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Tax evasion in a semi-decentralised Tax administration

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TAX EVASION IN A SEMI-DECENTRALISED TAX ADMINISTRATION

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ABSTRACT: This piece of work aims to analyse how a taxpayer behaves when she is presence of two tax administrations, and each of them has power over interconnected tax bases. We justify this is the present institutional framework in Spain. From our theoretical model, we find out the sign of the taxpayer's reactions when one tax instrument of an administration varies. Under these circumstances, in certain cases, the effectiveness of the tax instruments in reducing tax evasion certainly becomes quite reduced. We also present some numerical simulations to help interpreting the theoretical results with Spanish data.

JEL Code: D1, H26, H73

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1. Introduction

The aim of this paper is to analyse the behaviour of a potentially evader taxpayer in presence of what we call a Semi-decentralised Tax Administration, i.e., within an economic federation, there are two institutions at different levels of government with tax administration responsibilities¹. The important point to note is the fact that each one of them administers tax figures that have some kind of connection in the definition of their respective tax bases. The situation that induced us to analyse such problem is the existent connection between the Income tax (IRPF, or *Impuesto sobre la Renta de las Personas Físicas*), administered by the Central Tax Authority (CTA, or *Agencia Estatal de la Administración Tributaria*), which taxes, among others, private returns from labour and private capital, and the Wealth Tax (IPN, or *Impuesto sobre el Patrimonio Neto*), which taxes the possession of private capital, and is administered by the regional tax authorities (RTA)². Hence, this connection comes out from the fact the IPN is taxing private capital, and the IRPF its returns. Under these circumstances, we suppose the taxpayer will be influenced in her decision to declare such wealth by the possibility that later on such action might have consequences on her fiscal relation with the CTA with respect to the IRPF, and viceversa. For instance, when she has obtained some returns from capital not previously declared in the IPN, wonders something like this: might it be optimal not to declare such returns, since otherwise, the wealth that has provoked them should also fiscally emerge in the IRPF?.

Such institutional setting has not varied since 1997, when from that date on, the regional governments (AACC, or *Comunidades Autónomas*; above, generally named as RTA) have been given, within some limits, tax power over a portion of the tariff of the IRPF, but they have not been allocated administration power over that tax figure as well. Then, the argument stated above is still valid. On the whole, now the situation is as follows: the CTA has power to decide the probability of auditing in IRPF, and the central government sets the income tax rate³; the RTA has power to decide the probability of auditing in IPN, and the regional government partial power to vary the wealth tax rate, and less to do so with the income tax rate. The legal structure of tax fines is centrally determined.

To model such institutional setting, we will assume that audit probabilities are fixed or random, that is, are independent of the amount of declared tax base, at least within groups of taxpayers. Our analysis will be very similar to the seminal papers by Allingham and Sandmo (1972), from now on, AS (1972), and Yitzhaki (1974), YT (1974). More generally, the issue that arises behind this framework is the multiprincipal nature of

¹ See Esteller (1999) for a detailed description of the economic consequences of such institutional setting on the optimal taxation decisions of each tax administration.

² However, this type of institutional characterisation is not exclusive of Spain. For example, in the US, both the Federal and the States have tax and administration power over the same tax figures. See, e.g., "Tax Administration in the United States of America: A Decentralized System", Duncan, H.T., McLure, Ch.E., International Bureau of Fiscal Documentation, Vol. 51, No. 2, pp. 74-85, 1997.

³ Throughout the paper, it will not make any difference whether the tax rate, or any other tax instrument, is fixed by a government or by a tax administration.

government. As Martimort (1996) states:

"Economists are now also aware of the importance of the incentive issues for evaluating the efficiency of government intervention in various fields of the economy,... However, they have not, at least until very recently, evaluated this impact in a more realistic context taking into account explicitly that incentives are not provided through a unique and comprehensive contract but through a web of various (incomplete) contracts linking different bodies or principals to society" (p. 675).

And once we take into account such nature, being in our case the principals each one of the tax administrations or each one the governments,

"The general conclusion is that the power of incentives in the equilibrium among several such principals is weakened, sometimes dramatically" [Dixit (1997), p. 98].

That general conclusion becomes particular in our case.

The structure of the paper is as follows: we first analyse the decision of the taxpayer to evade taxes in presence of two tax administrations; next, through comparative static, we describe the reactions of the individual when one of the administrations varies its tax parameters; in section three, we present our conclusions, followed by an appendix that describes the computation process of the numerical simulations shown in the main text.

2. Optimal individual behaviour of the taxpayer

In order to analyse how the taxpayer behaves in front of two tax administrations, we will follow the standard analysis of AS (1972), and YT (1974), of which Myles (1995, Ch. 12) offers an excellent review, or more recently, Andreoni, et al. (1998) and Alm (1998) do. The individual lives in an economic federation, and will denote by p_1 and p_2 , the probability of being audited by the central tax authority (CTA) and by the regional tax authority (RTA) where she is located, respectively.

The optimal behaviour of each taxpayer comes from the maximisation of a von Neumann-Morgenstern expected utility function, $E[U_i(Y)]$, which being quasi-concave, $U_i''(Y) \leq 0 \leq U_i'(Y)$, ensures that individual i is either neutral or risk-averse, where Y is private disposable income, so the sole argument that enters into her utility function is private income, Y^4 . Therefore, the taxpayer is a rational individual, and also "predisposed to dishonesty", since "does not put responsibility to the State before her own interests. She is prepared to evade her due taxes if she thinks it might be worth her while financially"

⁴ Undoubtedly, we could have considered the introduction of the public goods offered by both layers of government into the utility function of the individual. However, if the population that finances them is great enough, even though these goods can effectively enter into it, can reasonably be assumed that the taxpayer takes them as given and, so the analysis does not change. See Cowell (1998, section 2.4.), and, in this study, see footnote (8).

[Cowell, 1998, page 2], and the election of how much income/wealth to declare is for her similar to the choice of a portfolio decision under uncertainty.

The existence of two tax administrations makes possible to arise the following four combinations of audit probabilities:

$p_1 \cdot p_2$: CTA and RTA carry out audit policies over the individual's return

$p_1 \cdot (1 - p_2)$: just the CTA audits

$(1 - p_2) \cdot (1 - p_1)$: none of both agencies carries out an audit process

$(1 - p_1) \cdot p_2$: just the RTA audits

Being X the amount of wealth tax base declared by the tax-payer, and W the true value of it, $W - X \geq 0$ (there are no "prizes" by declaring more than the true wealth), the private income after taxes of a taxpayer, according to the four cases mentioned above, will be the following:

$$ZZ \equiv I - \theta_1 X - \theta_2 X - F_1 \theta_1 (W - X) - F_2 \theta_2 (W - X) \quad (1)$$

$$ZY \equiv I - \theta_1 X - \theta_2 X - F_1 \theta_1 (W - X) \quad (2)$$

$$YY \equiv I - \theta_1 X - \theta_2 X \quad (3)$$

$$YZ \equiv I - \theta_1 X - \theta_2 X - F_2 \theta_2 (W - X) \quad (4)$$

Crucially, we suppose the taxpayer will declare just the sources of income (private wealth), X , in the IPN that will also be taxed in the IRPF, where the tax base will be then $r \cdot X$ (returns from private wealth), where r is the return rate on private capital, so we assume those who evade in one tax figure will do so in the other one as well, and to the same extent. The definition of each one of the previous variables is as follows, for agency j : $\theta_j \leq 1$ is the effective tax rate and $F_j \geq 1$ the fine imposed by unit of evaded taxes, $\theta_j \cdot (W - X)$; and I is the initial level of private income. Note that in (1)-(4) we have expressed net incomes as though the taxes were based on the same tax figure. This is so, since we can easily find the correspondence between both tax figures,

$$(r \cdot X) \theta_1 = X \tilde{\theta}_1 \quad \text{then} \quad \tilde{\theta}_1 = r \cdot \theta_1$$

that is, the tax on the returns of X can be transformed into a tax on the simple possession of X , if the tax rate on that possession (wealth tax rate) is equal to $\tilde{\theta}_1 = r \cdot \theta_1$, and viceversa, i.e., $\tilde{\theta}_2 = \theta_2 / r$.

