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Tax Evasion and Moral Constraints: some Experimental Evidence

Abstract

Tax evasion has been mainly studied as a problem of choice under uncertainty like any portfolio manager, the taxpayer has to allocate her/his fixed gross income between two assets: a risky asset, tax evasion, and a safe asset (with a zero return), tax payment. Tax evasion activity is risky because there is a certain probability that tax evasion will be discovered and punished. As suggested by the portfolio theory, the taxpayer's choice will be affected by her/his preferences, - mainly by her/his attitude towards risk-taking - and by the return on the risky asset determined by the tax structure, which includes both the tax rate and the penalties in the case of evasion. However, the pure gamble model appears unsatisfactory on various grounds . Among these and most importantly for our purpose, it neglects the psychological aspects of the decision to evade tax because it rules out any feeling of shame about evading or by being detected and punished, and it ignores any intrinsic pleasure from successful evasion. In other words, the pure gamble model does not take full account of the moral constraints involved in the tax evasion decision. The main objective of the experiment presented here was therefore to investigate the role played by moral constraints in determining the decision to evade taxes. This includes not only monetary elements but also psychological and moral factors in the taxpayer's decisional process.

1. Introduction

Tax evasion has been mainly studied as a problem of choice under uncertainty (Allingham and Sandmo, 1972): like any portfolio manager, the taxpayer has to allocate her/his fixed gross income between two assets: a risky asset, tax evasion, and a safe asset (with a zero return), tax payment. Tax evasion activity is risky because there is a certain probability that tax evasion will be discovered and punished. As suggested by the portfolio theory, the taxpayer's choice will be affected by her/his preferences, - mainly by her/his attitude towards risk-taking - and by the return on the risky asset determined by the tax structure, which includes both the tax rate and the penalties in the case of evasion.

However, the pure gamble model appears unsatisfactory on various grounds . Among these and most importantly for our purpose, it neglects the psychological aspects of the decision to evade tax because it rules out any feeling of shame about evading or by being detected and punished, and it ignores any intrinsic pleasure from successful evasion. In other words, the pure gamble model does not take full account of the moral constraints involved in the tax evasion decision.

The main objective of the experiment presented here was therefore to investigate the role played by moral constraints in determining the decision to evade taxes. This includes not only monetary elements but also psychological and moral factors in the taxpayer's decisional process.

The paper is organised as follows. In the first part we present the traditional approach to the tax evasion problem and propose an extention of the traditional model to include the role played by moral constraints. In the second part we describe the design of the experiment used to test our model. The choice of an experiment as the source of empirical data is justified by the particular nature of the tax evasion phenomenon, which renders hard statistics either entirely unavailable, or at any rate, highly unreliable. In the final part of the paper we report and discuss the results of the experiment.

2. Taxpayer model as a *pure gambler* model

Traditional theory assumes that the taxpayer has a von Neumann-Morgenstern utility function [1] that is concave in consumption:

$$E(U) = (1-\pi)\, U\{Cs\} + \pi\, U\{Ca\}$$

where:

λ is the percentage of tax evaded (λ=0 if taxpayer is perfectly honest, λ =1 if taxpayer is perfectly dishonest)

π is the probability that evasion will be discovered;

t is the tax rate;

$P(\lambda)$ is the punishment mechanism which links the surcharge to the level of evasion [2];

$Cs = [1-t(1-\lambda)]\, Y$ is the consumption level enjoyed if the taxpayer escapes detection;

$Ca = [1-t-\lambda P(\lambda)t]\, Y$ is the consumption level should the taxpayer be caught and punished.

Under these assumptions the problem of the taxpayer is the following:

$$\underset{\lambda}{\text{Max}}\, E(U)$$

From the first order condition of this problem we can obtain the optimal level of evasion [3]:

$$\lambda^{*} = \frac{(1-\pi)U'\{Cs\} - \pi P(\lambda)U'\{Ca\}}{\pi P'(\lambda)U'\{Ca\}}$$

This result warrants some comment. Tax evasion is a fair gamble if $1-\pi-\pi P(\lambda) \geq 0$. In this case, a rational risk neutral taxpayer will evade tax payment. On the other hand, a zero evasion equilibrium is possible if the tax-enforcement mechanism - the tax surcharge $P(\lambda)$ - and the probability of being audited are such that to render the gamble less than a fair one. If we

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[1] The use of the von Neumann-Morgenstern utility function is not completely satisfactory. Among other things, it rules out state-dependent utility and misperceptions by the taxpayer on the probabilities of being detected.

