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TAX EVASION AND PRESUMPTIVE TAXATION METHODS
A CASE STUDY IN ITALY: SECTOR STUDIES

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Tax Evasion and Presumptive Taxation Methods. A Case Study in Italy: Sector Studies

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Abstract

In this paper we analyze a fiscal mechanism used in Italy, which in Italian is called "Studi di Settore" (Sector Studies). This mechanism relies on information gathered on taxpayers to both partition the population into fairly homogeneous clusters and to determine the presumed income they should declare. When this estimated income is announced, before taxpayers fill out their tax returns, their optimal declaration strategies lead the tax- payer population to be naturally split into three homogeneous groups, one of which pays more taxes than are due, the second group comply but bears the audit cost, while the third evades and it is not audited. This result is close to the Italian situation where the greatest number of taxpayers make a tax declaration according to the announced cluster income, but there are always those who declare less and so are audited.

Keywords: Tax Evasion, "cut-off" policy, Noncooperative games, Asymmetric Information.
JEL Classification: H26, H32, D82, C72.

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1 Introduction

It is a widespread practice for governments to gather observable and measurable characteristics of taxpayers and to group the population into homogeneous categories in order to better estimate their real gross income. While it is common to keep those income estimations hidden (e.g. France), in Italy they are announced to the taxpayers before they are asked to fill their tax returns. This mechanism is called Sector Studies and it consists in a cut-off policy: once the government chooses and announces the estimated income, it is common knowledge that all those taxpayers who declare less than this estimation are surely audited.

The policy of introducing additional information eliminates uncertainty for the taxpayers. Once the estimated income is announced, taxpayers' payoff depend upon their own decisions; but it also gives a strong incentive to declare the estimated income.

The present article focuses on the problem a taxpayer faces when deciding his tax declaration in such a scenario. The principal aim is to understand if this cut-off policy is indeed optimal for the government and if it is fair for the taxpayer. Starting from what is happening in Italy, that is the majority declare their estimated income but there is a minority who do not, a simple model is constructed where there is a fixed distribution of income in the economy and audits are costly for both government and taxpayers.

The first model on this topic was proposed by Allingham and Sandmo (1972), and their aim was to understand if higher tax rates generate more or less compliance. Their model was then generalized by Pencavel (1979), Cowell (1981) and

Sandmo (1981) which make income endogenous by adding labour supply [1]. The research in the area was then surveyed by Cowell (1990) and Andreoni James and Jonathan (1998).

Reinganum and Wilde (1985) first introduced the cut-off rule [2], but while in their model taxes and fines are lump-sum and audit are costly only for the government in the model developed in the present paper taxes and fines are set proportionally to the declared or real income and audits are costly for both the government and the taxpayer. These assumptions are more realistic and closer to the situation in Italy.

In a model with risk-neutral taxpayers[3] that are distributed in a given segment we prove that the cut-off policy gives rise to three different groups into which taxpayers are naturally divided. **1)** A group is audited with certainty: these taxpayers bear the audit cost and no individual dishonestly reports their income (this group can be defined as Compliance Taxpayers). **2)** Tax reports in the middle group are equal to the estimated income so that no one is audited but individuals pay more taxes than are due (this group is a Fake Congruous group). **3)** Tax declarations in the highest group are equal to the estimated income so that no one is audited but since individuals' real income is greater than the estimated one, they pay less taxes than are due and so evade (this group is defined as Evaders).

The focus of this paper is the taxpayer's behavior and in order to understand it one

[1] Tonin (2011) builds a model of the labour market that predicts a spike in declared income at the minimum wage level, and supports this result with evidence based on Hungarian data.

[2] Also Sanchez and Sobel (1993) discuss these types of models.