Given the quasi-concave form of the utility function, we know that $U'_i(ZZ) \geq [U'_i(ZY) \cap U'_i(YZ)] \geq U'_i(YZ)$, though $U'_i(YZ) \leq, \geq U'_i(ZY), \forall i$. On the other hand, the fact the fine imposed on tax fraud is quantified according to the amount of evaded taxes, but not on the amount of the true tax base, is not trivial. According to that structure⁵, as YT (1974) showed, in a context where there is just one tax administration, and the coefficient of absolute risk-aversion decreases with income, an increase in the tax rate always implies an increase in the declared tax base, in contrast with AS (1972)'s result, who found an ambiguous sign when the fine is established instead on true private income.

From previous expressions, (1) to (4), we obtain the marginal income derived from declaring one additional unit of tax base, $RMg(Y)_x$, or, with a negative sign, the return of evading one unit of taxes in each one of the four possible situations mentioned above:

$$RMg(ZZ)_x = \theta_1(F_1 - 1) + \theta_2(F_2 - 1) \geq 0 \quad (5)$$

$$RMg(ZY)_x = \theta_1(F_1 - 1) - \theta_2 \leq, \geq 0 \quad (6)$$

$$RMg(YZ)_x = -\theta_1 - \theta_2 \leq 0 \quad (7)$$

$$RMg(YZ)_x = \theta_2(F_2 - 1) - \theta_1 \leq, \geq 0 \quad (8)$$

and, then, the net expected return of evading one unit of tax base, X , is

$$E_{-X} = -p_1 \cdot p_2 RMg(ZZ)_x - p_1 \cdot (1 - p_2) \cdot RMg(ZY)_x - (1 - p_2) \cdot (1 - p_1) \cdot RMg(YZ)_x - p_2 \cdot (1 - p_1) \cdot RMg(YZ)_x \leq, \geq 0$$

Given that $F_j \geq 1$, expression (5) is always positive, (7) is always negative, while the sign is ambiguous in the rest of cases. The ambiguity of those signs can be explained by the fact that declaring one additional unit of tax base supposes, on the one hand, a “virtual gain” for taxpayer i that equals her savings in the tax fine, $F_j \theta_j + F_{j-1} \theta_{j-1}$ but, on the other hand, implies a combined marginal tax rate as well, $\theta_j + \theta_{j-1}$. In the case both tax authorities audit [expression (5)], the marginal savings are always greater than the marginal tax rate, so there is an increase in disposable income, while if none of both agencies carries out an audit [expression (7)], the fact of declaring an additional unit of tax base just provokes the taxpayer pays the combined marginal tax, that is, there is a certain decrease in disposable income. Otherwise, when only one of both agencies audits, the sign is ambiguous, and will

⁵ In Spain, the fines for grave infractions are computed applying a percentile increase (from a 50% till a 150%) over the quantity of evaded taxes, while for simple fouls, usually applies a monetary fine that is within 1.000 and 150.000 ptas. by infraction. The former embody those situations in which there is concealment of tax bases. The Spanish regions do not have capacity to vary such penalties, so according to our model, $F_1 = F_2$, though this does not impede the RTA's might *de facto* set up different levels of sanctions than the CTA according to their respective tax auditors' praxis.

depend on the balance between the net savings (from the agency that audits) and the marginal tax payments (from the one that is not auditing) in each situation. As we will see, expressions (6) and (8) precisely represent those situations that make vary the standard analysis in which there is just one tax authority and, so, its sign will become crucial to obtain clear-cut descriptions of the individual behaviour.

Once we have defined the variables that enter into any taxpayer's problem (since they are potentially different with respect to their initial level of income, I , and wealth tax base, W , only), we move on analysing her optimal behaviour. As we know, we assume that she maximises her expected utility function through the choice of a level of wealth tax base to be declared, which is equal for both tax authorities. Analytically, that problem is the following:

$$\begin{aligned} \text{Max}_X \quad E[U] \equiv & p_1 \cdot p_2 U(ZZ) + p_1 \cdot (1 - p_2) U(ZY) + (1 - p_1) \cdot (1 - p_2) U(YY) + p_2 \cdot (1 - p_1) U(YZ) \end{aligned}$$

From which, the first order condition (FOC) we obtain is:

$$\begin{aligned} p_2 \cdot p_1 \left\{ \frac{RMg(ZZ)_X U'(ZZ)}{RMg(YY)_X U'(YY)} \right\} + p_1 \cdot (1 - p_2) \left\{ \frac{RMg(ZY)_X U'(ZY)}{RMg(YY)_X U'(YY)} \right\} + \\ + p_2 \cdot (1 - p_1) \left\{ \frac{RMg(YZ)_X U'(YZ)}{RMg(YY)_X U'(YY)} \right\} = -(1 - p_1) \cdot (1 - p_2) \quad (9) \end{aligned}$$

The expressions in brackets represent the marginal relation of substitution between disposable income in each one of the possible situations and YY (situation, recall, where none of the agencies audits). The concept of marginal utility plays the role of the "price" of disposable income in each situation, e.g., $RMgS_{ZY,YY} = - \frac{RMg(ZY)_X U'(ZY)}{RMg(YY)_X U'(YY)} \equiv \frac{dYY}{dZY} \Big|_U$; i.e.,

the marginal relations of substitution express the minimum amount of income the individual has to be compensated with in the situation YY in order not to have an additional unit of disposable income in any of the other situations, keeping her level of utility constant, or, in other words, measures to what extent individual i is disposed to exchange units of disposable income among states (of nature). The sign of these marginal relations of substitution are ambiguous in cases ZY and YZ , while it is clearly positive in case ZZ , since then, $RMg(ZZ)_X \geq 0$ and $RMg(YY)_X \leq 0$. Then, for example, if $RMg(ZY)_X \leq 0$, so $RMgS_{ZY,YY} \geq 0$, there is no a real marginal relation of substitution, since the individual does not need to be compensated across states ZY and YY , as they are not substitutes.

FOC (9) allows us to obtain the implicit function $X^* = X(\theta_1, \theta_2, F_1, F_2, p_1, p_2, W)$. In

order there produces evasion (existence of an interior solution of the taxpayer's problem), it has to be the case that $\left. \frac{dE[U]}{dX} \right|_{X=W} < 0$, that is,

$$(p_1 \cdot F_1 - 1)\theta_1 + (p_2 \cdot F_2 - 1)\theta_2 < 0 \equiv E_{-X} > 0 \quad (10)$$

condition we assume that effectively holds from now on, and $\left. \frac{dE[U]}{dX} \right|_{X=0} > 0$, i.e., implies that for the taxpayer it is always optimal to declare at least "something". On the whole, under these assumptions, the declared amount of tax base always lies within the open interval $(0, W)$.

Instead, when there is just one tax agency with audit capacity over X , in order a taxpayer finds optimal to evade, it is simply necessary that condition $p \cdot F < 1$ holds [Vid. AS (1972), exp. (6')], i.e., she will do so when the expected payment of evading one additional unit of taxes is less than the certain marginal tax over this additional unit of tax base. In our case, in a similar way, expression (10) implies that in order there exists evasion the *combination* of expected payments of evasion has to be less than the summation of marginal taxes. Therefore, it can be the case that, at the margin, the taxpayer is paying in expected terms to one tax authority $[(p_1 \cdot F_1 - 1)\theta_1 > 0]$, e.g., in contrast with the net balance with the other one $[(p_2 \cdot F_2 - 1)\theta_2 < 0]$, but condition (10) still holds.