[2] We employ the assumption that the penalty rate is imposed on evaded tax, an institutional device commonly used in many developed countries. We further assume that $P'(\lambda) > 0$ and $P''(\lambda) \geq 0$

[3] The first order condition problem is:

$$\frac{\delta E(U)}{\delta \lambda} = (1-\pi)U'\{Cs\}tY - \pi U'\{Ca\}\left[P(\lambda) + P'(\lambda)\lambda\right]tY = 0$$

The second order condition is verified once it is assumed that $U''\{C\} \leq 0$. It rules out the case of a risk lover taxpayer , i.e. a taxpayer willing to accept unfair gamble.

assume risk aversion, however, tax evasion should be more than a fair gamble in order to compensate the taxpayer for bearing the risk.

Using this general framework, the literature on tax evasion has obtained some interesting comparative static results [4].

It can be straightforwardly verified that:

$$\frac{\delta\lambda^*}{\delta\pi} < 0 \text{ and } \frac{\delta\lambda^*}{\delta P} < 0$$

Evidently, evasion will decrease when the fairness of the evasion gamble is reduced by an increase in the probability of being audited or/and by an increase in the surcharge should evasion be detected and punished.

Unfortunately, the influence of changes in the tax rate and income level on tax evasion cannot be unambiguously determined in this general case. However, some insights can be gained by imposing an extra assumption on preferences. If we assume that taxpayers' preferences are characterised by decreasing absolute risk aversion (DARA) [5] we find that:

$$\frac{\delta\lambda^*}{\delta t} < 0 \text{ [6] and } \frac{\delta\lambda^*}{\delta Y} > 0 \text{ [7].}$$

These results are driven by the wealth effect (via an increase in exogenous income or via a decrease in tax rate) on the optimal risk-bearing solution. They are perfectly in line with the well known result of portfolio theory which states that the portfolio manager whose net wealth increases is willing to expand the proportion of risky assets in his portfolio if his degree of risk aversion decreases as wealth increases. However, when this wealth effect is absent, because of

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[4] An interesting survey of this literature can be found in Cowell (1990)

[5] According to the definition of Arrow and Pratt, absolute risk aversion is defined as follows:

$$R_A = -\frac{U''\{C\}}{U'\{C\}}$$

Therefore DARA implies that $(R_A\{Ca\} - R_A\{Cs\} > 0)$.

[6] This result is due to Yitzhaki (1974). By using a framework that explicitly considers the role played by public goods, Cowell and Gordon (1988) shows that the effects of a tax increase on the quantity of the evaded tax is positive or negative according as public goods are underprovided or overprovided.

[7] See (Cowell 1990). It is to be said that in the formulation of the problem, we propose here, the assumption of DARA is not strictly sufficient to state the positive relation between income and tax impose:

$$R_A\{Ca\} - \frac{1-t+t\lambda}{1-t-P(\lambda)t\lambda} R_A\{Cs\} > 0$$

the assumption of risk neutrality - the utility function is linear in consumption - neither tax nor income have effects on optimal evasion.

2.1 Drawbacks to this model

As anticipated in the introduction, the approach to tax evasion based on the maximisation of the expected utility is not satisfactory on several grounds[8]. First of all, the analysis is restrictive insofar as it assumes, for example, that gross income (Y) is exogenous and unaffected by tax rates or surcharge rate (π and P). Secondly the assumption of full information embodied in the model is rather unrealistic. This objection mainly concerns π, whose "objective" value can be difficult to measure even by the fiscal Authority [9]. Lastly, and more importantly from our point of view, the pure gamble model rules out any psychological aspect to the decision to evade tax and neglects the role played by non pecuniary and moral factors.

The analysis presented in the previous section seems to assume that everyone except the tax administration behaves as an insulated individual playing a *game against nature.* However, the cognitive process leading to the decision to evade tax seems to be a more complex and richer process in analysis of which the individualistic approach is clearly unsatisfactory. Among other things, it overlooks the possibility that the tax evasion decision may be driven by perceived injustices or inequalities in the tax system, and it neglects the influence of the prevailing *social climate* on the decision of the taxpayer to break the fiscal law.

