

The Effect of Competition on Tax Compliance: The Role of Audit Rules and Shame*

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Abstract

Traditional models of tax enforcement assume that the decision to be tax compliant is the result of an interaction between individual taxpayers and a dedicated tax agency. Evidence shows that tax compliance is the result of a far more complex decision rule, involving both individual and group motivations, along with non-monetary components. In this paper, we consider a game in which the individual decision to be tax compliant is affected both by strategic competition between taxpayers and the psychological cost of being detected (i.e., shame). We ran a laboratory experiment using a sample of 138 students at the Centro di Economia Sperimentale A Roma Est (CESARE), in the experimental lab at the LUISS “Guido Carli” University of Rome, to evaluate the efficiency of random versus targeted audit rules and to verify the interaction between strategic competition and shame. The experimental results show that strategic competition between taxpayers plays a critical role in reducing tax evasion. In addition, shame reinforces this competition, but plays no significant role on its own (i.e., without competition).

Keywords: Tax evasion, Lab Experiment, Shame, Competition

JEL Codes: H26, C91, C72

1 Introduction

Tax administrations worldwide face great difficulties in collecting money from “hard to tax” taxpayers, mainly small firms and self-employed per-

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sons whose tax amounts theoretically due are quite low compared to the administrative costs of auditing them. Three different solutions have been developed to tackle this issue: 1) an increase in the resources available to tax administrations, 2) an improvement of the efficiency of audit procedures, and 3) an enhancement of the communication about the social costs of tax evasion.

An increase in the resources available to tax administrations entails a higher probability of detecting dishonest taxpayers and, in turn, a higher expected cost of evasion. Different audit procedures can imply either cost savings for the tax administrations (i.e., a relaxation of their resource constraints) or competition between the taxpayers (i.e., a change in the strategic interaction between the tax administration and the taxpayers). A strong communication about the social costs of tax evasion should induce dishonest taxpayers to feel guilty about the effects on others of their behavior, implying a reinforcement of social norms. Strict economic incentives (i.e., the probability of being apprehended and the size of the punishment for those apprehended), social norms, and audit procedures usually overlap in the attempt of tax administrations to fight tax evasion. However, the economic literature, both theoretical and experimental, has underestimated this complexity.

Since the seminal model of Allingham and Sandmo (1972), in which tax compliance is framed as the result of a pure gambling decision, the classical literature on tax enforcement has focused exclusively on the interaction between the taxpayers and the fiscal auditors (Reinganum and Wilde, 1988; Asilis and Juan-Ramon, 1994; Shleifer and R. Vishny, 1993): each taxpayer usually reports an income to the tax agency to maximize his/her after-tax expected payoff (which typically depends on the probability of being audited and on the fines to be paid if apprehended) and the tax agency audits a sample of taxpayers, given its resource constraint. In this basic framework, the interaction between the taxpayers and the tax agency is not affected by the individual behavior of other taxpayers.

More recent contributions have underlined the importance of audit rules (that depend on the objectives pursued by the tax administration, such as the maximization of net revenue from auditing activities or the maximization of the number of apprehended dishonest taxpayers) and competition between taxpayers (which takes place whenever the sample of taxpayers to be audited is not selected randomly): in fact, if the sample is strategically

targeted through an optimal audit rule, then the individual optimization problem becomes more complex and depends also on the behavior of others.¹ For example, if the tax agency chooses to audit the lowest reported incomes (a very plausible case when the tax agency faces a universe of homogeneous “hard to tax” taxpayers), then the probability of being audited perceived by each taxpayer crucially depends on the expected behavior of the others (Casagrande and Spallone, 1998; Glaeser et al., 1996; Staffler and Perez-Castrillo, 2006). We define as “strategic” all audit rules that induce competition between taxpayers.

Moreover, beginning with Allingham and Sandmo (1972), many authors have mentioned that tax evasion could be affected by social norms if individuals are scared of losing their reputation or are stigmatized when they behave dishonestly. The role of guilt and shame in individual decision making has been analyzed both by psychologists (for a review, see Seiter and Bruscke, 2007) and economists in many settings. In particular, Moffit (1983), by commenting on the individual irrational rejection of an income deriving from the participation in a welfare program, conjectured that this was due to the fear of a “welfare stigma”; Gordon (1989), focusing on tax evasion, introduced the concepts of “private and social stigma” and asserted that tax evasion induces “psychic costs through anxiety and guilt”. More recently, Coricelli et al. (2012) showed experimentally that shame, when triggered by individual responsibilities toward the welfare of other group members, may affect tax compliance.

The aim of this paper is to consider the role of audit rules together with the role of social norms. In particular, this paper evaluates the performance of two different audit rules on tax compliance, both with and without public exposure (used as a device to induce “shame”). More precisely, we answer the following questions:

1. Is a strategic audit rule able to induce higher compliance than a random one?
2. What is the effect, under different audit rules, of the “shame” induced by public exposure of tax evasion?

¹For empirical references about audit patterns, rules, and the enforcement behavior of tax agencies, see also Kastlunger et al., 2009, Alm and McKee, 2004, and Sanchez-Villalba, 2010.

To this end we ran an experiment on a sample of 138 undergraduate students, implementing two different audit rules: under the “random” audit rule, all subjects faced an equal probability of being audited; under the “strategic” audit rule, only subjects with the lowest reported incomes were audited. In both cases, we assumed that dishonest taxpayers were apprehended if audited, i.e., we excluded the possibility that the tax agency could be unable to detect evasion or could be corrupted by a taxpayer through bribes.

Under both audit rules, we induced shame by forcing the apprehended taxpayers to publicly reveal their identity to the others. The introduction of shame into our framework induces many changes: it increases the cost of getting apprehended, increasing the equilibrium level of compliance; moreover, it is an extra source of heterogeneity, since the cost of shame may be perceived differently across taxpayers;² finally, if shame is triggered by public revelation of dishonest behavior, it modifies the basic informational settings.

We show that competition between taxpayers, triggered by strategic audit rules, can increase the compliance rates for a large set of parameters.³ Moreover, we provide robust evidence that public shame favors compliance under audit rules that are capable of inducing competition, while it is ineffective otherwise. We suggest that this occurs because experimental subjects (even those who do not fear public exposure) anticipate that shame will induce higher compliance rates from the others, and so adjust their optimal behavior by increasing their reported incomes so as not to be apprehended.

Our experimental results have relevant policy implications in terms of both saving public resources devoted to fighting tax evasion, and using them more efficiently. In fact, we found that tax revenues can be increased by implementing efficient audit rules: in particular, it is convenient to employ a targeted rule if the sample of taxpayers to be audited is homogeneous in terms of income. Moreover, by coupling efficient audit rules with bold communication policies (aimed at reinforcing social norms and inducing shame), it is possible to increase compliance without dramatically increasing the bud-

²The cost of shame is a non-monetary cost that depends on education, family history, and other individual specific factors.

³We experimentally treated tax compliance in a way that resembles the experimental analysis of peer effects and within-team competition. Some scholars have shown that within-team competition is able to increase effort levels and voluntary rates of contributions to public goods (Fatas et al., 2006; Croson et al., 2006).

get of the tax administration.

This paper is organized as follows. In Section 2, we depict the theoretical environment that we take as a reference for our experimental setting; in Section 3, we describe the experimental design; in Section 4, we comment on the experimental results; Section 5 summarizes our main findings. Appendix I contains tables and figures; Appendix II contains a translation of the instructions handed to the experimental subjects.

2 The theoretical framework

The theoretical predictions for our experiment are derived from a basic model of strategic interaction between the universe of taxpayers and a tax agency, in which monetary motives drive the choices of all economic agents, as described in Section 2.1. Moreover, in order to understand the role of shame, the basic model is augmented, as clarified in Section 2.2.

2.1 Basic game

The following game defines the theoretical environment for our experiment:

Players

- One tax agency willing to enforce tax compliance subject to a resource constraint: it can monitor only a fixed fraction of the overall tax payers.
- Many taxpayers willing to maximize their payoffs: each of them has a different income.