3. Optimal reactions of the taxpayer

We now move on to study the signs of the variation in X_i with respect to p_j, F_j and θ_j . Given that we will be interested just in those signs, and the second order condition of the individual maximisation problem holds⁶, we have that $-\phi_{X_i} \geq 0$, where ϕ_i is the FOC (9), and then the sign of the variation will be equal to the sign of the partial derivative of ϕ with respect to each tax instrument of the tax agency, that is, $\text{sign}\{dX_i/dp_j\} = \text{sign}\{\partial\phi_i/\partial p_j\}$, given that $\frac{dX_i}{dp_j} = \frac{\partial\phi_i/\partial p_j}{-\partial\phi_i/\partial X_i}$, holding the same reasoning for F_j and θ_j . Taking into account this fact, we first analyse how the declared tax base varies with the tax rate of the central government, θ_1 ⁷,

$$\begin{aligned} \phi_{X_i} &\equiv p_2 p_1 RMg(ZZ)^2 U''(ZZ) + p_1 (1 - p_2) RMg(ZY)^2 U''(ZY) + p_2 (1 - p_1) RMg(YZ)^2 U''(YZ) + \\ &\quad + (1 - p_1)(1 - p_2) RMg(YY)^2 U''(YY) \leq 0 \end{aligned}$$

⁷ Evidently, the analysis of a change in any regional variable over the individual declared wealth tax base

$$\begin{aligned}
\frac{\partial \phi}{\partial \theta_1} = & -\frac{p_2}{1-p_2} RMgS_{YZ,YY} X \{RA(YY) - RA(YZ)\} - \\
& -\frac{p_1}{1-p_1} RMgS_{ZY,YY} [X \{RA(YY) - RA(ZY)\} - RA(ZY) \{F_1(W - X)\}] - \\
& +\frac{p_2}{1-p_2} \frac{p_1}{1-p_1} RMgS_{ZZ,YY} [X \{RA(YY) - RA(ZZ)\} - RA(ZZ) \{F_1(W - X)\}] - \\
& -\frac{\{(1-p_2)[p_1(F_1-1)U'(ZY) - (1-p_1)U'(YY)] + p_2[p_1(F_1-1)U'(ZZ) - (1-p_1)U'(YZ)]\}}{(1-p_1)(1-p_2)RMg(YY)_X \cdot U'(YY)} \leq, \geq 0
\end{aligned} \tag{11}$$

where $RA(YY) \equiv -U''(YY)/U'(Y) \geq 0$ is the coefficient of absolute risk aversion, and $RMgS$ are the marginal relations of substitution as have been previously defined. Even under the assumption of decreasing absolute risk aversion [suggested by AS (1972), and assumed by YT (1974)], $RA(YY) \leq [RA(YZ) \cap RA(ZY)] \leq RA(ZZ)$, we do not obtain a definite sign of expression (11), since only the third summand has a clear-cut positive sign. As we have already commented, in the way the sanction has been set up, the assumption of decreasing risk aversion is enough to obtain a positive sign when there is just one tax agency with tax and audit power over X [YT (1974), expression (14)]⁸. Thus, it can be shown that in that particular situation, being $\theta_2 = p_2 = F_2 = 0$, and once we have used the FOC, expression (11) transforms into

$$\frac{\partial \phi}{\partial \theta_1} = \frac{p_1}{1-p_1} RMg(Z)_X \frac{U'(Z)}{U'(Y)} [X \{RA(Y) - RA(Z)\} - RA(X) \{F_1(W - X)\}] \geq 0 \Rightarrow \frac{dX}{d\theta_1} \geq 0 \tag{12}$$

and, then, effectively tax evasion always decreases when the marginal tax rate increases.

In expression (11), the sign of the first and second summand depend on the sign of $RMgS_{YZ,YY}$ and $RMgS_{ZY,YY}$, respectively, while in the fourth summand, we have grouped the direct effects that produce by the variation in θ_1 (a *substitution effect*). Then, even in the case both $RMgS_{YZ,YY}$ and $RMgS_{ZY,YY}$ have a negative sign⁹ (i.e., there is a positive *income effect*, that given decreasing risk-aversion, unfailingly implies a decrease in tax evasion)¹⁰,

would follow the same procedure, and would then just change the subscripts, 2 for 1.

⁸ This circumstance is not necessarily so, if public goods are introduced into the individual utility function. Then, independently of the fact that such preferences are homogenous or not, but income effects are null, evasion will increase/decrease when the tax rate increases, depending on whether the public goods are under or over-provided, respectively [Cowell (1998, pages 12-15)].

⁹ It can be easily shown that either $RMg(ZY)_X \geq 0$ and $RMg(ZY)_X \leq 0$, or $RMg(ZY)_X \leq 0$ and $RMg(ZY)_X \geq 0$, but can never be the case that $RMg(ZY)_X \leq 0$ and $RMg(ZY)_X \leq 0$. Of course, both can be positive at the same time.

¹⁰ Note, however, nothing impedes that the income effects that affected by that situations in which only one of

the variation in the declared tax base can be negative if the direct effects are strongly negative. The sign of this fourth summand depends on:

$$(1 - p_2)[p_1(F_1 - 1)U'(ZY) - (1 - p_1)U'(YY)] + p_2[p_1(F_1 - 1)U'(ZZ) - (1 - p_1)U'(YZ)] \leq, \geq 0 \quad (13)$$

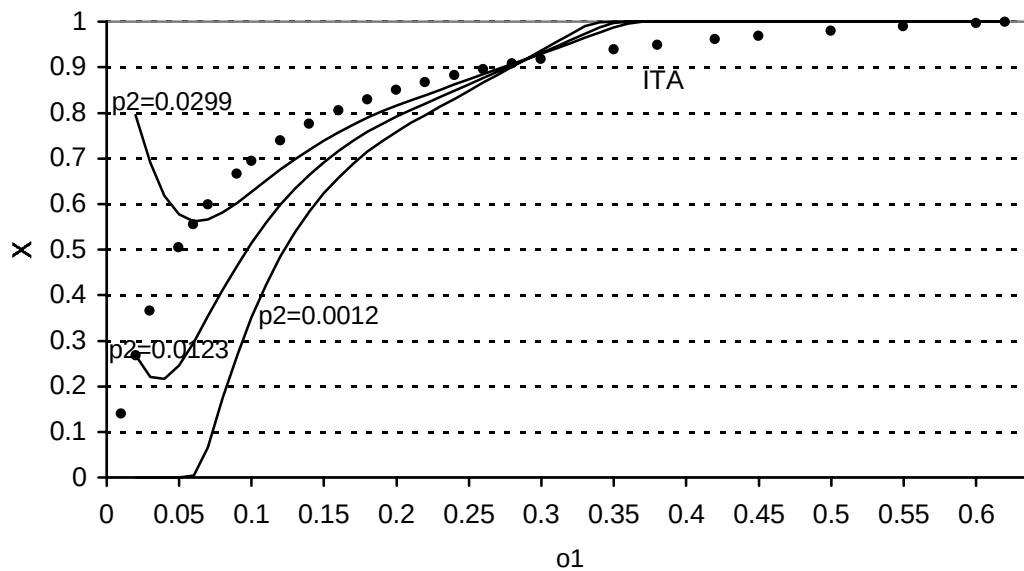
so, it is negative, and so contributes to decrease tax evasion, when so it is the expected (through the term p_2) variations in marginal utility when the central tax authority passes from auditing to not auditing, independently of the absolute degree of risk-aversion of the individual¹¹. Then, it is measuring the greater potential gains of evading taxes, given that θ_1 has increased, when the CTA passes from auditing to not auditing.