The available empirical evidence on the tax evasion phenomenon seems to support these criticisms (Marrelli, 1987). In general terms, for example, it has been shown that evasion behaviour varies considerably by income type and population group (Clotfelter, 1983)[10]. Moreover some of the results of comparative statics derived from the above model are not supported by empirical analysis. Again Clotfelter, along with Poterba (1987) and Crane and Nourzad (1986), shows that evasion increases with the tax rate while the theoretical prediction is the reverse. Baldry (1986 and 1987) reports experimental results in which the chooses not to

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[8] The literature about tax evasion theory has reached an high degree of development; an interestd reader is again referred to Cowell (1990).

[9] We could also argue about the degree of tax payers' knowledge of the fiscal system, which is synthetically represented in the model by the fee. Modern fiscal systems are often very complex and most of tax payers have only an imprecise knowledge of the rules to respect and of the punishments.

[10] Curiously enough, he found that married people evade more than single persons and younger people more than old.

evade, apparently on moral grounds, and in which the tax structure appears to have an effect on people's decision to evade over and above any income or wealth effects which it may induce[11] .

The drawbacks of the model presented in the previous section point to the general conclusion that the tax evasion game cannot be reduced to a pure gamble. On the contrary, rather than being solely a pure gambler, taxpayer is also a free rider: by evading tax s/he is not excluded by the consumption of the public goods out to fiscal revenues. Therefore the taxpayer may be aware that her/his evasion will damage the welfare of the community in which s/he lives: hence evasion can produce different types of psychological cost. On the other hand, we cannot exclude that, in the same circumstances, and mainly when taxpayer is convinced that s/he is paying *too much* in absolute or relative terms or with respect to the public goods provided, an increase in welfare, as well as the saved tax payment, may accrue to the taxpayer when evasion is successful.

3. The rational taxpayer model with moral constraints

In this section we will extend the model of section 2 in order to take full account of the moral constraints involved in the tax evasion decision. The first problem to solve is therefore how to define the concept of moral constraint in the tax evasion context. This topic has been partially treated by the literature and from various perspectives, of which two are of particular interest to here:

1) *the "Kantian" morality approach* (Laffont, 1975; Sudgen, 1984): this approach is broadly related to the Kant's definition of morality and is built on the assumption that for a given taxpayer a "fair tax" ($\bar{t}\,Y$) is the amount of money that s/he believes fair for all other taxpayers to pay under the same conditions [12]. Thus a Kantian moral cost $K(\lambda)$[13]. can be defined where $K(\lambda)$ represents a psychological cost incurred irrespective of whether the act of evasion is observed. Thus rests on the assumption that a false declaration will generate anxiety, guilt or a reduction in

[11]It is important to underline that even if a quite large number of experiments have been carried on fiscal evasion, most of them have exclusively pursued the objective to test the validity of predictions of tax evasion theory. More precisely has been tested the role played by tax audit risk alone (e.g. Spicer and Thomas, 1982 and Chang and Nichols, 1987), by the dimensions of fines and tax audit risk jointly (e.g. Friedland, Maital and Rutemberg, 1978).

[12] The degree of the perceived (un)fairness of the tax burden mainly depends from the amount of services (public goods plus merit goods), that the State provides. Wealth redistribution can be seen as one of the duties performed by the State and therefore can be included among the services that the State provide. In this sense the degree of perceived tax fairness should also depend from the degree of inequality, and by the expected effectiveness of the equity policies carried on by the State.

[13] We assume that the cost component K is an increasing function of λ.

self-image. Our assumption is that taxpayers feel these costs only if They do not believe that they are not paying an amount of tax higher what is fair. No moral constraint can work as a spontaneous device in reducing tax evasion if taxpayers feel that they are subject to an unfair tax burden. If this is the case, and then $t > \bar{t}$, rather than inducing guilt or a reduction in self-image, tax evasion may be perceived as necessary self-defence, and the act of tax evasion in itself may increase the welfare of the taxpayer.