Strategies

- Each taxpayer chooses whether to act dishonestly and be non-compliant or to be honest; honest individuals report their true income, z , while dishonest individuals report an income y , with $0 \leq y < z$;
- The tax agency selects a sample of the population to audit.

Payoffs

- Honest taxpayers receive a payoff equal to their after tax income; i.e., for any tax rate $0 < \tau < 1$:

$$P_H = U[z(1 - \tau)]$$

- Dishonest taxpayers save on taxes, but incur the expected cost of getting apprehended; i.e., given the level of fines that must be payed as a percentage of the unreported income $\tau < \varphi < 1$ and the probability of getting apprehended Π :

$$P_D = (1 - \Pi)U[z - y\tau] + \Pi U[z - y\tau - \varphi(z - y)]$$

- The tax agency is willing to maximize an objective function whose only argument is the fraction of dishonest taxpayers apprehended, F :

$$U = f(F)$$

If we consider an audit rule that selects randomly the sample of taxpayers to audit, the equilibrium of this game is very easy to characterize: the tax agency audits the maximum number of taxpayers given its resource constraint, thus defining the probability of getting apprehended for each taxpayer; taxpayers best respond by reporting an income such that their after tax expected utility is maximized.

In particular:

1. If taxpayers are risk neutral, then their reported income is

$$y = \begin{cases} 0 & \text{if } \tau \geq \Pi\varphi, \\ z & \text{if } \tau < \Pi\varphi. \end{cases}$$

2. If taxpayers are risk averse, then their reported income is

$$y = \begin{cases} [0, z) & \text{if } \tau \geq \Pi\varphi, \\ z & \text{if } \tau < \Pi\varphi. \end{cases}$$

Note that the in both cases the choices of taxpayers do not depend on the behavior of other taxpayers, since the auditing policy is random and does not consider reported incomes. Actually, choices depend on the tax rate, the probability of being audited, and the level of fines. Risk neutrality implies corner solutions, while risk aversion potentially implies internal solutions⁴.

Now, suppose that the tax agency interprets reported incomes as signals; in other words, suppose that the tax agency is willing to extract information from reported incomes in order to make an efficient use of its resources.

⁴Obviously, different levels of risk aversion imply different reported incomes.

We assume that reported incomes y are randomly distributed according to the random variable Y with distribution function $G(y)$ and density function $g(y)$. We make the extra assumption that taxpayers reporting low incomes are more likely to be dishonest⁵; then, it is easy to characterize the optimal behavior of the tax agency: in fact, it audits all those taxpayers who reported the lowest incomes (given its resource constraint).⁶

Again, taxpayers best respond by reporting an income such that their after tax expected payoff is maximized; however, in this case the strategic interaction between taxpayers kicks in. In fact, the probability of being audited for each taxpayer is no longer exogenous (i.e., it does not depend only on the resources of the tax agency), but it depends on the reported incomes of all the other taxpayers as well. In particular, the probability of getting apprehended for each taxpayer is defined as

$$\Pi = G(y^*|y < z)$$

where y^* is the threshold chosen by the tax agency, i.e., the highest audited reported income. In other words, the probability of getting apprehended is the conditional probability of being audited given that the reported income is smaller than the real one. The probability of being audited depends on the distribution of reported incomes: in fact, it is the probability that the reported income is among the lowest reported incomes that the tax agency is capable of auditing, given its resource constraint. So:

1. If taxpayers are risk neutral, then the optimal reported income satisfies

$$\tau(z - y) = \varphi(z - y)G(y^*|y < z)$$

⁵More precisely, we assume monotonicity, i.e., we assume that the conditional distributions of reported incomes are such that the ratio $\frac{g(y|y < z)}{g(y|y = z)}$ is decreasing in y .

⁶A formal proof is the following. Define $P(D|s)$ as the probability of dishonest behavior associated with each signal s . We show first that $P(D|s)$ is decreasing in s . Let s_L and s_H be two signals, with $s_L < s_H$. Then,

$$\frac{P(D|s_H)}{P(D|s_L)} = \frac{g(s_H|D)}{h(s_H)} \frac{h(s_L)}{g(s_L|D)} < \frac{g(s_H|H)}{g(s_L|H)} \frac{h(s_L)}{h(s_H)} = \frac{P(H|s_H)}{P(H|s_L)}$$

where the strict inequality is a consequence of the assumption in the previous footnote. Since for all $s \in S$, $P(H|s) + P(D|s) = 1$, the result follows. Now, since $P(D|s)$ is a decreasing function of s , then the tax agency monitors the lowest signals.

2. If taxpayers are risk averse, then the optimal reported income satisfies

$$\frac{dU}{dy}(z - \tau y) = G(y^*|y < z) \left[\frac{dU}{dy}(z - \tau y) - \frac{dU}{dy}(z - \tau y - \varphi(z - y)) \right]$$

In both cases the optimal reported income is such that the benefit from evading is equal to the expected cost of getting apprehended. In particular, the choices of taxpayers depend on:

- The behavior of other taxpayers, since the probability of being apprehended depends on the incomes reported by other taxpayers;
- Their actual income, since the probability of getting apprehended depends on the reported income, which is a function of the actual one;
- The tax rate and the level of fines, since the marginal benefits and costs of cheating depend on these parameters.

Note that taxpayers do not know the threshold (in terms of reported incomes) implemented by the tax agency before making their choices, since it depends on the ex post realization of reported incomes and, at the same time, the tax agency does not know whether taxpayers reporting the lowest incomes are tax evaders or not. In other words, the strategic interaction between the taxpayers and the tax agency can be represented as a simultaneous move Bayesian game: in equilibrium, the tax agency audits those taxpayers reporting the lowest incomes⁷ and different types of taxpayers (i.e., differently endowed taxpayers) report different incomes that maximize their expected payoffs⁸.

2.2 The role of shame

If we assume that apprehended taxpayers are publicly exposed, we induce substantial changes to the basic game. In fact:

- The cost of getting apprehended is increased;

⁷As already mentioned, this is a consequence of monotonicity assumptions on the distribution of reported incomes.

⁸Different levels of risk aversion may again induce different reported incomes. Moreover, in the presence of a non-monotonicity of $G(y^*|y < z)$, it is possible to have multiple equilibria

- An extra source of heterogeneity among taxpayers is introduced (since shame could be perceived differently by different taxpayers);
- The basic informational setting is changed by the revelation of the identity of the apprehended taxpayers.

All these changes should lead to an increase in the compliance rate. However, it is difficult to measure the effect of shame. Moreover, it is very difficult to predict whether this effect is more intense under a random audit rule or a strategic one. We are going to deal with these issues through the analysis of experimental data.

While answering these main questions, we also deal with comparative statics exercises about the exogenous parameters of the model, as for example the amount of resources available to the tax agency, and the level of fines. In particular, we test whether the results of these exercises change under different auditing policies.

3 The experiment

In order to answer our research questions, we ran a computerized experiment, in which we implemented two different audit rules:

- A strategic audit rule (hereafter STRATEGIC), in which the computer audits the lowest reported incomes;
- A random audit rule (hereafter RANDOM), in which the computer randomly audits reported incomes.

We implemented each audit rule under two different settings:

- Public shame (hereafter SHAME), in which apprehended subjects are exhibited to all the other participants through an alarm sound lasting one minute. The indicated subjects are obliged to stand up in order to be visible to the others until the alarm stops.
- Private shame (hereafter NO SHAME), in which apprehended subjects are privately informed about the audit and privately made aware of the fines that they have to pay.

The combination of audit rules and settings defines a four treatment experiment, as shown in Table 1, where the acronyms in the cells represent the labels assigned to the treatments:

- 1) **SS**: Strategic audit rule with shame;
- 2) **SNS**: Strategic audit rule without shame;
- 3) **RS**: Random audit rule with shame;
- 4) **RNS**: Random audit rule without shame.

Table 1: The Four Treatment Experiment

	STRATEGIC	RANDOM
SHAME	SS	RS
NO SHAME	SNS	RNS

The experiment was carried out at the CESARE laboratory at Luiss Guido Carli in Rome in May and September 2011. The subjects were recruited using ORSEE (Greiner 2004) from a sample of undergraduate students in Economics, Law, and Political Science. Instructions were in Italian. An English translation is available in Appendix II.