Next, we present three graphs that show up different possibilities of individual reaction in the amount of declared wealth tax base when varies the central marginal tax rate, keeping all the rest of parameters constant. Such graphs derive from the simulations that are described in the appendix, calibrated with Spanish data. In the graph below, the black dots represent the behaviour of the individual when there only is one tax authority with power over both the IRPF and IPN (we call it *Integrated Tax Administration*, ITA), while in the other three cases, a RTA and CTA are present at the same time. We present cases of RTA's with different levels of tax audit probabilities: the maximum level right now in Spain ($p_2 = 0.0299$), the minimum ($p_2 = 0.0012$), and the average one ($p_2 = 0.0123$), while the regional wealth tax rate is always set up at $\theta_2 = 0.002712$ (the average). In the case there is an ITA (with θ_2 set up at the average, and $p = 0.0054$), the taxpayer effectively always responds positively to increases in the central marginal rate, though this is no longer so when there are two tax authorities. In this latter situation, the graph 1.1 is showing us cases in which only the substitution effect might provoke $dX/d\theta_1$ to be negative (since it is always the case $RMg(ZY)_x$ and $RMg(YZ)_x$ are positive, so income effects are). This precisely occurs the greater the value of p_2 is, what can be inferred from (13): though the income effect is always great enough in that situation (so it always pays to declare more than in any other situation), for relatively low levels of θ_1 , the substitution effect dominates, the more, the greater p_2 is, since the marginal gains are more important (due to the quasi-concavity of the utility function), *ceteris paribus*, when passing from ZZ to YZ than passing from ZY to YY, the former multiplied by p_2 .

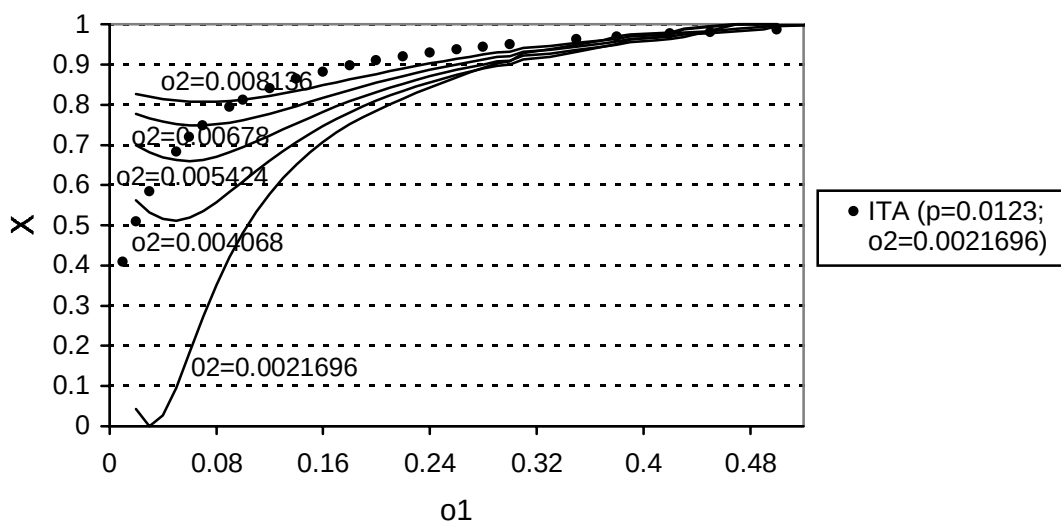
the two agencies audits are negative.

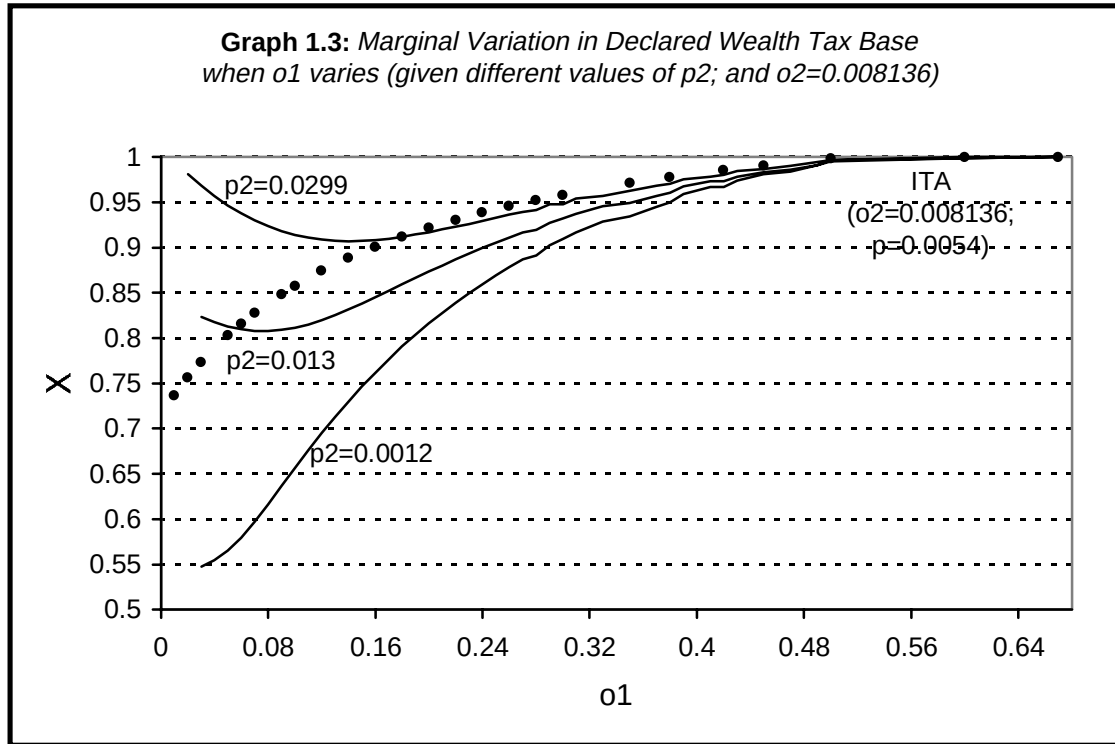
¹¹ Note that a decrease in marginal utility means an increase in absolute disposable income. Then, when due to an increase in X , that variation is negative, there has produced an increase in disposable income, and so it is financially worth to declare more tax base, otherwise there produces just the inverse effect.

Graph 1.1: Marginal Variation in Declared Wealth Tax Base when σ_1 varies (given different values of p_2 ; and $\sigma_2=0.002712$)



Graph 1.2: Marginal Variation in Declared Wealth Tax Base when σ_1 varies (given different values of σ_2 ; and $p_2=0.0123$)





Depending on the regional tax level, we can check from graph 1.2, the curve $dX/d\theta_1$ is flatter (substitution and income effect tend to cancel) and also greater the level of declared tax base, the greater the regional tax rate is. Finally, in graph 1.3, we show the case in which the regional tax rate is considerably high (threefold the average; in the IRPF, it would represent a tax rate on capital returns equal to 16.27%), for different values of p_2 .