[3] While Risk-Neutrality is a nice feature that simplify the discussion in this paper, it can be shown that all the results hold even without it. Note that there is not uncertainty about taxpayer payoff since all the elements of the game are common knowledge.

needs to analyze the government problem. So we also characterize the solution to the government problem, the optimal threshold value, as noted by Reinganum and Wilde (1985), is chosen so that the audit budget is just exhausted at equilibrium.

The next section briefly presents a description of the Italian system. Section 3 describes the model and characterizes the solution to taxpayer and government problems. Section 4 describes the equilibrium. Section 5 provides a discussion about the result and further research perspectives while section 6 concludes.

2 Description of the System

The Sector Studies were introduced in the Italian regulations in 1993[4] in order to overcome the incongruities of the old fiscal system[5] and to regulate and avoid possible conflicts between the revenue-authorities and taxpayers.

One can see the Sector Studies as an instrument which is used to estimate the capability of producing revenues of medium-small businesses and practitioners. The Sector Studies are accomplished with a systematic gathering of data. There are two types, fiscal and structural data, which characterize the taxpayer's activity and the economic framework where it is supposed to be developed. Therefore the **Sector Studies** allow one to **estimate** the **taxpayer's revenues**, identifying the potential taxpayer's capability of producing revenues and the features which can affect it. Moreover, the Sector Studies take into account some peculiarities of the

[4]As reported by the *Societá per gli Studi di Settore* (Sose) they were introduced by *D.L. 30/08/1993, n. 331.*

[5]The previous fiscal system, in 1970, linked the determination of firm's and autonomous worker's income to the published accounts, in a way that the system favored the heedful evaders and penalized the honest but forgetful taxpayers.

geographical area in which the taxpayers' activity is developed (externalities, etc.).

The **single** Sector Study is achieved through the following legal process:

Data gathering. The data gathering uses two different sources depending on the Sector Study. If it is a new one, an initial version is created using data collected from **questionnaires** which **taxpayers** are asked to compile. Instead, an advanced form of data gathering is used for an *already achieved* Sector Study through an analysis of previous declarations. Independently of the approach used, data are screened so that only significant information will continue to the next stage in the process.

Significant Data Elaboration. A first analysis leads to the choice of the main variables through which homogeneous groups (called **clusters**) of taxpayers are detected. Then any cluster is **normalized** in the sense that outliers are not considered in its definition.

Performing Gerico. Gerico is the software which applies the Sector Studies, processing information and computing the foreseen revenues. At this stage it assigns to any of the former clusters a function (for instance, $F : C_i \to \mathcal{R}_+$, where C_i can be a single cluster) which gives the expected income for that cluster.

Implementing the Sector Study. Finally gerico assigns every taxpayer to one or more clusters, according to her *structural features*, which are objective so that taxpayers cannot choose them at this stage, is assigned through gerico . The foreseen income is computed and produced by Gerico through a regression on the taxpayers features taking into account also some feasible correctives (environmental factors for instance).

The following tables present some important empirical data concerning the Sector Studies:

Tab 1 - The Sector Studies audience (Sose 2005)

Fiscal Year	Number of Sector Studies	Obliged Taxpayers	Non-obliged Taxpayers	Total Taxpayers
1998	45	1.442.351	3.736.799	5.179.150
1999	86	2.128.336	3.041.430	5.169.766
2000	129	3.023.068	2.136.405	5.159.473
2001	168	3.786.079	1.366.416	5.152.495
2002	202	4.197.813	949.794	5.147.607
2003	228	4.424.498	716.920	5.141.418
2004	206	4.440.108	701.277	5.141.385

Tab 2 - Data concerning the overall audience (Sose 2005)

	2003			**2004**			**2003/2004**
	Non congruous	Congruous	Tot	Non congruous	Congruous	Tot	% rising
Taxpayers	901.980	2.221.199	3.123.179	1.003.562	2.189.613	3.193.175	2,24%
% composition	28,88%	71,12%	100,00%	31,43%	68,57%	100,00%	
% of Fitted	36,36%			46,90%			28,99%

The previous tables shows that italian taxpayers use to declare a *congruous* income so that the Sector Studies prophecy is almost always realized, but still there is a group who declare a *non congruous* income. The objective of this paper is to understand why this is so through a specific model.