The total number of subjects was 138, of which 43% were female. Each subject participated in only one session and none of them had previously participated in a similar experiment. Each experimental session lasted about one hour; on average, each participant earned 21.40 Euros from the experiment. At the beginning of each session, detailed written instructions were provided and read aloud by experimenters.

We ran 14 computerized experimental sessions of 10 participants each:⁹ two for the RS treatment, two for the RNS treatment, four for the SS treatment, and eight for the SNS treatment.¹⁰

3.1 Choices

In each of the four treatments (SS, RS, SNS, RNS), experimental subjects took a set of six independent tax decisions. In each of them the subjects

⁹We ran one of the sessions, that with treatment SNS, with only eight subjects, since some of the subjects booked for that session did not show up.

¹⁰Our main focus was on the behavior of taxpayers under the strategic audit rule: this is why we ran a larger number of experimental sessions for the SNS treatment. In any case, the amount of data recovered from the sessions dedicated to other treatments were enough to obtain robust estimations about the determinants of taxpayer behavior.

decided what percentage of their actual income to report, depending on a large set of parameters (the actual income, the tax rate, the magnitude of fines, and the probability of being audited).

Table 2: The Parameters

Tax Rate	Fine	Audit rate
20%	40%	20%
35%	50%	40%
55%	60%	60%

In particular, we let the actual incomes be randomly drawn by the computer from a discrete uniform distribution taking the following values: 50, 100, 150, 200, and 250.¹¹ All remaining parameters are reported in Table 2.

More precisely:

- Each subject faced the whole set of incomes in a random sequence.
- Each subject made their choices under the following sets of parameters:
 - Basic:
 - * Tax rate 20%;
 - * Fine rate 40%;
 - * Audit rate 20%.
 - Change of audit rates:
 - * Tax rate 20%;
 - * Fine rate 40%;
 - * *Audit rate 40% or 60%.*
 - Change of fine rates:
 - * Tax rate 20%;
 - * *Fine rate 50% or 60%;*
 - * Audit rate 20%.
 - Change of tax rate (third set of controls):

¹¹Different incomes were assigned to subjects for each choice within a single round, in such a way that each subject faced all ranges of incomes without knowing it.

- * Tax rate 35% or 55%;
- * Fine rate 40%;
- * Audit rate 20%.

- Each subject made 35 choices, under the 35 combinations of 7 different sets of parameters with 5 levels of income.

All other combinations of parameters were disregarded because deemed either implausible or irrelevant.

As shown in Figure ?? in Appendix I, a scroll bar on the computer screen allowed each subject to calculate, for each possible reported income, the corresponding payoffs, i.e., the amount of taxes to be paid (*Imposta dovuta*) and the correspondent income net of taxes (*Reddito netto*). The example represented in Figure ?? refers to the SNS treatment. Subject *Cacciavite* could see on the left box of her screen all the information needed to decide how much income to report: the actual income (*Reddito*), the tax rate (*Aliquota fiscale*), the level of fines (*Multa*) as a percentage of the underreported income, and the number of reported incomes to be audited. *Cacciavite* could see on the bottom right of her screen the consequences of her possible choices, in terms of taxes due and net income.

The individual profit (*Profitto*) is the difference between the actual income and the amount of taxes paid. If the reported income is below the actual income, the subject could be audited or not: in the first case, the profit is equal to the difference between the net income and the fines to be paid (which are calculated as a fraction of the difference between the actual income and the reported one); in the second case, the profit corresponds to the net income.

In the SHAME (SS and RS) treatments, the tax choice is presented to experimental subjects in the same way, but the screen that they face after the audit is slightly different because of public disclosure, as shown in Figure ?? and Figure ??.

3.2 Controls

We checked for the robustness of our results by controlling for risk aversion, income endogeneity, and for observed and unobserved heterogeneity of our sample.

The risk aversion of the experimental subjects was elicited using the standard Holt and Laury (2002) rule, as shown in Figure ??.

In order to check whether subjects were more compliant when they exerted an effort to earn their income or not, in Round 6 the experimental subjects were required to answer a questionnaire. The actual incomes were assigned considering the number of correct answers provided by each subject: in particular, the subjects were ranked on a list going from 1 to 10, where the first place was awarded to the subject that provided the highest number of correct answers; then, the highest income (250) was assigned to the two subjects ranked first and second, the second highest income (200) was assigned to the two subjects ranked third and fourth, and so on. In case of an equal number of correct answers, the subjects that answered more quickly were ranked first. Then, they made just one choice, similar to the other 35 choices, apart from the fact that they had earned their income.

At the end of each session, the participants were asked to fill out an anonymous post-experimental questionnaire in order to collect information about individual characteristics, such as age, gender, and enrollment. Additional items were added to elicit the individual degree of pro-social behavior, civil obedience, and propensity to respect rules.

3.3 Payoffs

The total payment that the subjects received from the experiment was the sum of the payoff from their tax choices and the payoff from their lottery choices in the Holt and Laury procedure.

The actual payoffs from the tax choices were obtained through a standard random incentive mechanism:¹² at the end of the experiment, the computer randomly selected one round and subjects were paid the profit that they made in the selected round. Also the actual payoffs from the lottery choices were calculated through a standard random incentive mechanism: at the end of the experiment, the computer randomly selected one lottery choice and played the correspondent lottery for real.

As for the conversion of experimental payoffs into monetary payoffs, the payoff from the tax choice was equal to the profit obtained in the choice

¹²We chose this kind of mechanism to avoid potential wealth effects on the behavior of experimental subjects across rounds.

selected randomly by the computer divided by ten. In contrast, the payoff from the lottery choice coincides with the outcome of the lottery randomly selected by the computer.

4 The experimental results

The results confirm that the experimental subjects understood the instructions and reacted properly to the incentives provided in the game that they were asked to play. Obviously, the theoretical predictions cannot be completely verified since they depend on the degree of risk aversion of each single subject.¹³

In subsection ??, descriptive statistics are presented; in subsection ??, the econometric results are described and discussed.

4.1 Descriptive statistics

The experimental results can be classified along two dimensions: the fraction of evaders and the fraction of income underreported (see Tables ?? and ?? in Appendix I).

As for the fraction of evaders, the experimental subjects responded to the basic incentives as follows:

- The higher the tax rate, the higher the fraction of evaders;
- The higher the fine rate rate, the lower the fraction of evaders;
- The higher the audit rate, the lower the fraction of evaders;
- The income effect on the fraction of evaders is ambiguous.

As for the fraction of underreported income, the experimental subjects responded to the basic incentives in a more complex way, that depends on both the audit rule and on the effect of shame.

¹³The risk aversion of the experimental subjects was elicited using the standard Holt and Laury (2002) procedure, in order to double check the absence of corner solutions (i.e., underreporting either 0% or 100% of income). The vast majority of our sample subjects were risk averse (58%). Moreover, this percentage was constant across experimental groups (i.e., we did not find any statistically significant difference in terms of risk aversion across groups). This explains why many subjects underreported only a fraction of their income; however, since we did not assume any specification of the utility function, this is not enough to make predictions of the behavior of each experimental subject.

4.1.1 The role of the audit rule

The role of the audit rule is consistent with the theoretical framework set out in Section 2. Even though the fraction of evaders is smaller under the random audit rule than under the strategic one, as shown in Table ?? (0.401 versus 0.612), the fraction of underreported income is much larger under the the random audit rule than under the strategic one (0.635 versus 0.327), as shown in Table ??.

Combining these two effects, the expected underreported income can be measured by multiplying the fraction of evaders by the fraction of underreported income (see Table ??). For the whole sample of experimental subjects, the fraction of expected underreported income is equal to 20% under the strategic audit rule while the same percentage goes up to 25.5% under the random one. So, the strategic audit rule implies higher expected tax returns.

In fact, when the audit is strategic, high-income subjects have an incentive to underreport their income since they know that they are not very likely to be audited. However, they also know that they cannot report too little income, because the lowest reported incomes are targeted by the tax agency. Conversely, when the audit is random, the decision to evade implies very low reported incomes: in fact, evaders know that the probability of being audited does not depend on the reported income.