Then, we can conclude,

RESULT 1: *in front of a change in θ_1 , the sign of the variation in the amount of tax base declared by the taxpayer is ambiguous, and will depend on the net effect of an income and a substitution effect, as expression (11) reflects.*

Hence, this ambiguity in the sign of the reaction is similar to the one found by AS (1972): there also is a substitution effect, since having increased the effective tax rate, evasion now becomes more attractive, but on the other hand, the disposable income of the taxpayer has decreased, so given decreasing risk-aversion implies an increase in the amount of tax base declared. In our case, there being two tax authorities, the *substitution effects* are still present join with a positive or negative *income effect*, even though we have adopted the same fine structure than YT (1974), which overcomes the substitution effect in the traditional case. When θ_1 increases, it might still worth for the taxpayer to evade taxes,

having kept the RTA all its parameters constant. Moreover, our income effect can be either positive or negative, i.e., it will not ever be true that an increase in θ_1 will suppose a decrease in individual i 's disposable income for each additional unit of declared tax base, since, for instance, in situation ZY , it can instead suppose an increase when $RMg(ZY)_x \leq 0$ (the return on evasion has simply increased).

The rest of partial derivatives can also present ambiguous signs. With respect to variations in the fine per amount of evaded tax, we get

$$\frac{\partial \phi}{\partial F_1} = \theta_1 \frac{p_1}{1-p_1} U'(ZZ) RMg(ZZ)_x \left[\frac{p_2}{1-p_2} \left\{ \frac{1}{RMg(ZZ)_x} + RA(ZZ)(W-X) \right\} + \right. \\ \left. + RMgS_{ZY,ZZ} \left\{ \frac{1}{RMg(ZY)_x} + RA(ZY)(W-X) \right\} \right] \leq, \geq 0 \quad (14)$$

In contrast with expression (11), a sufficient condition for expression (14) to be positive is simply that $RMg(ZY)_x$ is also positive. In (14), the *substitution effect* is now positive, since each unit of taxes evaded is certainly now more costly to the taxpayer [first summand in expression (15), which is the development of the portion in brackets in (14)], and at the same time, there will produce an *income effect* [second summand in (15)], which will always be positive, though in principle could be negative (if $RMg(ZY)_x \leq 0$),

$$\frac{p_2 U'(ZZ)}{(1-p_2) U'(ZY)} + \left[\frac{1 + RA(ZY)(W-X) RMg(ZY)_x}{1 + RA(ZZ)(W-X) RMg(ZZ)_x} \right] \geq 0 \quad (15)$$

The fact that $RMg(ZY)_x \leq 0$ simply makes the effectiveness of the central tax policy to decrease, but never to turn out the positive sign of (15) [see graph 2.4 for a case in which effectively $RMg(ZY)_x \leq 0$, and different values of the coefficient of relative risk-aversion]. That is, both effects point out in the same direction, i.e., to an increase in the amount of tax base declared. In the particular case in which there is only one tax administration, the sign of (14) is clearly positive,

$$\frac{\partial \phi}{\partial F_1} = \theta_1 \frac{p_1}{1-p_1} U'(Z) [1 + RA(Z)(W-X) RMg(Z)_x] \geq 0 \Rightarrow \frac{dX}{dF_1} \geq 0 \quad (16)$$

On the whole,

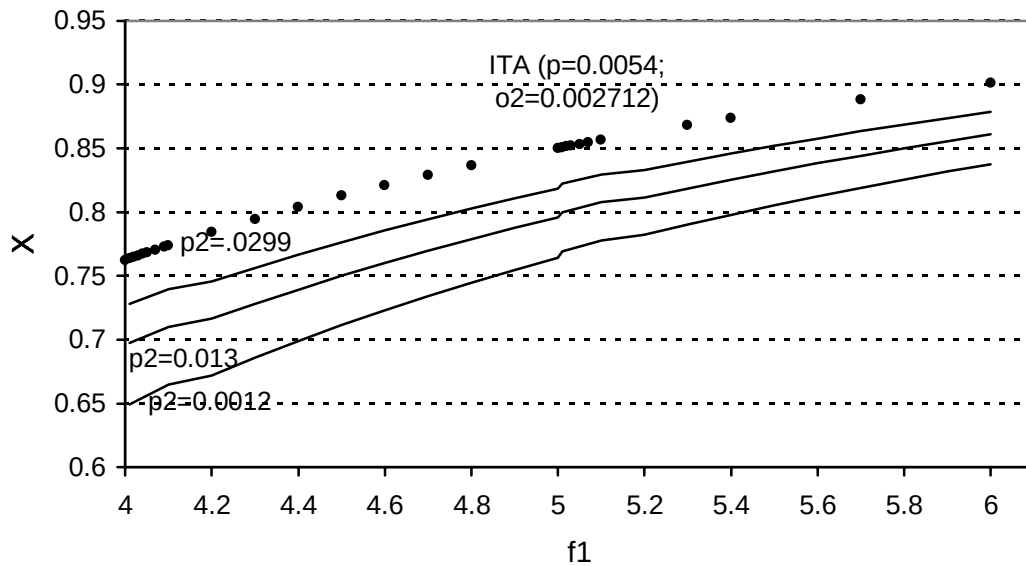
RESULT 2: *in front of an increase in the fine per unit of evaded tax of any tax authority, keeping the rest of parameters constant, the taxpayer will decrease the amount of evaded taxes in a semi-decentralised tax administration. The magnitude of such variation is expressed by (16), which shows up both a positive income and substitution effect.*

In the graphs below, we show different possibilities of individual reaction, according to the previous structure of presentation. Recall graph 2.4 is presenting a situation in which, from the parameters, $RMg(ZY)_x$ results to be negative. Nonetheless, as we have said before, the reaction of the taxpayer is still positive along all the range of values of F_1 , even for different values of the coefficient of absolute risk-aversion. In any case, under that circumstances, the power of the incentives given by the variation in the central tax parameters is clearly weakened, as shows the flatness of the individual reaction curve.

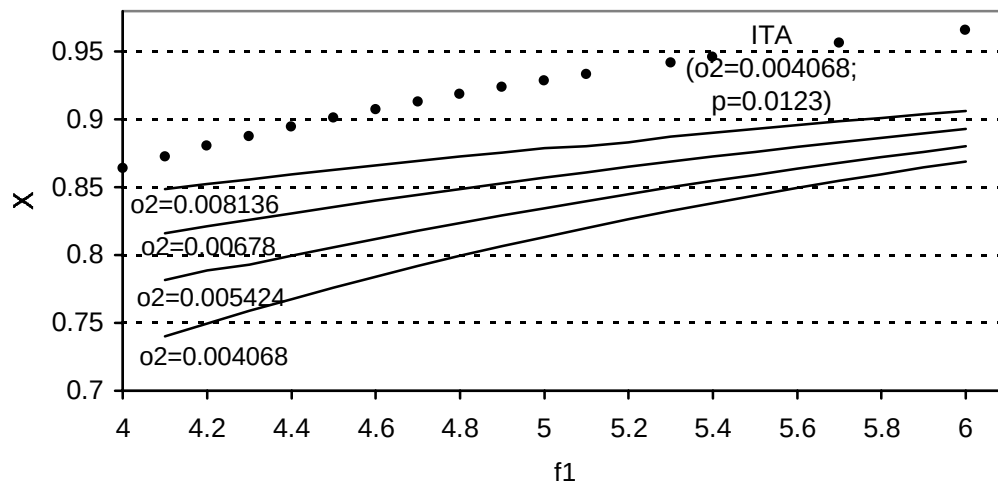
With respect to the probability of being audited, the expression that serves us to analyse the effects in motion is:

$$\frac{\partial \phi}{\partial p_1} = \frac{U'(ZZ)RMg(ZZ)_x}{(1-p_1)^2} \left[\frac{p_2}{1-p_2} + RMgS_{ZY,ZZ} \right] \leq, \geq 0 \quad (17)$$