3 Model

The model developed in this paper focuses both on the *evasion decision* and on the *optimal government threshold value* within a given cluster. For simplicity one assumes that there is a population of taxpayers each of which possess a true income I_i which can be viewed as the taxpayer's type. There is a continuum of types since true income is distributed along a continuum between l and h (where l and h are respectively the lowest and the highest level of income within a given cluster[6])

[6]One assumes the lowest level of income l to be high enough to assure a non negative profit so that there is not exit in the model.

according to the density function $f(I)$ where $F(\cdot)$ is the associated distribution function. *Perfect detection* is assumed, i.e. the government can learn a taxpayer's type (their true income) by performing a costly audit [7].

The timing of this game[8] can be represented as follows: first, the government, knowing $f(I)$, choses and announces the **gerico income**, g, to the taxpayers. Then, each taxpayer, knowing their type I_i, submits their income declaration d_i, and pays taxes accordingly. In doing so, each taxpayer knows that the probability of being audited is zero if the declared income is congruous (i.e. at least equal to the gerico's one) and it is equal to one if not[9]. Finally, the revenues-authorities, knowing both the *gerico income* and all the declarations, undertake **audits** accordingly to the already committed audit rule, and collect fines where due.

It should be clear that the revenues-authorities in this setup do not make any choice since the *cut-off rule* which fixes the audit probability to one for all those who have declared less than the *gerico income*, but leaves unaudited all that have declared it or more, is exogenously stated by law.

3.1 Taxpayer Problem

Taxpayer i's problem consists of choosing how much income to declare in order to maximize their utility function.

[7] A different assumption is used by Snow and Warren (2005) who show how an increase in taxpayer uncertainty about the amount of tax evasion that will be detected affects the choice of evasion.

[8] One assumes that the Sector Study under analysis have already been completed and approved.

[9] Even if the Italian regulation states that declaring a congruous income does not exclude one from an audit, in practice the probability of an audit is drastically reduced to nearly zero.

Taxpayers are uniformly distributed on the $[l, h]$ segment and their income is their type. Taxpayers are assumed to be risk-neutral, so that their utility function is linear in disposable income:

$$u_i = I_i - td_i - a_i \Big[\max \big\{ 0, (I_i - d_i) \big\} (t + f) + c \Big] \tag{1}$$

where I_i is taxpayer $i's$ gross income, $t \in (0, 1)$ is the tax rate, $d_i \in [0, +\infty)$ is taxpayer $i's$ income declaration, $a_i \in \{0, 1\}$ is a boolean value defined as:

$$a_i = \begin{cases} 1 & \text{if } d_i < g \text{ and so taxpayer } i \text{ is audited} \\ 0 & \text{if } d_i \geq g \text{ and so taxpayer } i \text{ is not audited} \end{cases} \tag{2}$$

and $f \in (0, 1)$ is the additional rate taxpayer i should pay if caught cheating while $c \in \Re^+$ is the fixed cost each taxpayer suffers if audited.

All the parameters of the problem are common knowledge. Moreover, since at this decision node the threshold value g is already decided and announced by the government, the taxpayers have *no uncertainty.* This lack of uncertainty is due to both the fact that taxpayers know about the cut-off policy and the assumption of perfect detection.

Therefore, once taxpayer i knows about her type I_i, her problem is to maximize (1) choosing d_i. Since there is no uncertainty, the optimal declaration will be a function of the taxpayer's type I_i. Hence two cases need to be considered: one is when $I_i \geq g$ and the other is when $I_i < g$. In both cases, taxpayer i has to decide how much to declare.