4.1.2 The role of shame

The effect of shame is clear only in the presence of a strategic interaction, since it reduces both the fraction of evaders and the fraction of underreported income: under the random audit rule, shame has no role in terms of the fraction of evaders, but increases the fraction of underreported income.

So, under the strategic audit rule, shame becomes crucial for tax revenues since it sharply reduces the expected underreported income (on average from 0.225 to 0.154, see Table ??). In particular, shame always increases tax revenues for each level of income, tax rate, level of fine, and audit rate (see Table ??).

4.1.3 The interaction between audit rules and shame

The strategic audit rule induces an honesty race, and subjects' fear of being revealed as evaders reinforces competition. In fact, whenever public shame

is disentangled from competition, it has no relevant effect on tax choices. In other words, a strong complementarity between public shame and competition emerges: in fact, in this setting non-monetary motives play a role only when the behavior of subjects either affects or is affected by the behavior of others. We suggest that this occurs because our experimental subjects (even those who do not fear public exposure) anticipate that shame will induce higher compliance rates and adjust their optimal behavior so as not to be apprehended. Given its relevance, the issue of complementarity will be tackled from an econometric point of view in the next section, thus providing a deeper interpretation of the experimental results.

4.2 Econometric results

The weights of the determinants of tax evasion were estimated using a two-step model.

First, we estimated a Probit model for the probability of evading taxes: we tried two different specifications of the model: one including group random effects (to control for the potential lack of independence within the same group of decision makers) and another including individual random effects (to control for individual unobserved heterogeneity, since each individual is observed 36 times). In order to select the best of the two models, we estimated the value of the intra-class correlation coefficient ρ , which represents the proportion of the total error variance attributable to unobserved heterogeneity.

In the second step, considering only the subjects who decided to evade, we estimated a model for the fraction of underreported income. The regressors of this model also included the inverse of Mill's ratio obtained from the first-step estimations to control for the potential correlation between the error terms of the two equations. Even in this case, two different specifications of the model were estimated, one GLS model with group random effects and another with individual random effects.

The results of the Stage 1 estimations (Probability of Evading) are displayed in Tables ?? to ??, while the results of the Stage 2 estimations (the proportion of underreported income conditional on the decision to evade) are displayed in Tables ?? and ?. The results are presented in the next four subsections for both the probability of evading and the fraction of underreported income (Stage 1 and 2). In particular, ?? shows the contribution of

the main economic determinants and ?? the effect of audit rules and shame.

4.2.1 The main economic determinants

The relation between the probability of evading and a set of relevant variables (income, tax rate, fines, audit rate, effort, and demographics) is depicted in Table ??.

In all models, the probability of evading increases with income and tax rate, while it decreases with the audit rate. Effort significantly reduces the probability of evading as well as being female. These results are statistically significant and consistent with the empirical evidence.

The value of the ρ coefficient signals that both the “group random effect model” and the “individual random effect model” fit our data, but the latter seems more appropriate since it explains about 64% of total variance. Moreover the marginal effects shown in Table ?? confirm that the proportion of evaders increases with income and tax rate, while it decreases with fines, audit rate, effort, age, and gender.

The results about the fraction of underreported income are shown in Table ?. The value of the constant measures the percentage of underreported income of the representative subject: this value ranges from about 56% in the “group random effect model” to about 63% in the “individual random effect model”. However, the value of the ρ coefficient shows that only the “individual random effect model” fits our data, explaining about 38% of total variance.

As far as the other main economic determinants are concerned, we found that only income and tax rate are statistically significant while the level of the fine, the audit rule, the demographic variables, and effort seem to play no role in the decision on how much income to report.

4.2.2 Strategic interaction and shame

The role of competition is clear and robust from an econometric point of view: it increases the probability of evading, but strongly decreases the amount of underreported income (see Tables ?? and ??). So, the experimental subjects evade more, but by a smaller amount under the strategic audit rule than under the random one.

The contribution of shame *per se* is ambiguous and not statistically significant. The role of shame becomes clear only when it is associated with a strategic audit rule since it reduces both the number of evaders and the amount of underreported income. This result reinforces the crucial role of competition between taxpayers in preventing tax evasion, as is clear from the marginal effects shown in Table ??: the proportion of evaders greatly decreases as soon as shame is associated with strategic interaction, while it does not under a random audit rule.

Figures ?? and ?? show the role of the audit rate on the fraction of evaders and on the amount of underreported income, respectively.

As for the fraction of evaders, it is evident from Figure ?? that the fraction of evaders decreases with the audit rate: in fact, if there is no resource constraint and the audit rate is 100%, all taxpayers behave honestly. Two other important results can be observed from Figure ??:

1. Strategic versus random audit rule. A marginal increase in the audit rate away from zero has a larger effect in the case of a random audit rule than for a strategic one: this is because, as we already said, a random audit rule induces all taxpayers (also the high income subjects) to be more compliant, while the strategic audit rule affects only low income subjects. This is why the green and orange lines (relative to the strategic audit rule) have a higher intercept than do the red and blue lines.
2. The strategic rule with shame versus the strategic rule with no shame. The effect of shame is evident in the case of a strategic audit rule: in fact, the orange line (the one with shame) lies well below the green one. In contrast, shame has no relevant effect in the case of a random audit rule: in fact, the red line (the one with shame) lies above the blue one (even if the difference between the two cases is not statistically significant).

As for the fraction of underreported income, it is evident from Figure ?? that the fraction of underreported income decreases with the audit rate, except for the case of the random audit rule with shame. Two other important results can be observed from Figure ??:

3. The strategic versus the random audit rule. Assuming that an experimental subject has already decided to evade, the strategic audit rule

induces a drastic reduction in the amount of underreported income. As we have already said, in the case of a strategic rule, the experimental subjects are scared of evading too much because they do not want their declared income to fall below the auditing threshold.

4. The random rule with shame versus the random rule with no shame. Shame does not affect in a statistically significant way the amount of underreported income. In the case of a random audit rule it seems to have a counterintuitive effect: it increases the fraction of underreported income with increasing audit rate. However, this effect is not so relevant (the line is almost flat), particularly if only the actual interval of audit rates employed in the experiment (from 20% to 60%) is taken into account.

Table 3: Stage 1—Probability of Evading

	Group RE	Ind. RE
Income	0.016 ***	0.026 ***
Tax rate	0.030 ***	0.046 ***
Fines	- 0.027 ***	- 0.041 ***
Audit rate	- 0.016 ***	- 0.024 ***
Shame	- 0.022	0.256
audit rate with shame	0.001	0.000
Strategic int.	0.836 ***	1.502 ***
audit rate with strategic int.	- 0.006	- 0.011 *
Strategic int. with shame	- 0.529	- 1.179 *
audit rate strategic int. and shame	0.006	0.009
Effort	- 0.382 ***	- 0.595 ***
Age	- 0.007	- 0.014
Female	- 0.086 **	- 0.106
Constant	0.015	- 0.180
Obs.	4,968	4,968
Log-likelihood	- 2,816.6	- 2,000.3
Chi2	706.1	843.8
p(Chi2)	0.000	0.000
Sigma_u	0.244	1.322
Rho	0.056	0.636

Notes: * significant at 0.1, ** significant at 0.05, *** significant at 0.01.

Age-23; (Income-150)/10; Tax rate-35;

% Fine-50; % Monitor.-20; Inverse Mill's ratio-0.5.

Table 4: Stage 1—Marginal Effects

	Group RE	Ind. RE
Income	0.006 ***	0.010 ***
Tax rate	0.012 ***	0.018 ***
Fines	- 0.011 ***	- 0.016 ***
Strategic int.	0.297 ***	0.478 ***
Effort	- 0.149 ***	- 0.209 ***
Age	- 0.003	- 0.005
Female	- 0.034 **	- 0.041

Notes: * significant at 0.1, ** significant at 0.05, *** significant at 0.01.
Age-23; (Income-150)/10; Tax rate-35;
% Fine-50; % Monitor.-20; Inverse Mill's ratio-0.5.