2) *the altruistic approach* (e.g. Chung, 1976): under this approach the taxpayer is not exclusively interested in her/his own welfare but is also concerned about the general welfare of her/his society. Hence the decision to evade is to some extent constrained by the knowledge that her/his evasion will reduce the amount of resources available for social welfare. We may thus define a moral constraint based on the social evaluation of the tax evasion. $S(\lambda)$ is non-pecuniary costs represented by the damage to the evaders' reputation resulting from detection[14]. It therefore represents what we may call the *social stigma*: the moral cost incurred by an individual who is discovered to be in break of the law[15]. In other words we may imagine that an ethical censure of fiscal evasion may emerge in a given society. In this case, those that decide to evade must must consider both the risk of being fined ans of being censured by public opinion, even when they do not feel any moral constraint to evade. The intensity of this social stigma clearly depends on how widespread evasion behaviour is in the community. The social stigma may be very great if taxpayer perceives herself to be in a tiny minority, but if there is a economy-wide propensity to tax evasion, such a taxpayer may feel far less morally culpable. Note that what is important is the prevailing *perceived* rate of evaders because the true number of evaders, is unknown not only to tax payers but to the fiscal Authority as well. Our assumption is that the taxpayer compares the perceived average level of evasion μ^e ($\mu^e = \frac{1}{N}\sum_1^N \lambda_i^*$)[16] against $\bar{\mu}$, a level which s/he judges to be physiological[17]. If $\mu^e > \bar{\mu}$, rather than a free rider, the taxpayer may feel s/he is one of the few

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[14] We assume that the cost component S is an increasing function of λ.

[15] We may also appeals to the literature on social customs (Akerlof, 1980 and Naylor, 1989). See also Gordon, 1989

[16] N represents the dimension of the community in which our taxpyer lives.

[17] Some studies suggest that the number of evaders personably known to a taxpayer (the simplest way in which μ^e might be computed) is an important factor predisposing people to evasion; see Spicer and Lundstetd (1976) and Vogel (1974).

who pays for all the others: by conforming with the component which does not pay, s/he can increase her/his welfare.

Under these assumptions, the utility function of the taxpayer becomes:

$$E(U) = (1-\pi)\, U\{Cs,Ms\} + \pi\, U\{Ca,Ma\}$$

where:

$$Ms = (\bar{t} - t)K(\lambda) \text{ and } Ma = (\bar{t} - t)K(\lambda) + (\bar{\mu} - \mu^e)S(\lambda)$$

In order to render the problem analytically tractable, we assume that $U_{CM}=U_{MC}=0$, $U_{MM}=0$ and $K''(\lambda) = S''(\lambda)=0$. The taxpayer's problem is still the following:

$$\underset{\lambda}{Max}\, E(U)$$

but under these assumptions, the taxpayer 's utility function is:

$$E(U) = (1-\pi)\, U\{Cs\} + \pi\, [U\{Ca\} - (\bar{\mu}-\mu^e)S\lambda] - (\bar{t} - t)K\lambda$$

From the first order condition we can obtain the optimal level of evasion:

$$\lambda^* = \frac{(1-\pi)U'\{Cs\} - \pi P(\lambda)U'\{Ca\}}{\pi P'(\lambda)U'\{Ca\}} - \frac{\pi(\bar{\mu} - \mu^e)S + (\bar{t} - t)K}{\pi P'(\lambda)U'\{Ca\}tY}$$

It is now evident that the fairness of the gamble, even when accounting for the degree of risk aversion, is not longer sufficient to generate evasion behaviour. In order to induce evasion the fairness of the gamble has to overcompensate the psychological costs involved in the tax evasion decision. This funding explains some experimental results (for example Baldry 1986, 1987) which shows that there are some people who choose not to evade even if it would appear convenient for them to do so. On the basis of the apparatus used here, we can state that for these taxpayers the non pecuniary disadvantages were higher than the pecuniary advantages deriving from evasion. It is worth noting, moreover, that the moral constraints have been defined in such a way that the opposite result is possible too. The effect of moral constraints on the decision to evade is, in fact, contingent to the sign of $(\bar{\mu} - \mu^e)$ and $(\bar{t} - t)$. If the level of taxation is perceived as too high and as therefore unacceptable to the taxpayer - $(\bar{t} - t) < 0$ - and/or if the proportion of evaders in the community is judged to be greater than the normal, physiological, proportion - $(\bar{\mu} - \mu^e) < 0$ - moral considerations may operate in reverse and increase the level of evasion.