The first case is straightforward and it is characterized in the following:

Lemma 1 *High type taxpayers ($I_i \geq g$) always choose to declare the threshold* *value g, paying tg and bearing no risk of an audit. Formally,*

$$d^*(I_i, g) = g \qquad \forall I_i \geq g \tag{3}$$

Proof. From the comparison of the utilities a high type taxpayer ($I_i \geq g$) gets, when they declare less than g ($u_i^{d_i<g} = (1-t)I_i - (I_i - d_i)f - c$), more than g ($u_i^{d_i>g} = I_i - td_i$) or exactly g ($u_i^{d_i=g} = I_i - tg$). ■

In the second case, i.e. when $I_i < g$, since there is no uncertainty, a threshold g declaration leads to an utility of $u_i^{d_i=g} = I_i - tg$. Of course this strategy strictly dominates declaring more than g. This follows by the fact that the audit probability is a step function 2. Moreover, also by the previous fact, it follows that cheating, i.e. $d_i < I_i$ or declaring more than real income, but less than g, are both strictly dominated strategies by the *compliance strategy*, i.e. declaring I_i, paying tI_i of tax and c as audit cost. Hence, it is clear that the cut-off policy, by setting an audit probability equal to one if the declaration d_i is below the threshold g, eliminates evasion making compliance much more attractive than evasion. However, since being audited is not costless for the taxpayer, the cut-off policy allows them to avoid such cost c, by a *congruous declaration.* It follows by the previous argument that the cheapest *congruous declaration* is the *threshold declaration* $d_i = g$.

Low type taxpayers' decisions depend on the comparison between *compliance* and *threshold declaration* as follows:

$$d^*(I_i, g) = \begin{cases} I_i & \text{if } I_i < \bar{I} \\ \in \{I_i, g\} & \text{if } I_i = \bar{I} \\ g & \text{if } I_i > \bar{I} \end{cases} \tag{4}$$

where $\bar{I} := g - \frac{c}{t}$ is the type which is indifferent between the two.

Jointly the lemma 1 and the equation (4) present the solution to the taxpayer problem.

Intuitively, high type taxpayers evade since they bear no risk of an audit, while low type taxpayers are split into two groups, i.e. there is a gross income level $\bar{I}$ below which taxpayers comply and above which taxpayers declare the threshold value g. This implies that a taxpayer's declaration is (strictly) increasing for income levels $I_i \in [l, \bar{I})$ and constant for $I_i \in (\bar{I}, h]$.

The latter results are summarized in the following lemma:

Lemma 2 *A taxpayer's optimal declaration strategy is: (1) (weakly) increasing in their type I_i. and (2) it is the same for all taxpayers. Formally:*

$$\text{(1)} \qquad \frac{\partial d^*(I_i, g)}{\partial I_i} \geq 0 \tag{5}$$

Proof. The first follows by direct inspection of equation (5). For the second part, it is the result of $\bar{I}$ being a constant that is independent of the taxpayer's type whose strategy has being analysed. ■

To a characterize further the taxpayers optimal declaration strategy, the next proposition shows how it is influenced by the threshold value g:

Proposition 1 *Given a type I_i, (1) there exists a critical value $\bar{g} := I_i + \frac{c}{t}$ for which taxpayers' optimal declaration strategy makes a downward jump. Moreover, taxpayers' optimal declaration strategy is (2) (strictly) increasing in the threshold* *value g, below $\bar{g}$ and (3) constant above it. Formally:*

$$\textit{(1)} \quad d^*(I_i, g) = \begin{cases} g & \textit{if } g < \bar{g} \\ \in \{I_i, g\} & \textit{if } g = \bar{g} \\ I_i & \textit{if } g > \bar{g} \end{cases} \tag{6}$$

$$\textit{(2)} \quad \frac{\partial d^*(I_i, g)}{\partial g} > 0 \qquad \textit{if } g \in [l, \bar{g}) \tag{7}$$

$$\textit{(3)} \quad \frac{\partial d^*(I_i, g)}{\partial g} = 0 \qquad \textit{if } g \in (\bar{g}, h] \tag{8}$$

Proof. For the first part, it is simply expressing the equation 4 in terms of g. The second and the third follow by direct inspection of equation 7. ■

The idea is straightforward: given a type I_i, as the threshold value g increases the optimal declaration increases accordingly up to the point where declaring g and paying tg is as costly as declaring I_i, paying tI_i and suffering the cost c of an audit. Above such point, a taxpayer of type I_i prefers to comply rather than being congruous. It is important to note that the model gives rise to an empty segment in the distribution of the tax declarations.