Table 5: Stage 1—Marginal Effects: Shame

	Group RE	Ind. RE
Shame		
Shame no strategic int.	- 0.009	0.102
Shame with strategic int.	- 0.185 ***	- 0.252 ***

Notes: * significant at 0.1, ** significant at 0.05, *** significant at 0.01.

Table 6: Stage 2—Fraction of Evaded Income

	Group RE	Ind. RE
Income	0.003	0.002 *
Tax rate	0.008 ***	0.006 ***
Fines	- 0.002	0.000
Audit rate	- 0.005	- 0.003
Shame	0.056 ***	0.044
audit rate with shame	0.005 ***	0.005
Strategic int.	- 0.182 *	- 0.250 **
audit rate with strategic int.	0.002 ***	0.001
Strategic int. with shame	- 0.137 *	- 0.092
audit rate strategic int. and shame	- 0.003 **	- 0.004
Effort	- 0.055	- 0.019
Age	- 0.000	0.001
Female	0.018	0.007
Inverse Mill's ratio	0.154	0.006
Constant	0.562 ***	0.631 ***
Obs.	2,890	2,890
R^2		
Sigma_u	0.000	0.157
Rho	0.000	0.377

Notes: * significant at 0.1, ** significant at 0.05, *** significant at 0.01.
Age-23; (Income-150)/10; Tax rate-35;
% Fine-50; % Monitor.-20; Inverse Mill's ratio-0.5.

Table 7: Stage 2—Marginal Effect: Shame

	Group RE	Ind. RE
Shame		
Shame no strategic int.	0.056 ***	0.044
Shame with strategic int.	- 0.081	- 0.048

Notes: * significant at 0.1, ** significant at 0.05, *** significant at 0.01.

Figure 1: The Effect of The Audit Rate on The Fraction of Evaders: Individual Random Effect Model

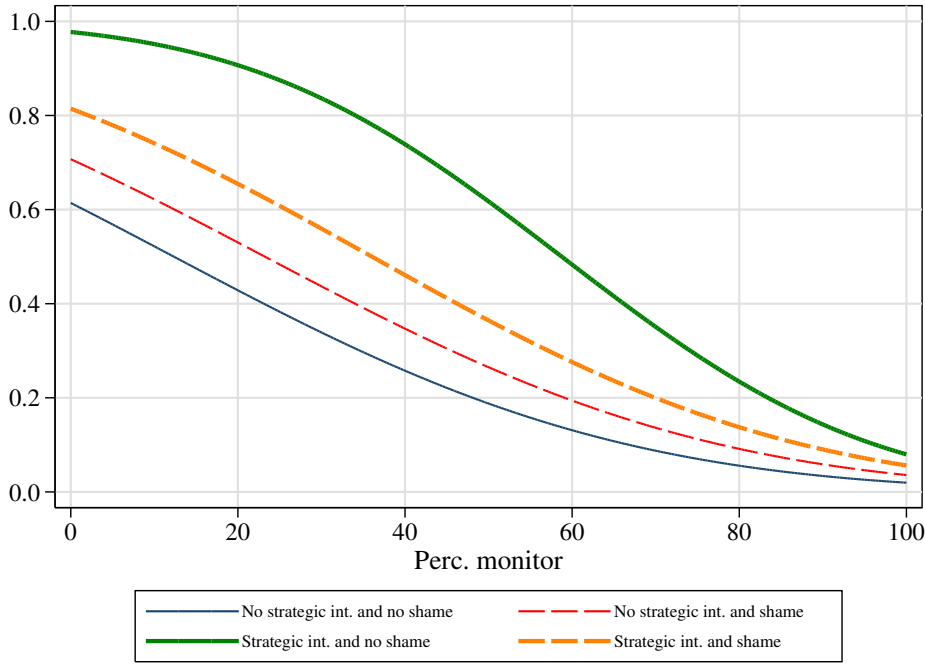
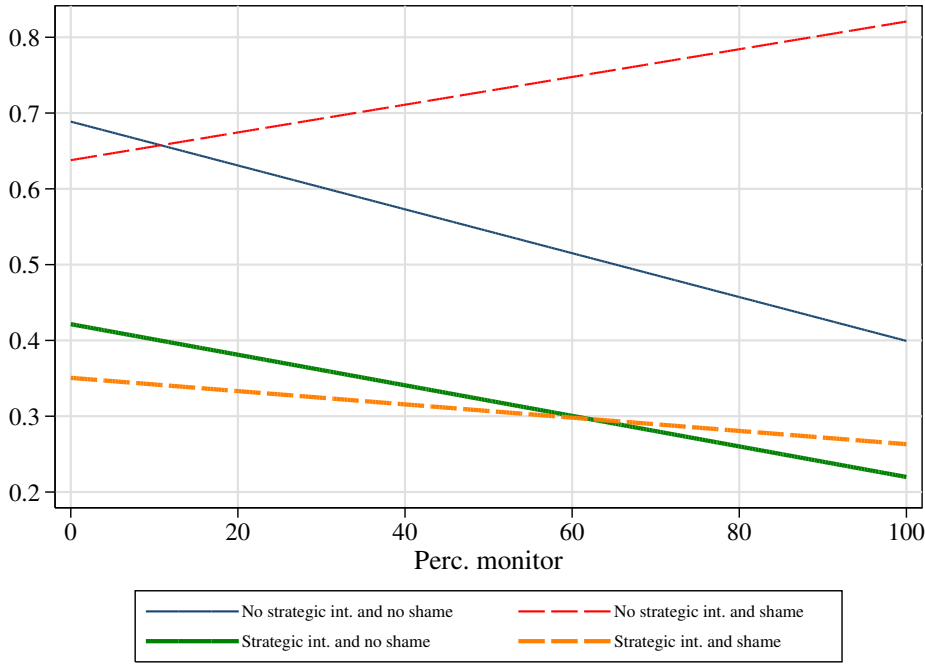


Figure 2: The Effect of The Audit Rate on Evaded Income: Individual Random Effect Model



5 Concluding remarks

In a world where there is common agreement about the need to fight tax evasion, the results of our experiment shed new light on the debate about the different policies to be implemented to achieve this goal. We found that the choice of efficient audit rules by tax agencies crucially affects individual tax compliance rates.

In particular, we checked for the relative effectiveness of two alternative audit rules: one that randomly selects the taxpayers to audit, and the other that selects the taxpayers to audit from among those reporting the lowest incomes.

The main result that is that competition between taxpayers induces more compliance: we found *ceteris paribus* higher tax revenues under the strategic audit rule than under the random one.

We also introduced public exposure of evaders in order to investigate whether shame could affect our results or not: shame was introduced by forcing apprehended taxpayers to reveal their identity to others under each audit rule, and we found that it affects tax compliance rates only under the strategic rule. This result is important, since it measures the impact of public exposure on tax compliance, highlighting its informational role.

The policy implications of our results are quite relevant, too: by implementing the appropriate mix of audit rules and communication policies, it is possible to induce taxpayers to behave honestly. We believe that these relevant findings need to be further investigated, either selecting a different sample of experimental subjects (for example, professionals or self-employed persons instead of students) or performing a field experiment. Moreover, we plan to backup our experimental results through an empirical investigation of real data from Italian tax administrations: in particular, we plan to analyze data that refer to the compliance rates of selected categories of professionals under presumptive taxation rules.