Whatever the sign of the parameters, one notes with interest that in the model proposed here the level of evasion depends not only on the tax-enforcement variable (t and P) and on the probability of being audited (π), but also on variables that, although naively, capture the role played by the prevailing *social climate* and by the perceived injustices or inequalities in the tax system.

It is of interest to investigate the sign of the comparative static analysis. Since this with reveal whether our model is able to shed light on the discrepancies between the comparative static results obtained by the theoretical analysis and those deriving from experimental and empirical analysis. In the case of an increase in the tax rate, the result on the optimal level of evasion is no longer definite:

$$\left.\frac{\delta\lambda^*}{\delta t}\right|_{M\neq 0} = \left.\frac{\delta\lambda^*}{\delta t}\right|_{M=0} + \frac{K}{-SOC}$$

In this case, the effect of an increase in the tax rate can be distinguished into two different and opposite effect: a wealth effect of negative sign, as long as the assumption of DARA is retained, and a *tax unfairness* effect that is positive. The overall effect is not unambiguously definite a priori. However, it may happen that if the value of K is high enough, - i.e. if the tax unfairness effect is relatively stronger than the wealth effect - the result obtained by the traditional analysis is reversed, so that the level of evasion tends to increase with an increase in the tax rate. The reason for this is quite obvious: an increase in tax either decreases the psychological cost of evasion (if $(\bar{t} - t) > 0$) or increases the pleasure of evasion (if $(\bar{t} - t) < 0$).

Interestingly if $\bar{t}$ decreases the level of optimal evasion increases [18]. When, because of political or cultural changes, the level of tax judged as *fair* by taxpayer decreases, the incentive to evade increases as well al the optimal level of evasion.

Although we have not defined the cognitive process that determines the perceived average level of evasion it is reasonable to assume that this variable is in some way directly influenced by

[18] More precisely: $\frac{\delta\lambda^*}{\delta\bar{t}} = -\frac{K}{-SOC}$

the true (albeit unknown) level of evasion[19]. In this sense the evasion choice can no longer be considered a merely individualistic choice. Admitting then that μ^e is directly influenced by the actual total number of evaders, the behaviour of the other taxpayers will enter the optimal response function of our taxpayer.

We observe that:

$$\frac{\delta\lambda^*}{\delta\bar{\mu}} = -\frac{\delta\lambda^*}{\mu^e} = -\frac{S}{-SOC}$$

Therefore, the optimal level of evasion depends negatively on the subjective judgement of the physiological, and therefore acceptable, average level of evasion, and positively on the perceived current proportion of evaders in the community. Note thus it introduces a dragging effect: should a change occur in one variable affecting the decision to evade (tax rate, tax surcharge, income, probability of being audited), there will be a direct effect on the individual's decision to evade and an indirect effect based the change induced in μ. Furthermore some of the factors that can influence the perceived tax fairness may be completely independent of fiscal policy. For example: since wealth redistribution can be considered one of the duties performed by the state, the level of perceived tax fairness should depend directly on the degree of inequality in society, and on the perceived effectiveness of the equity policies implemented by the state.

4. Hypotheses to test and a further topic

Summarising the foregoing discussion the main hypotheses to be tested by the experiment were the following:

H_1) Does a feeling of collective blame somehow influence the decision to evade taxes? Our assumption is that, in the presence of a risk of exposure to collective disapproval, people have a lesser propensity to evade tax.

H_2) Does knowledge that one is damaging others (or reducing the value of some form of a social welfare function) reduce tax evasion? We expect this moral cost[20] to reduce the number of tax evaders.

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[19] Many factors reasonably influence the perceived rate of evaders: among these the prevailing attitude of the media in respect to this phenomenon, the relative position of each tax payer in respect to the others (a poor tax payer can have a different perception of evasion than a rich one), and so on.

[20] We will use the term "moral cost" as synonymous of "moral constraint" and *vice-versa*.

H_3) Is there any form of mutual reinforcement between the two forms of moral constraint, or are their effects independent? We assume that joint action by both constraints achieves the best results in terms of reduced tax evasion.

