium value for θ is 0,0612. In Figure A1, we show the distribution of taxpayers along Δ, being this calculated for different values of θ_i given $\theta_j = 0{,}0612$.[16]

In fact, on the horizontal axis, we have θ_i instead of using Δ. On the vertical axis, we have *F*. In this way, it is easier to interpret the consequences of increasing θ_i (and so Δ). If $\theta_j = \theta_i = 0{,}0612$, $\Delta = 0$, and nobody moves. At that point the density is null. On the right of that point, *F* taxpayers of region *i* move to region *j*. On the contrary, on the left, some taxpayers of region *j* move to region *i*, so the number (or percentage) of taxpayers is now negative, -*F*. We suppose the distribution function of taxpayers along Δ is equal in region *i* and in region *j*.

[15] $\partial H/\partial Z = (Z/(1-Z\Delta))^2 > 0$

[16] Recall that θ_I is defined in a broad way, such that $\theta_I = p \times F$, where *p* is the tax auditing probability and *F* is the fine per unit of tax evaded. Hence, for example, $\theta_i = 0{,}0612$ is compatible with $F_i = 2{,}5$ and $p_i = 0{,}0245$.

Figure A1: Distribution function of taxpayers for different mobility costs



If $\theta_i = 0{,}08$, *F*=0,465% for *Z*=1, while *F*=2,323% for *Z*=5. Hence, the parameter *Z* captures the degree of mobility between jurisdictions, being *Z*=0 the case of null mobility (or centralized tax administration). In the extreme case in which $\theta_i = 1$, *F*=12% for *Z*=1 and *F*=59% for *Z*=5. Thus, within that range of values of *Z*, there will always taxpayers in both jurisdictions even if Δ reaches its maximum.

A5. Regarding the tax administration, we suppose the tax administration costs are proportional to the intensity in tax enforcement: $CA_i = c \times \theta_i^2$, being the cost function strictly convex. The tax administration aims at maximising expected payments of the taxpayers net of administration costs. We will solve for a Nash-Cournot type equilibrium, that is, each administration chooses its best strategy given the action taken by the other tax administration. Then, for example, the reaction function of *i*-TA is: $\theta_i = \theta(\theta_j, Z, K, c; \overline{B}, t)$, where recall we have assumed $\overline{B} = t = 1$.

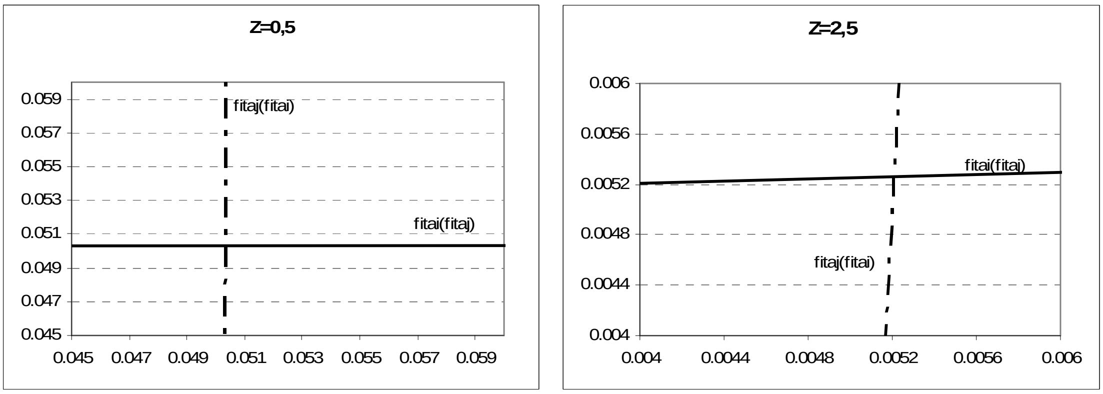
Once we have established all necessary assumptions of the exercise, we calibrate the model in order to obtain reasonable equilibrium values of θ. The benchmark case is parametrized such that the values in Table A1 hold.

There is no *a priori* a strong justification for the restrictions imposed, nor for the basic parameters obtained. For instance, according to the "Memoria de la Agencia Tributaria" (2005), the average *CA*/*T* for OECD countries is 0,0178, while for the very AEAT that value is 0,0078. Thus, we have decided to impose a relatively high value (0,02), as it is usually argued that decentralized tax administrations have higher operating costs. Regarding the level of tax compliance, a value around 0,8 is supposed to be reasonable. Given these two restrictions, we obtain the "basic parameters" (see also fn. 15).