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Appendix I: Tables and Figures

Table A: The Fraction of Evaders

	No Strategic Int.			Strategic Int.		
	No Shame	Shame	Total	No Shame	Shame	Total
Income						
50	0.500	0.361	0.431	0.552	0.343	0.485
100	0.458	0.458	0.458	0.661	0.515	0.614
150	0.417	0.333	0.375	0.726	0.577	0.678
200	0.319	0.403	0.361	0.701	0.547	0.652
250	0.306	0.458	0.382	0.693	0.507	0.633
Tax rate						
20%	0.277	0.281	0.279	0.566	0.403	0.514
35%	0.700	0.620	0.660	0.913	0.695	0.842
55%	0.740	0.820	0.780	0.942	0.795	0.895
Fine						
40%	0.458	0.458	0.458	0.704	0.530	0.648
50%	0.340	0.280	0.310	0.605	0.453	0.556
60%	0.160	0.240	0.200	0.533	0.374	0.481
Audit rate						
20%	0.469	0.462	0.465	0.736	0.556	0.678
40%	0.220	0.300	0.260	0.570	0.389	0.512
60%	0.220	0.200	0.210	0.403	0.305	0.371
Total	0.400	0.403	0.401	0.667	0.498	0.612

Table B: The Fraction of Underreported Income

	No Strategic Int.			Strategic Int.		
	No Shame	Shame	Total	No Shame	Shame	Total
Income						
50	0.511	0.655	0.571	0.325	0.298	0.319
100	0.539	0.761	0.650	0.334	0.300	0.325
150	0.681	0.564	0.629	0.332	0.302	0.324
200	0.686	0.591	0.633	0.331	0.322	0.329
250	0.598	0.762	0.697	0.350	0.306	0.339
Tax rate						
20%	0.458	0.645	0.552	0.273	0.245	0.266
35%	0.609	0.616	0.613	0.347	0.355	0.349
55%	0.845	0.775	0.808	0.516	0.426	0.491
Fine						
40%	0.628	0.693	0.661	0.349	0.324	0.342
50%	0.353	0.553	0.443	0.293	0.233	0.278
60%	0.601	0.646	0.628	0.286	0.262	0.280
Audit rate						
20%	0.622	0.685	0.654	0.360	0.327	0.351
40%	0.476	0.604	0.550	0.239	0.191	0.227
60%	0.399	0.669	0.528	0.233	0.256	0.239
Total	0.594	0.676	0.635	0.335	0.306	0.327

Table C: Expected Underreported Income*

	No Strategic Int.		Strategic Int.	
	No Shame	Shame	No Shame	Shame
Income				
50	0.256	0.236	0.179	0.102
100	0.247	0.349	0.221	0.155
150	0.284	0.188	0.253	0.174
200	0.219	0.238	0.232	0.176
250	0.183	0.349	0.243	0.155
Tax rate				
20%	0.127	0.181	0.155	0.099
35%	0.426	0.382	0.317	0.247
55%	0.625	0.636	0.486	0.339
Fine				
40%	0.288	0.317	0.246	0.172
50%	0.120	0.155	0.177	0.106
60%	0.096	0.155	0.152	0.098
Audit rate				
20%	0.292	0.316	0.265	0.182
40%	0.105	0.181	0.136	0.074
60%	0.088	0.134	0.094	0.078
Average	0.240	0.273	0.225	0.154

* Percentage of gross income

Table D: The Effect of Effort

	Stage 1					
	No Strategic Int.			Strategic Int.		
	No Shame	Shame	Total	No Shame	Shame	Total
Effort						
No	0.394	0.409	0.401	0.669	0.501	0.615
Yes	0.600	0.200	0.400	0.587	0.395	0.525
	Stage 2					
Effort						
No	0.596	0.672	0.635	0.337	0.308	0.329
Yes	0.543	0.905	0.645	0.254	0.249	0.253

Figure I: The Computer Screen - SNS Treatment

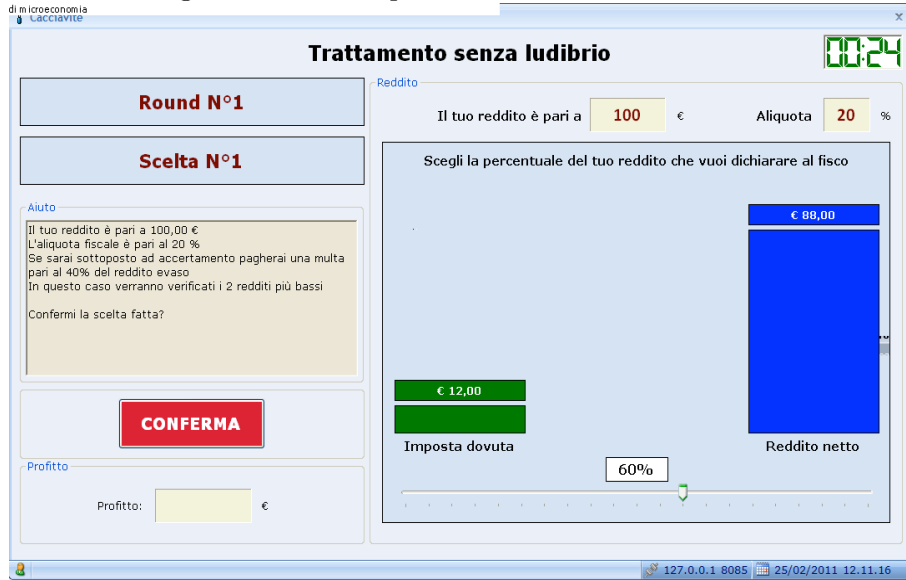


Figure II: The Computer Screen - SS Treatment

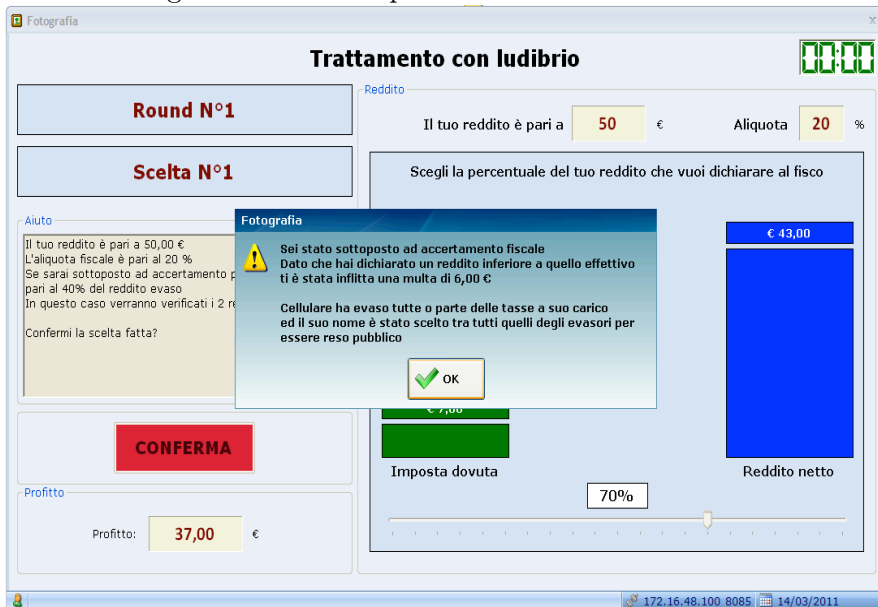
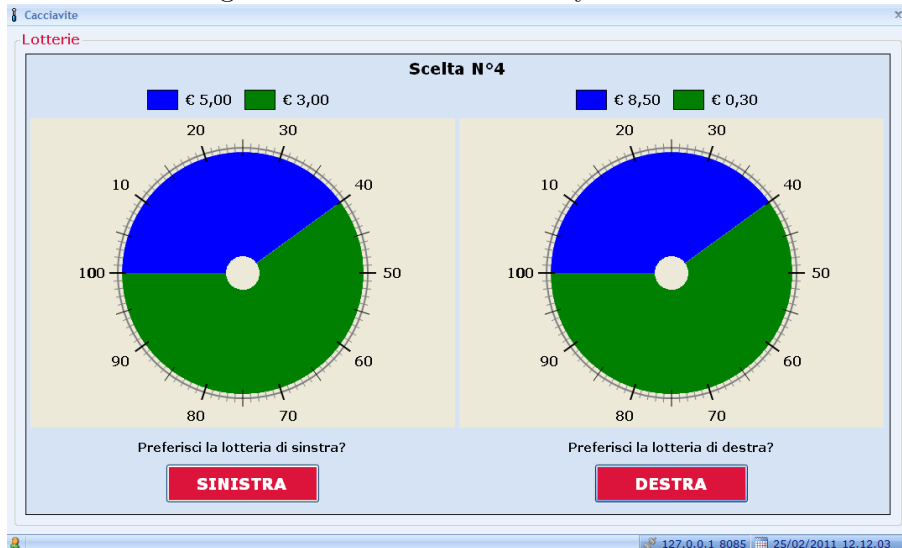


Figure III: The Computer Screen 2 - SS Treatment



Figure IV: The Holt and Laury Procedure



Appendix II: Instructions (English translation)

Welcome. This is an experiment on individual decision making about tax evasion.