Again according to our theoretical premises, another interesting point to investigate is the role played by tax fairness. The problem with this topic is that a dynamic experimental context is required for it to be correctly tested. Since we do not know the prevailing believed fair level of taxes, we should repeat the charging using the same sample of subjects, to test if a modification in tax rates has any sensible effect on tax evasion level. As our project is concerned only with an one shot experiment this problem cannot be suitably treated. Nevertheless we have included in the experiment some devices aimed to check in some way the existence of some form of tax unfainess effect, these mechanisms will be described in the following sections.

Parallelly to the topics just illustrated in the previous points we would to explore a further issue, that is to verify is the existence of some form of relationship between the presence-absence of moral constraints and the value of the expected probability to be audited. An experiment that has some point in common with this topic has been carried on by Spicer and Thomas (1982) that have analysed the importance that complete information about audit probabilities can play in determining tax evasion. The results of that experiment seem to show that people tend to reduce tax evasion as much as precise the information about real audit risk becomes. In other words if subjects analysed are uncertain about the real audit risk they tend to underestimate it, and therefore they more frequently decide to evade.

Our aim is less ambitious, we simply want to investigate if the subjective evaluation of audit risk changes in presence of a moral constraint. The broad idea is that some participants could "include" their evaluation of the moral cost implied by the decision to evade taxes in their forecast of audit risk, that we expect will consequently raise in presence of a moral constraint. We are therefore assuming that moral cost modifies the cognitive process that agents must perform in forecasting the uncertain audit risk.

H_4) Does the presence of one or both the moral constraints influence the cognitive process that the participants must perform in determining the expected audit risk? Our assumption is that in presence of some form of moral constraint the participants tend to overestimate the risk to

be audited. Also in this case the effects produced by the two form of moral constraints here considered should be tested both separately and jointly.

Looking now very briefly to the main empirical problems the first one to solve is surely that to produce an "artificial" feeling of collective blame, and to test the effects of a subjective moral constraint. More precisely it is very difficult to be sure that the artificial environment of the experiment should reproduce some form of a moral value system, really felt by participants. Furthermore it is even harder to be sure that what we respectively define as subjective moral constraint and as collective disapproval should be perceived by participants in the desired way.

As it will be clearer after having read the section about the experiment design, the solution to this problem that we have adopted is to incorporate in the experiment some questions aimed to explore the opinions of participants about their perceived audit risk and about the importance that they attribute, from a moral point of view, to tax evasion. Part of these questions have been extracted from a field survey made by the Italian Exchequer[21], and give us the possibility to test the degree of homogeneity of our participants' opinions, about these problems, with the opinions of the Exchequer's sample.

It is important to underline that we have also used this field survey to weight tax rates used in the experiment. As in fact we have just seen, one of the problems implied by the moral constraint is that if participants feel to be unfairly taxed they could be strongly incentivated to evade. Even if we did not investigate about the extent of this phenomenon, as few lines before we anticipated, we need nevertheless some guarantee that the disincentive effects of what we have defined as moral constraints should not be too weakened by the incentive effect produced by a perceived unfair tax pressure. For this reason the tax rates we use are similar to those considered as "normal" by the majority of respondents to Exchequer's questionnaire.

A second important problem to solve is to improve, as much as possible, the degree of realism of the decisional problem perceived by participants. Our aim is to put participants in condition to perceive the money that we would give them as a true personal income and not as the "prize" of a game. To realise this objective we have anticipated the experiment with a sort of job

[21] Unpublished data, the survey has considered a sample of 696 subjects extracted from the Ministry's lists.

assigned to each participant. For this reason we asked to participants to answer to a quite long and heavy set of psychological tests, thus we presented them the true experiment as it should be the final payment stage of the whole procedure. In this way the participants should not perceive the money that we give them as a prize of some totally artificial game but as a real earning for a work produced.

5. The experiment's design

The experiment was planned to be realised using four groups of participants each made by 16 subjects, but the real sample used has been made only by 60 subjects because 4 of the selected didn't come to the meeting. The groups were the following:
- group A, total absence of moral constraints;
- group B, only collective moral constraint (social blame);
- group C, only subjective moral constraint;
- group D, collective and subjective moral constraints.