3.2 Government Problem

The government's objective is to raise revenue by choosing the threshold value g taking into account the distribution of income $F(I)$ and that the cut-off policy is already stated. Moreover, we assume that the government has a budget B which is exogenously determined, and since any single audit has a cost of k the government's expenditure can be at most B. For a taxpayer of true income d_i the expected utility is the following:

$$E\big(U(d_i)\big) = td_i + Pr(d_i < g)\Big[\max\big\{0, (I_i - d_i)\big\}(t + f) - k\Big] \tag{9}$$

The government anticipates taxpayers' strategies, and since the gross income's density function $f(I)$ is common knowledge, the government knows that to any given threshold value g, it has to audit each taxpayer whose declaration is below the critical level of income $\bar{I} = g - \frac{c}{t}$, and it gains tI_i [10] for each of them. Moreover, all the other taxpayers (that is above $\bar{I}$) will declare the threshold value g so that the government will acquire tg from each of them.

Therefore the government solves the following problem

$$\max_{g} \quad \int_{l}^{\bar{I}} (tI - k)\, dF(I) + \int_{\bar{I}}^{h} tg\, dF(I) \tag{10}$$

$$\text{subject to} \qquad k \int_{l}^{\bar{I}} dF(I) \leq B \tag{11}$$

The solution to this problem depends on the actual income distribution and in order to characterize the solution we recall the assumption of a uniformly distributed taxpayer on the $[l, h]$ segment.

Proposition 2 *The best response of the government to taxpayers strategies is to set a threshold value equal to:*

$$g^* = l + \frac{c}{t} + \frac{B}{k}(h - l) \tag{12}$$

We obtain the following lemma:

Lemma 3 *The optimal government threshold strategy is : (1) increasing in its budget B, (2) increasing in taxpayers audit cost c, (3) decreasing in the tax rate t,*

[10] This because the government knows that all such taxpayers will declare truthfully.

(4) decreasing in its audit cost k, (5) increasing in the highest cluster income level h, (6) decreasing in the lowest cluster income level l. Formally:

$$\begin{array}{llllll} (1) & \dfrac{\partial g^*(\cdot)}{\partial B} > 0 & (2) & \dfrac{\partial g^*(\cdot)}{\partial c} > 0 & (3) & \dfrac{\partial g^*(\cdot)}{\partial t} < 0 \\ \\ (4) & \dfrac{\partial g^*(\cdot)}{\partial k} < 0 & (5) & \dfrac{\partial g^*(\cdot)}{\partial h} > 0 & (6) & \dfrac{\partial g^*(\cdot)}{\partial l} < 0 \end{array} \tag{13}$$

Proof. By direct inspection of equation (12). ■

Intuitively, since the government cannot overreach its budget B, and since, by law, it has to audit all the taxpayers who are declaring less than the threshold value, g^* will be chosen so that the audit budget B is just exhausted in equilibrium, and hence the g^* will be an increasing function of the audit budget.

Furthermore, it is straightforward to show that if one assumes an unconstrained maximization for the government, the threshold value g is not set to the highest cluster income level h.