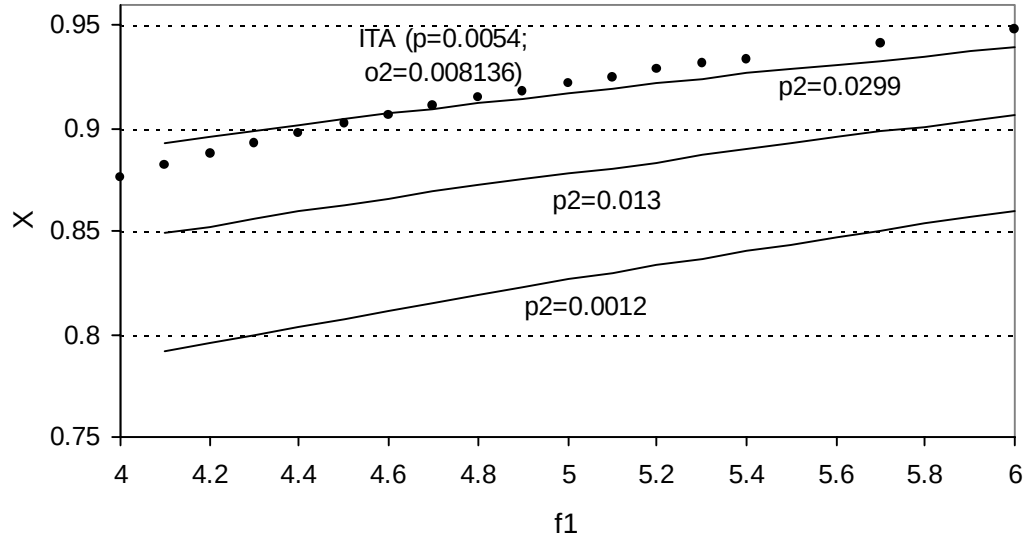
Graph 2.1: Marginal Variation in Declared Wealth Tax Base
when f_1 varies (given different values of p_2 ; and $\sigma_2=0.002712$)



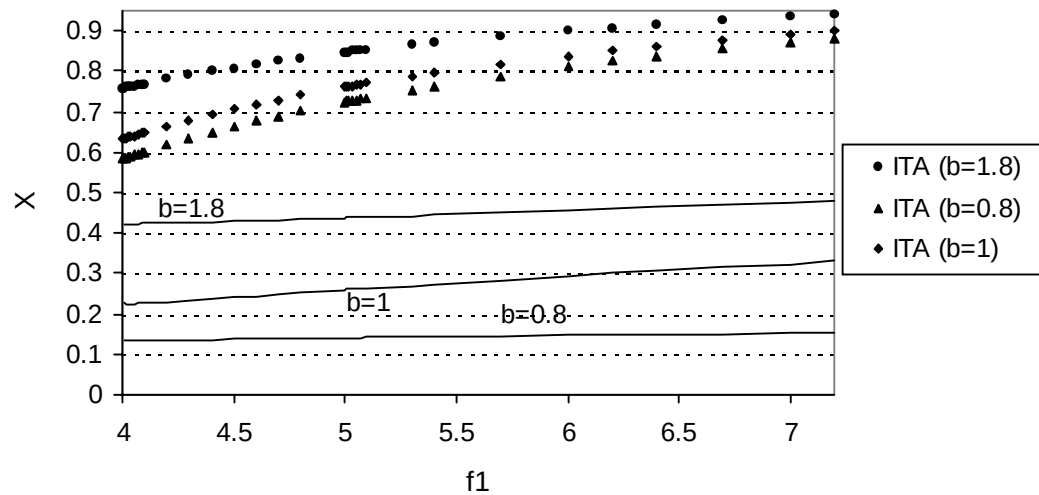
Graph 2.2: Marginal Variation in Declared Wealth Tax Base
when f_1 varies (given different values of σ_2 ; and $p_2=0.0123$)



Graph 2.3: Marginal Variation in Declared Wealth Tax Base
when f_1 varies (given different values of p_2 ; and $\sigma_2=0.008136$,



Graph 2.4: Marginal Variation in Declared Wealth Tax Base
when f_1 varies (given different values of b_2 ; $\sigma_1=0.05$; $\sigma_2=0.0100344$;
 $p_2=0.0012$; $p=0.0054$)



Again, a sufficient condition for (17) to be positive, and then the comparative static result is in accordance with the traditional theory, i.e., $dX/dp_1 \geq 0$, even in presence of two tax administrations, is that $RMg(ZY)_x \geq 0$. More generally,

$$\frac{p_2 U'(ZZ)}{(1-p_2)U'(ZY)} + \frac{RMg(ZY)_x}{RMg(ZZ)_x} \geq 0 ; \text{ o } 1 \geq p_2 \geq \frac{-RMgS_{ZY,ZZ}}{1-RMgS_{ZY,ZZ}} \quad (18)$$

As before, the *substitution effect* is positive [first term of the first expression in (18)], but the *income effect* can be either positive or negative [second term in the same expression]. Now, having increased p_1 , but remained constant p_2 , it is more likely that disposable income is ZY , a state in which each unit of evaded taxes increases disposable income as long as $RMg(ZY)_x \leq 0$, and the income effect would then be negative (increase of disposable income). Last, we show the situation in which $\theta_2 = F_2 = p_2 = 0$, then the sign of (17) is always positive,

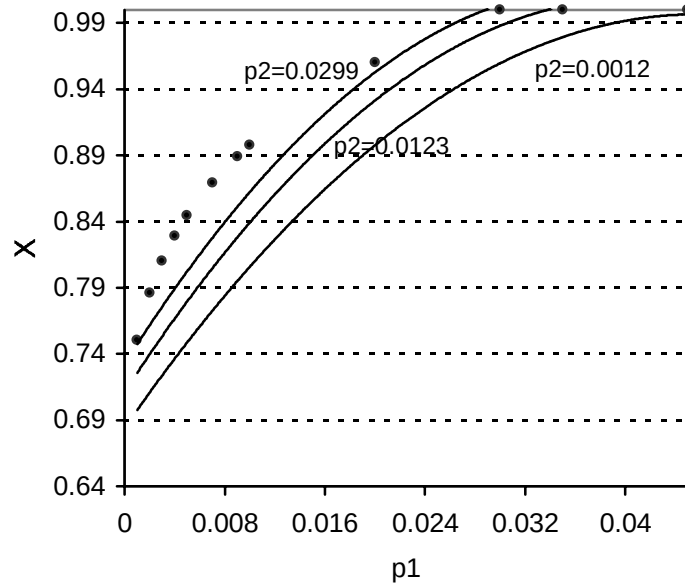
$$\frac{\partial \phi}{\partial p_1} = U'(Z)RMg(Z)_x - U'(Y)RMg(Y)_x \geq 0 \Rightarrow \frac{dX}{dp_1} \geq 0 \quad (19)$$

RESULT 3: *in front of an increase in the probability of tax audits, and keeping all the rest of parameters constant, a necessary condition for the taxpayer increases the amount of tax base declared is that expression (18) holds; a sufficient condition is simply that $RMg(ZY)_x \geq 0$.*