The presence-absence of a collective moral constraint has been realised respectively by making a public tax audit (obviously restricted only to whom has been extracted), or by assuring total anonymity to all participants independently from their choices. The presence-absence of a subjective moral constraint has been realised by introducing a system of partial redistribution of the yield of taxation among the participants.

The assumptions implied by these operating definitions are the followings:

A_1) collective moral constraint: participants believe that the other agents involved in the experiment (researchers, fellow participants) resolutely condemn tax evasion;

A_2) subjective moral constraint: participants dislike the idea that someone could suffer because of their behaviour (tax evasion reduces the total yield and therefore leaves less money for the final redistribution).

Assumption A_1 seemed reasonably realistic because our participants will be undergraduate students, and we imagined that they should be quite worried about the risk to be detected as potential "criminals" by their teachers. For a similar reason we also believed that the idea to be stealing money (assumption A_2) to their fellows should be a good *altruistic* based deterrent to tax evasion (see the definitions of moral contraints).

Summarising we have:

- group A, total anonymity, absence of any redistribution of tax yield;

- group B, public audit, absence of any redistribution of tax yield;

- group C, total anonymity, partial redistribution of tax yield;

- group D, public audit, partial redistribution of tax yield.

Each group has been divided in two sub-groups that originally we planned made by 8 subjects[22], these two sub-groups are distinguished by the total amount of work (number of psychological tests) that the participants did before the experiment. Each group is therefore made by two sub-groups: the sub-group "heavy workers" that worked for about one hour, and the sub-group "light workers" that worked approximately 30 minutes. These two sub-groups have received different amounts of money as a reward for their time spent in the experiment but they have been taxed using the same tax rate. The members of the two sub-groups (heavy or light workers) has been recruited on a voluntary base, in other words they were free to choose to make an heavy or a light work.

We payed 60,000 Italian liras (about 27 pounds) the heavy workers, while the light workers received 30,000 Italian liras, a 40% tax rate has then been applied to the members of both groups. The introduction of two different levels of income is intended as another tool to check the presence-absence of an "unfair tax" incentive to tax evasion. As the tax rate is identical for both the sub-groups, we expect that if some form of tax unfairness incentive to tax evasion should work, this should be stronger in the low income group than in the high income group. It is important to underline that a parallel reason that has influenced our decision to keep constant the tax rate is due to the need to reduce the number of participants, (and consequently the experiment's total cost) having at the same time a number of subjects enough great to allow reasonable generalisations.

After the pre-experiment phase[23] all the participants has been convoked the same day at the same time and has been divided in the experiment's groups (A, B, C, and D). Each group has been gathered in a separate room and has received a different set of written instructions that we will describe in the following pages. The common steps of the procedure for every group are:

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[22] The actual number of heavy workers that participated to the experiment has been 31, the light workers 29.

[23] The phase in which the participants must produce the provided amount of work.

1) both the sub-group "heavy workers" and the sub-group "light workers" of each group has been invited to enter in the room where they found a sort of pooling-booth;

2) in each room there were two boxes on which there were written "more work" and "less work";

3) from the "more work" box has been extracted a set of envelopes for each participant of the heavy work sub-group, from the "less work" box we extracted a similar set of envelopes for each participant of the light work sub-group;

4) each set of envelopes included:

a) a white envelop that contained respectively 60,000 liras (five 10,.000 liras notes, one 5,000 liras note and five 1,000 liras notes) for the heavy workers group and 30,000 liras (two 10,000 liras notes, one 5,000 liras note and five 1,000 liras notes) for the light workers group and two tickets with an identity number,

b) two envelopes: the first one was labelled "ticket envelop" and the second one "personal reward envelop", both open and joined (glued on) together,

c) an envelop labelled "tax envelop" inside which there was written the tax rate and the amount of money that the participant should pay, more precisely: light work group 12,000 liras, heavy work group 24,000 liras,

d) a clip;

5) each participant received the experiment's instructions;

6) the supplementary questions were contained in the tax envelop and were the followings:

a) how much do you believe is the probability that you will be audited? Use the following scale to indicate your expected probability:

1----------7

min. probability max probability

b) how much of the other participants do you believe that will evade taxes? Write it as a percentage.

c) How high is your regret to know that someone of the other participants has decided to evade her/his taxes? Use the following scale:

1----------7

low regret high regret

d) Do you know the Ministery of Finance's audit procedure?

e) How many Italians in your opinion are audited each year by the Ministery of Finance? Write it as a percentage.

f) Describe the audit procedure that you believe is actually used by the Ministery of Finance.