We are only interested in your choices. There is no correct or incorrect way to perform the experiment, however your choices will determine how much money you will earn. In particular, the amount of money that you can get at the end of the experiment will depend both on your choices and on your luck. *Therefore, make your choices carefully since they will contribute to determining the amount of money that you will be paid immediately and in cash at the end of the experiment.*

This experiment is composed of three separate tasks: **the tax choice, the lottery choice, and the questionnaire.**

In the **tax choice** you are asked to decide the amount of taxes that you are willing to pay in different situations, called “choices.” Each decision and its corresponding result is independent from the decisions made in the other choices; for example, this means that the decision that you will take in “choice 1” will have no effect on your profit in “choice 2.” At the end of the experiment the computer will randomly select one of the choices and you will get the profit earned in that choice, divided by ten.

In the **lottery choice** you will have to choose between many pairs of lotteries that will be presented sequentially on your computer screen. At the end of the experiment the computer will select one of these choices and it will play for real the lottery that you have chosen; finally, your profit from the selected lottery will be computed.

Your payoff from the experiment will be the sum of the profit obtained in the tax choice plus the profit earned in the lottery choice.

At the end of the experiment you will be asked to fill out a short on-line **questionnaire.**

The results of the experiment will be used only for academic research purposes and will be published anonymously.

The tax choice: Basic explanation

The tax choice is composed of **six rounds** in which you will make similar (but not identical) decisions

In each round, from 1 to 5, you will be asked to make **7 independent choices**; in round 6 you will be asked to make **only 1 choice**. Therefore you will be asked to make **36 independent tax choices**.

In each choice your actual income will be randomly generated from a distribution ranging from 50 to 250 and it will be displayed on the top right side of your computer screen. You will have to decide how much income to report to the tax office: your tax choice will determine the tax due, which will be displayed on the top right side of your computer screen.

After each choice the computer will calculate your **profit** based on that choice. Your profit will depend both on your choice and on the possibility that you are audited by the tax agency. In particular, if you are not audited, your profit will be equal to your **net income**, i.e., the income that you have decided to report minus the tax due on the reported income. If you are audited your profit will depend on your initial decision to be honest or dishonest (reporting an income lower than the actual one).

- i. **Random without shame**—After all participants have made their decisions, the computer will randomly select a given number of reported incomes and will audit them (the number of audits will vary across experiments and it will be displayed on the left of your computer screen). If you turn out to be a “tax evader,” you will have to pay a **fine**, a percentage of your underreported income. (Be careful! This percentage changes during the experiment: in each choice it will be displayed on the left of your computer screen). Therefore, your profit for that choice will be equal to your net income minus the fine. If you don’t turn out to be a tax evader, your profit for that choice will be equal to your net income.
- ii. **Strategic without shame**—After all participants have made their decisions, the computer will audit the lowest reported incomes (the number of audits will vary across experiments and it will be displayed on the left of your computer screen). If you turn out to be a “tax evader,” you will have to pay a **fine**, a percentage of your underreported income. (Be careful! This percentage changes during the experiment: in each choice it will be displayed on the left of your computer screen). Therefore, your profit for that choice will be equal to your net income minus the fine. If

you don't turn out to be a tax evader, your profit for that choice will be equal to your net income.

- iii. **Random with shame**—After all participants have made their decisions, the computer will randomly select a given number of reported incomes and will audit them (the number of audits will vary across experiments and it will be displayed on the left of your computer screen). If you turn out to be a “tax evader,” you will have to pay a **fine**, a percentage of your underreported income. (Be careful! This percentage changes during the experiment: in each choice it will be displayed on the left of your computer screen). Therefore, your profit for that choice will be equal to your net income minus the fine. If you don't turn out to be a tax evader, your profit for that choice will be equal to your net income. **Attention! The computer will select one of the audited tax evaders and will ask that evader to stand up in front of all the other taxpayers for a minute. For that minute, an alarm will sound.**

- iv. **Strategic with shame**—After all participants have made their decisions, the computer will audit the lowest reported incomes (the number of audits will vary across experiments and it will be displayed on the left of your computer screen). If you turn out to be a “tax evader,” you will have to pay a **fine**, a percentage of your underreported income. (Be careful! This percentage changes during the experiment: in each choice it will be displayed on the left of your computer screen). Therefore, your profit for that choice will be equal to your net income minus the fine. If you don't turn out to be a tax evader, your profit for that choice will be equal to your net income. **Attention! The computer will select one of the audited tax evaders and will ask that evader to stand up in front of all the other taxpayers for a minute. For that minute, an alarm will sound.**

After all participants have made their decisions, the computer will randomly select a given number of reported incomes and will audit them (the number of audits will vary across experiments and it will be displayed on the left of your computer screen).

If you turn out to be a “tax evader,” you will have to pay a **fine**, a percentage of your underreported income. (Be careful! This percentage changes during the experiment: in each choice it will be displayed on the left of your computer screen). Therefore, your profit for that choice will be equal to your net income minus the fine.

If you don't turn out to be a tax evader, your profit for that choice will be equal to your net income.

Do not worry about making any calculations: for each choice, the computer will do all the necessary calculations on the basis of the parameters involved in your decisions. The results will be displayed on your computer screen.

In particular, your profit for each choice will be displayed on the bottom left of your computer screen.

At the end of all your tax choices, the computer will randomly select one of them and you will receive in cash the profit earned in that choice, divided by ten.

The tax choice: Examples and figures

Take a look at the pictures below. Each player is identified by a symbol shown on the top left side of your computer screen. In the following examples, you are **Casa**. Moreover, in the left box on the screen, you can find all the information you need to know before making your decision: your **Income**, the **Tax rate** (as a percentage of the reported income), the **Fine** (as a percentage of the difference between the actual income and the reported income), and the number of taxpayers who will be audited.

On the top right of the screen you can still find your initial **Income** and the **Tax rate**. On the bottom right of the screen you can find two columns with variable heights. The digits on the top of the two columns shows your **Net Income** and the **Tax due**, which depends on your reported income.

In order to make your **Choice**, you have to move the cursor along the bar at the bottom right of your computer screen. The number you see above the bar indicates the percentage of income that you want to report. If you have decided to report 100% of your income, which means paying taxes in full, you have to move the cursor all the way to the right; if you decide to report 0% of your income, which means paying no taxes, you have to move the cursor all the way to the left. You can place the cursor on any point on the bar before making your decision. Note that the height of the left column, and the number above it, indicate the tax due on the basis of your decision. The right column shows you how your net income decreases according to the amount of taxes you decide to pay. In the example below, the cursor indicates 100% (*this means that Casa has decided to declare 100% of the income*), but you are free to modify the cursor's position as you prefer. You are encouraged to play with the cursor to measure the effect of your decision

on your earnings before you decide to confirm your choice.

Figure V:



Figure VI:



After you have made your choice, you have to wait until all taxpayers

have confirmed their decisions before knowing your profit. Your profit will depend on your reported income and, eventually, on the outcome of your audit. **In this case, the computer will warn you about the audit and will calculate your profit accordingly.**

In the second example, “Cacciavite” has decided to report 60% of her income (50 Euros); given the tax rate, 20%, her net income would be 44 Euros and her profit would be 44 Euros in case she is not audited. Actually, “Cacciavite” was audited. Therefore, her profit was not 44 Euros, since she had to pay a fine equal to 40% of her underreported income. As you can see her profit was 36 Euros: the tax agency reduced her net income (44 Euros) by charging a fine (8 Euros) equal to 40% of her underreported income (50%–60% of 50 = 20).