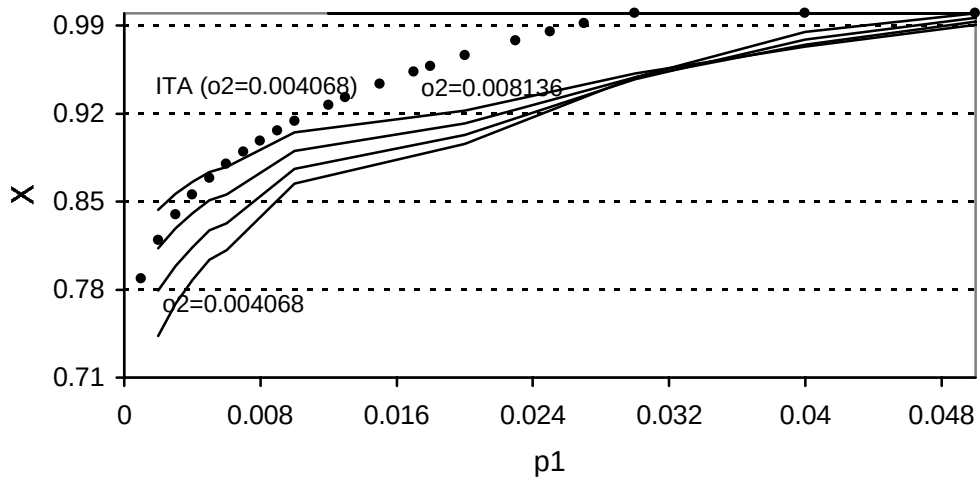
In the graphs above and below, we show four different combinations of tax parameters. In graph 3.4, we present a situation in which $RMg(ZY)_x \leq 0$ ¹². However, as in the case of F_1 , that fact never ends provoking $dX/dp_1 \leq 0$, though can appreciate how, under those circumstances, the taxpayer becomes almost insensitive to the tax policy of the CTA, and so evasion would remain at very high levels even for values of p_1 as high (and unrealistic) as 0.3.

¹² Unfortunately, we cannot show the case of a semi-decentralised tax administration and $\beta = 1$, since the employed algorithm does not converge.

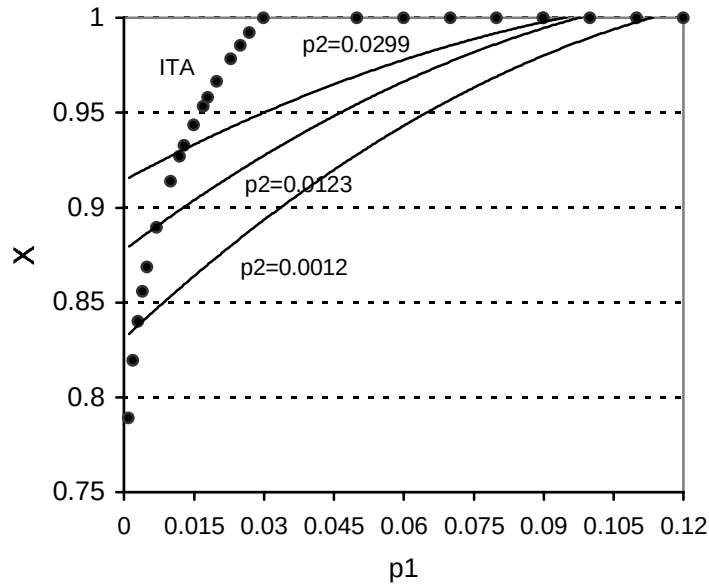
Graph 3.1: *Marginal Variation in Declared Wealth Tax Base when p_1 varies (for different values of p_2)*



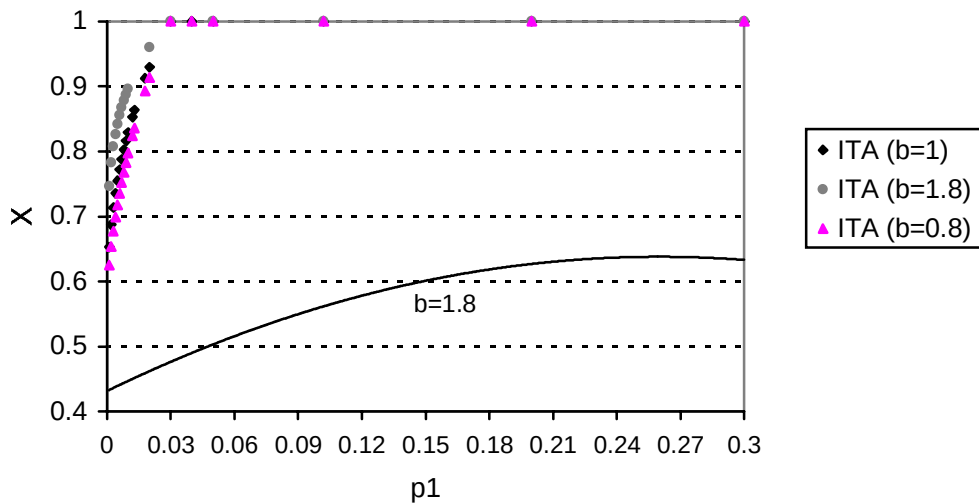
Graph 3.2: *Marginal Variation in Declared Wealth Tax Base when p_1 varies (given different values of σ_2 ; and $p_2 = 0.0123$)*



Graph 3.3: Marginal Variation in Declared Wealth Tax Base when p_1 varies (given different values of p_2 ; and $\sigma_2=0.008136$)



Graph 3.4: Marginal Variation in Declared Wealth Tax Base when p_1 varies (given different values of b_2 ; and $\sigma_2=0.010072$; $p_2=0.0012$; $\sigma_1=0.05$)



4. Conclusions

In the context of what we have called a semi-decentralised tax administration, from our theoretical model, we have been able to check how the reactions of a taxpayer and the extent of tax evasion varies with respect to a situation in which there is only one tax administration. We have justified the former setting is now present in Spain.

Evidently, with respect to the levels of tax evasion, the magnitude of the tax parameters under responsibility of the regional tax administration or government causes them to vary across regions, as can be easily checked from the graphs. Also, the effectiveness of a tax policy, via increases in the probability of tax audits or the imposed fine by unit of evaded tax, can be greatly weakened depending on the tax parameters of the other tax agency or layer of government.

The main conclusion of the paper is to point out the need of analysing the fraud in an economic federation, in which the responsibilities of tax administration or, more generally, tax setting are not fully integrated, taking into consideration the tax parameters of all the agents involved in tax decisions. That is, if we want to evaluate the fraud on the IRPF (IPN), or reforms carried out on this particular tax by the central (regional) government, or aim to assess the effectiveness of a specific policy anti-fraud, cannot only focus on the instruments of the CTA (RTA), since this would lead to misleading conclusions. Nevertheless, such lack of effectiveness of tax policy in a semi-decentralised tax administration has to be balanced with the gains of greater fiscal responsibility that both levels of government enjoy, through tax administration and tax setting¹³.

Appendix: Numerical simulations

In order to test the predictions of the model with real data, we have carried out a set of simulations based on Spanish data, which results have been graphically shown in the main text. With respect to the utility function, we have chosen the following iso-elastic functional form:

$$U(X) = X^{1-\beta} / (1-\beta)$$

where β is then the coefficient of relative risk-aversion, as defined in the main text. The individual will be risk averse as long as $\beta \geq 0$, and the greater β , the more. A reasonable value for this coefficient is 1.8 [Karni and Schmeider (1990), and Epstein (1992), both cited by Bernasconi (1998)].

¹³ More on this issue, see Esteller (1999).

Table: Probability of audits at Personal Wealth Tax (regional tax), from data 1995.