4 Equilibrium

Once the private information variables (the government's budget B and each taxpayer's type I_i) are realized, the equilibrium appears to be *unique*: partial overdeclaration. The taxpayers are divided into three groups:

1. **Evaders** ($h \geq I_i > g^*$): these taxpayers declare the threshold value g^*, pay tg^* and since they are not audited they evade an amount of tax, $t(I_i - g^*)$;

2. **Fake Congruous** ($\bar{I}^* \leq I_i < g^*$)[11]: taxpayers in this gorup declare the threshold value g^* and pay tg^* even if their real income I_i is lower. Hence

[11]Where $\bar{I}^* = g^* - \frac{c}{t}$.

they pay an extra amount of tax $t(g^* - I_i)$ (overdeclaration) and they are not audited;

3. **Compliance Taxpayers** ($l \leq I_i \leq \bar{I}^*$): these taxpayers comply, truthfully reporting their real gross income I_i and paying tI_i but since they are audited they bear a cost c.

Therefore, the government bears a total cost of $k \int\limits_{l}^{\bar{I}^*} dF(I)$ without earning any fines since evaders are not caught. Note that the establishment of the **Fake Congruous** group is due to the taxpayers audit cost c. The previous result are summarized in the following proposition:

Proposition 3 *The unique equilibrium appears to be the case of partial overdeclaration: high type taxpayers ($I_i > g*$) evade and are not audited as middle type taxpayers ($\bar{I}^* \leq I_i < g^*$) who declare more than their real income, while low type taxpayers ($l \leq I_i \leq \bar{I}^*$) comply and are audited with certainty.*

Proof. Follows directly from the definition of the payoff function of the players (equation 1 and 10), their optimal strategies (lemma 2 and 5 and proposition 4) and the assumption of a uniform distribution. ■

The proposition highlights the fact that the chosen cut-off policy, although allows for optimal government strategy, penalizes **low-type** taxpayers either in bearing the audit cost or in paying more than due taxes. On the other hand, it gives a great incentive to evade for **high-type** taxpayers who are never audited.

5 Discussion and Future Research Perspectives

The model developed here gives a plausible explanation of what is happening in Italy. It is easy to see how a lot of small businesses and practitioners flatten their declaration to the gerico value, but there are still those who declare a non congruous income. While this model gives a twofold explanation to the former phenomenon, that is either taxpayers have a greater real income than the gerico's one or they prefer to pay taxes accordingly to the sector study in order not to bear the cost of an audit, it gives one motivation to the latter, i.e. they prefer to bear the cost of an audit rather than paying taxes accordingly to the sector study, since it is less costly for them to do so.

Finally, the model captures the importance of the **partial overdeclaration** phenomenon which follows by the cut-off policy decided by the Italian regulatory authority. Consider that there might be a case where, within a cluster, the total amount declared could exceed the total income.

An open question is why the Sector Studies set the audit probability equal to one for reports below the threshold value? It is true that this gives to taxpayers whose type is lower than the threshold value the incentive for honest declarations. However using the model in this paper one can notice that the probability that eliminates evasion which gives the same incentives is lower than one, although it implies a reduction of the *fake congruous* group. The idea can be that the government wants to keep this group as numerous as possible. It may be also possible that the explanation is political or maybe it lies in the income distribution. Maybe the income variability within a cluster is very low and so the government is almost sure about its estimation or perhaps it is just what it wanted to show. If the former hypothesis is correct then the audit probability would be a decreasing function of the income distribution variance. We leave this question open for further investigation.

6 Conclusions

The question of a taxpayers' optimal strategy in the presence of this kind of cut-off rule is relevant because it is not unusual for such policies to be the main source of unfairness and an obstacle for new small businesses and practitioners. Implementing this policy requires a lot of information to be gathered by the government and, under these circumstances, while the governments best policy consists of setting a threshold value accordingly to its audit budget, a taxpayer's optimal strategy consist of either declaring the threshold value or declaring their true income according to their type. Taxpayers are therefore divided, accordingly to their types, into three homogeneous groups; one of which pays more taxes than due (overdeclaration), another complies but bears the audit cost, while the third evades and it is not audited.

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