Table A1: Parametrization for the Benchmark Case

Restrictions	
$\overline{B}$	1
B	0,75
CA/T	0,02
Basic parameters	
K	1,877
c	4,083
θ	0,0612

Figure A2: Tax auditing reaction functions for different levels of mobility



In Figure A2, we show the reaction functions for two values of *Z* (*Z*=0,5: low mobility; *Z*=2,5: highest level of mobility compatible with positive tax auditing rates). As expected, the slope of the reaction function is positive, and it is increasing in the value of *Z*. Moreover, as long as mobility increases (measured by *Z*), the equilibrium tax auditing policies tend to zero. For values of *Z* above 2,5, the tax auditing policy is fully lax.

Table A2: Benchmark case

	Z=0	**Z=1**	**Z=2,5**	**Z>2,5**
θ	0,0612	0,0392	0,0052	0
B	**0,750**	0,744	0,735	0,734
$\Delta B/B$	-.-	-0,781%	-1,990%	-2,133%
T-CA	0,750	0,738	0,736	0,734
tmg	0	0,374	0,920	1

In the following tables, we provide information about some alternative symmetric equilibrium. In Table A2, we show the complete results for the "Benchmark case". As already suggested by Figure A2, the greater the value of *Z*, the lower the level of tax enforcement (*i.e.*, the "race to the bottom" becomes fiercer). Tax compliance decreases up to 2,133% when Z>2,5 with respect to the case in which mobility is null (Z=0). In the last row, we calculate the distortion due to mobility as a marginal tax rate on gross tax revenues, i.e., *tmg*=1-(CA'/T'). The marginal tax rate is increasing in the degree of mobility.

Table A3a: More tax morale ($K=K_0\times 2$)

	Z=0	Z=1	Z=2,3	Z>2,3
θ	0,0316	0,0181	0,0001	0
B	0,871	0,869	0,867	0,867
$\Delta B/B$	-.-	-0,206%	-0,481%	-0,483%
T-CA	0,871	0,870	0,867	0,867
tmg	0	0,435	0,997	1

With respect to the basic parameters used in Table A2, in Table A3a we multiply by two the value of K (K_0=1,877). That is, taxpayers either simply have higher evasion costs or their level of tax morale is higher. Although, the cause of the higher value of K is unimportant, we will consider that a higher value of K is due to a higher level of tax morale. *Ceteris paribus*, a higher level of tax morale permits the tax administration to reduce the level of tax enforcement and still have a very high level of tax compliance. This low level of tax enforcement makes the presence of taxpayer mobility quickly reduces the value of θ in comparison with the Benchmark Case. In any case, the negative impact on tax compliance is modest. On the contrary, in Table A3b, we obtain the equilibrium assuming a low level of tax morale. Then, the impact of tax competition on the level of tax compliance is quite high, which is normal since the sensitiveness of tax compliance with respect to θ increases with lower K[17]. For instance, for Z>4,25 (highest level of mobility compatible with positive tax auditing rates), the level of tax compliance decreases 11,621% with respect to the benchmark case (0,529 *vs.* 0,467).

Table A3b: Less tax morale ($K=K_0/2$)

	Z=0	Z=1	Z=2,3	Z=2,5	Z=4,25	Z>4,25
θ	0,1154	0,0877	0,0512	0,0457	0,0007	0
B	0,529	0,514	0,495	0,492	0,468	0,467
$\Delta B/B$	-.-	-2,784%	-6,464%	-7,020%	-11,552%	-11,621%
T-CA	0,529	0,525	0,510	0,506	0,468	0,467
tmg	0	0,263	0,586	0,633	0,995	1

In tables A4, we show the equilibrium for different marginal unitary costs of the tax administration. In Table A4a, we suppose marginal unitary costs are twofold the benchmark case. As a consequence, the level of tax enforcement is lower and so it is the level of tax compliance. Given this low level of tax enforcement, the consequence is tax competition drives the

[17] $\partial/\partial K(\partial B/\partial K)=-1/(2K^2)<0$.

level of tax enforcement to zero for lower values of *Z* than in the benchmark case. The results are just the reverse when the tax administration becomes more efficient with respect to the Benchmark case (Table A4b).

Table A4a: Inefficient tax administration ($c=c_0\times 2$)

	Z=0	**Z=1**	**Z=2,4**	**Z>2,4**
θ	0,0316	0,0201	0,0038	0
B	0,742	0,739	0,735	0,734
$\Delta B/B$	-.-	-0,411%	-0,996%	-1,092%
T-CA	0,742	0,741	0,736	0,734
Tmg	0	0,371	0,883	1

Table A4b: Efficient tax administration ($c=c_0/2$)

	Z=0	**Z=1**	**Z=2,4**	**Z=2,7**	**Z>2,7**
θ	0,1154	0,0748	0,0143	0,0011	0
B	0,764	0,754	0,737	0,734	0,734
$\Delta B/B$	-.-	-1,414%	-3,522%	-3,980%	-4,020%
T-CA	0,764	0,761	0,748	0,734	0,734
tmg	0	0,380	0,889	0,992	1

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