	Total number of audits (A)	Total number of returns (B)	Estimated probability of being audited, p (A)/(B)	Transformed- Estimated probability of being audited, $f(p)$	Amount of Wealth Tax Base Declared (10 ³ ptas.) (C)	Wealth Tax Base per Return (10 ³ ptas.) (C)/(B)	Percentage of Evasion from calibrated data
<i>Andalucía</i>	1270	94.771	0.0134	0.13759	5.717.680	60.331	19.82%
<i>Aragón</i>	585	31.711	0.0184	0.16031	2.990.390	94.301	19.08%
<i>Asturias</i>	103	18.183	0.0057	0.08974	1.761.536	96.878	21.38%
<i>Baleares</i>	73	51.462	0.0014	0.04295	2.885.650	56.073	22.97%
<i>Canarias</i>	633	33.622	0.0188	0.16196	2.807.296	83.496	19.03%
<i>Cantabria</i>	106	10.984	0.0096	0.11675	1.188.877	108.237	20.49%
<i>Cast. y León</i>	728	45.696	0.0159	0.14948	3.725.675	81.532	19.43%
<i>Cast. y LM</i>	209	18.560	0.0113	0.12656	1.286.544	69.318	20.17%
<i>Catalunya</i>	1.561	229.701	0.0068	0.09817	26.672.815	116.120	21.10%
<i>Extremadura</i>	66	8.512	0.0077	0.10454	528.987	62.146	20.89%
<i>Galicia</i>	877	45.399	0.0193	0.16399	3.739.423	82.368	18.97%
<i>La Rioja</i>	232	7.748	0.0299	0.20109	760.150	98.110	17.77%
<i>Murcia</i>	193	15.385	0.0125	0.13300	1.316.166	85.549	19.97%
<i>Valencia</i>	118	98.356	0.0012	0.03954	9.302.737	94.582	28.86%
Total	6.754	693.386			63.999.791		
Average			0.0123	0.1233		92.300	20.71%
Coeff. of variation			63.80%	37.10%			12.89%

Source: Informe sobre la gestión de los tributos cedidos en 1995, Presupuestos Generales del Estado para 1997; and own processing.

To calibrate the model, and later on for the very simulations, we have limited the value of the parameters within an estimated real interval. We report some of the values of those parameters according to Spanish data (1995), see table in next page for sources and detailed values. First, on the one hand, the probability of carrying out an audit in the regional tax return (IPN) has been empirically ranged within the interval [0.0012, 0.0299], which correspond to the case of the AC of Valencia and La Rioja, respectively, while the average is 0.0123. On the other hand, the calculated average probability of being audited in the federal tax (IRPF) is 0.0054. These probabilities have been calculated as the result of the following formula [e.g., see Witte and Woodbury (1985) or Pommerehne and Weck-Hannemann (1996)]:

$$p \equiv \frac{\text{Total number of audits}}{\text{Number of taxpayers}}$$

In the case of the federal tax administration, according to the *Memoria de la Administración Tributaria 1996*, in 1995, the total number of audits were 160.359, out of which 46% were just for the IRPF, while the total number of taxpayers was 13.571.647, so $p_1 = 0.0054$. The regional probabilities of auditing have been calculated in the same way from the *Informe sobre la Recaudación de los Tributos Cedidos*, that appeared in the National Public Budget of 1997.

From our model, such low probabilities of auditing would represent artificially high levels of tax evasion. Several authors have dealt with that paradox, once it is compared with reasonable estimations of percentages of evasion [20-40%]. This may be due to the fact that individuals do not have a clear idea of what the real probabilities of auditing are [Erard and Feinstein (1994)], or simply tend to overestimate them [e.g., Karni and Safra (1990), both quoted by Bernasconi (1998)].

However, even in that case, it does not look sufficient to accommodate the predictions of the model with the real expected level of evasion. Recently, Bernasconi (1998) has proposed to apply a new definition of attitude towards risk to tax evasion: *risk aversion of the order 1*, different from the one implied by the expected utility model (risk aversion of the order 2). Briefly, this new definition implies that the indifference curves of the individual are kinked at certainty (where there is no evasion), so the function is not differentiable around that point, and then no-evasion may become optimal. In order to model this new behaviour, Bernasconi (1998) uses an expected utility with rank dependent probabilities (EURDP), which implies the new "gamble" is of the form:

$$[1 - f(p)]U(Y) + [1 - f(1 - p)]U(Z)$$

where $f(p)$ is a continuous, strictly increasing and onto probability transformation function. The relevant range of values given by this transformation is that in which the slope of the indifference curve is flatter than the usual one, non-transformed, i.e., the case $f(p) \geq p$, so the individual overweighs the probability of being audited. Bernasconi (1998) proposes the following $f(p)$, based on Camerer and Ho (1994):

$$f(p) = 1 - \left[(1-p)^\lambda / [p^\gamma + (1-p)^\lambda] \right]^{1/\gamma}; \quad \gamma = 0.56$$

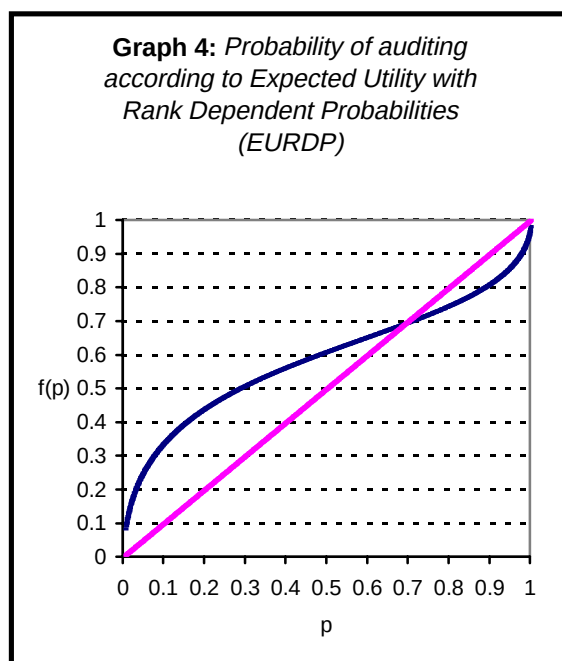
This is graphically represented in the next page (graph 4). Then, for instance, from the graph, we see how the regional average probability of being audited passes from 0.0123 to 0.1233¹⁴. From the same table, we can also check how the average probability of being audited in the federal tax (IRPF) is 0.0054, which once is transformed is 0.0873.

Secondly, we have calculated the average tax rate in the IRPF for 1995, 15.39%, though have increased it up to 20%, since from a Panel of taxpayers¹⁵, both of IPN and IRPF, can see how that group of taxpayers always pays a higher effective tax rate in IRPF than the average, around a 5% more. The average tax rate of the IPN in 1995 has been 0.2712%¹⁶.

¹⁴ The coefficient of correlation between the probability of being audited and the quantity declared of wealth tax base per capita is 0.129. Thus, it does not seem that the amount of declared tax base determines the probability of auditing at the cross-section level of the AACC, so the assumption of fixed auditing probabilities of our theoretical model does not seem so far from reality.

¹⁵ *Panel de declarantes del IRPF e IPN*, Instituto de Estudios Fiscales.

¹⁶ We have not considered the possible differences in the effective tax rate among AACC, since in 1995 the statutory tax rates were the same for all them. Then, there were no differences in fiscal pressure directly derived from the tax code, and the differences in the effective tax rate just came out from the slightly progressive structure of the tariff.



With all these values, setting up an initial level of fraud of 20% (see *Memoria...*, op.cit., table IV.I, p. 677, according to which the index of fraud in tax bases was 21.4% and 19.5% in 1994 and 1995, respectively), the fine per unit of evaded taxes $F_1 = F_2 = 5$ ¹⁷, and the real wealth tax base $W=1$, we have calibrated the model, calculating an initial level of income: $I=0.03382$. This value has served us later on to carry out the numerical simulations¹⁸. Hence, we have analysed the reactions of an individual with $W=1$ and $I=0.03382$.

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¹⁷ See footnote (5). We know the Spanish legislation penalises for grave infractions in such a way that $F \in [1.5, 2.5]$. We have decided to set it up at a higher level, since nothing impedes the infractions accumulate, or even there equally applies non-monetary sanctions, depending on the type of tax fraud.

¹⁸ To solve the non linear FOC's of the model, and so obtain the individual reaction function with respect to each variable, we have employed a variant of Newton's method.

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