The Tax choice: Rounds 1 to 5

In Rounds 1, 2, 3, 4, 5 your actual income will be randomly drawn by the computer from a distribution ranging from 50 to 250.

The Tax choice: round 6

In Round 6 your actual income will not be randomly drawn by the computer; you will earn it by answering a questionnaire. In particular, you and the other taxpayers will be ranked on the basis of the number of correct answers: whoever ranks first will earn the highest income, whoever ranks second earns the second highest income, and so on. In the figure below, 2 out of the 12 questions of the questionnaire are shown as an example.

Figure VII:

The image shows a web browser window with the title "Questionario sforzo". The main heading is "Questionario sforzo". There are two questions displayed in a scrollable area:

1. Tra i sottostanti numeri quale completa la serie: 2, 14, 26, 38, ...

- 50
- 60
- 70
- 80

2. Quale e' il numero che manca nell'operazione e che andrebbe inserito nel quadratino bianco? $2[] + 1/(8 - 1) = 3$

- 3
- 2
- 1
- 0

At the bottom of the window, there is a red button with the text "CONFERMA LE RISPOSTE".

The lottery choice

In the **lottery choice** you have to choose between pairs of lotteries with different prizes. For each pair of lotteries you have to pick the one you would like to play. *The computer will select randomly one of the lotteries you have chosen and will run it for real and your earnings will depend on the result of that lottery. Therefore think carefully before making any of your choices.* In the figure below you can find an example of the lottery choice.

At the end of the experiment the computer will select one of these choices and it will play for real the lottery that you have chosen; finally, your profit from the selected lottery will be computed. In our example, **Choice No. 4** was drawn; in that choice the left lottery was preferred. The computer will run the left lottery for real: if the spinning device stops on the green area, 3 Euros will be earned; if it stops on the blue area, 5 Euros will be earned.

Figure VIII:

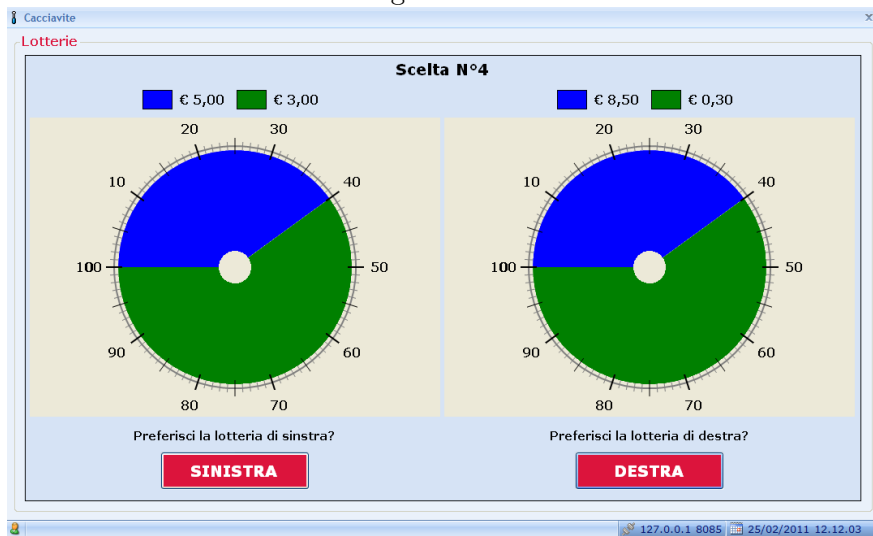
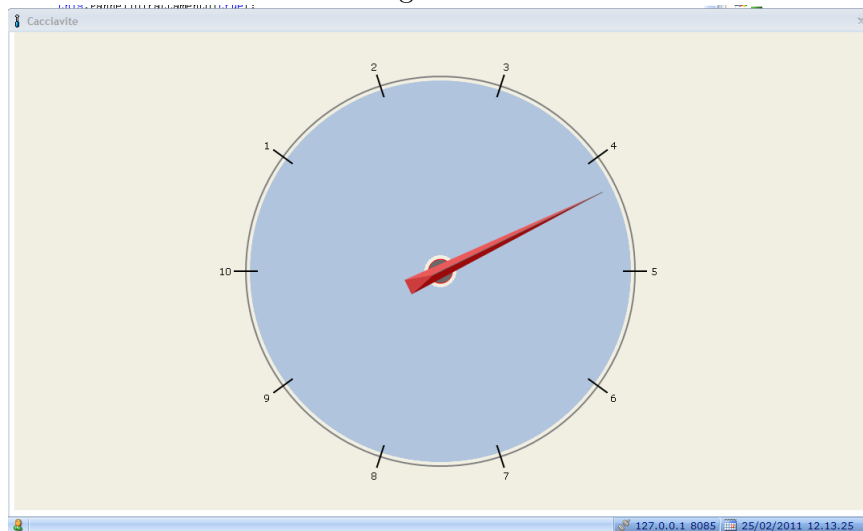


Figure IX:



Your payoff from the experiment

The total payoff from the experiment will be the sum of the profit earned in the **tax choice** plus the profit earned in the **lottery choice**.

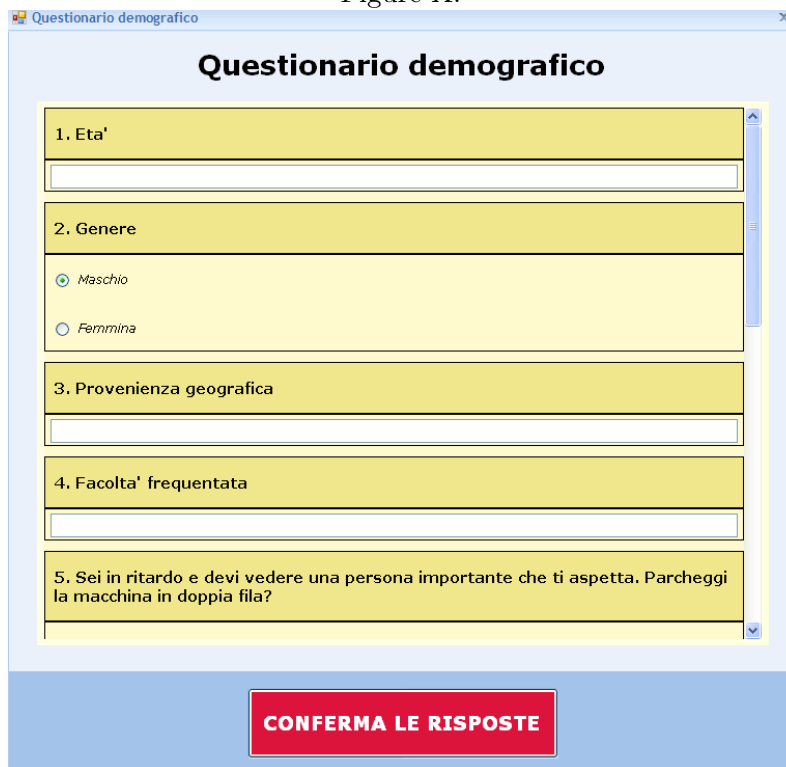
The payoff from the tax choice will be equal to the profit obtained in the choice selected randomly by the computer divided by ten.

Instead, the payoff from the lottery choice coincides with the outcome of the lottery randomly selected by the computer.

The questionnaire

At the end of the experiment you will be asked to answer a simple questionnaire. In the figure below you can find an example of the questions contained in the questionnaire.

Figure X:



The image shows a screenshot of a web browser window titled "Questionario demografico". The page has a light blue header and footer. The main content area is white with a yellow background for the question boxes. There are five questions:

1. **Eta'**
[Text input field]
2. **Genere**
 Maschio
 Femmina
3. **Provenienza geografica**
[Text input field]
4. **Facolta' frequentata**
[Text input field]
5. **Sei in ritardo e devi vedere una persona importante che ti aspetta. Parcheggi la macchina in doppia fila?**
[Text input field]

At the bottom of the page, there is a red button with white text that says "CONFERMA LE RISPOSTE".

Please do not disturb the other participants during the experiment. If you need help, please raise your hand and wait in silence. The experimenters will help you as soon as possible.

Good luck!