We have decided to use a 1-7 scale instead of a more common 0-9 scale because the first one seemed easier to understand by the subjects.

These are the instructions that each participant has received:

- *group A: total anonymity, absence of any redistribution of tax yield)*

"First of all we want to thank you for having answered to the questions of the questionnaires we gave you.

The reward for your work is in the envelope that you have just received. Inside the envelope, besides the money, you will find also two tickets with a number, that will maintain you anonymous meanwhile you cash the reward.

The reward, as you just know, is proportioned to the time spent and to the amount of work that you have done to answer to the questionnaires. In fact to some of you has been given a greater number of questionnaires ("more work" state) compared to another group ("less work" state). To the members of the first group we have assigned a reward of 60,000 liras, while to the others we have given a 30,000 liras reward. These rewards, as any form of earned income, is subjected to a taxation.

Your tax rate is written in the "tax envelope" together with the amount of the tax burden (made round to the lower 1,000 liras), that you should pay.

Before to pay the tax you must answer, please, to the questions that we gave you together with this instructions.

The operations that you must perform to pay your tax are the followings (you cannot use more than 3 minutes to do everything):

1) enter in the pooling-booth;

2) put the money for the tax in the "tax envelope" together with your answers to the questions;

3) put the remaining money in the "personal reward envelope" and one of the two identification tickets in the "ticket envelop";

4) seal up all the envelopes;

5) join together all the envelopes with the clip;

6) keep for yourself the second ticket, don't show it to anyone, you will use it at the end to cash your money;

7) put the envelopes in the box of your group (i.e. "more work" box or "less work" box), then go back to your seat and wait until all the other participants finished their tax payment operations.

It is important that you know that in the case that you put into your pocket the whole reward without using the "personal reward envelop" you will loose the right to anonymity and the right to receive the personal reward.

If you decide to evade tax you take the risk to be detected by the fiscal enquiry, in that case (only in the case that you 'll be detected by the fiscal enquiry) you must pay your debt plus the following fines:

I) tax evasion lower that the 30% of the amount due: fine equal to the 50% of the value of the tax evaded;
II) tax evasion from 31% up to 60% of the amount due: fine equal to the 80% of the value of the tax evaded;
III) tax evasion over 61% of the amount due: fine equal to the 140% of the value of the tax evaded;

The procedure used to carry on the fiscal enquiry is identical to the revenue office's one. The procedure that will assure your anonymity has the following characteristics: after having decided the envelopes that will be inspected (more precisely the sets of three envelopes kept together with the pin),

a) will be opened the "personal reward envelopes" and the "tax envelopes";

b) will be applied the fine, in the case that there is a tax evasion, putting back in the "personal reward envelope" the remaining money;

c) the "ticket envelope" will not be opened (unless both the "personal reward envelope" and the "tax envelope" should be empty). In this way, therefore, we will protect also tax evaders' anonymity.

Eventually will be opened all the remaining envelopes, except the "ticket envelopes", contained in boxes with the aim to check the tax evasion dimensions. On those envelopes will not be applied any fine. At the end of this last step we will keep the "tax envelopes", while the

"personal reward envelopes" (that will be closed) and the "ticket envelopes" (obviously still glued on together with the "personal reward envelopes") will be put in one box, shuffled, and distributed to the participants using the reference ticket.

The instructions for the second group (group B, public audit, absence of any redistribution of tax yield) are identical to those just exposed with the only difference that none form of anonymity is assured to the participants.

Also the instructions for the third group (group C, total anonymity, partial redistribution of tax yield) are basically identical to those of group A with the addition of a further piece of information:

> "It is important that you know that a part of the total yield will be redistributed among all the participants. More precisely it will be redistributed the 70% of the total yield in identical individual parts. For example if the total yield (that is the sum of the individual payments of all the members of both the "less work" and "more work" groups) should be 200,000 liras then each participant will receive 12,500 liras."

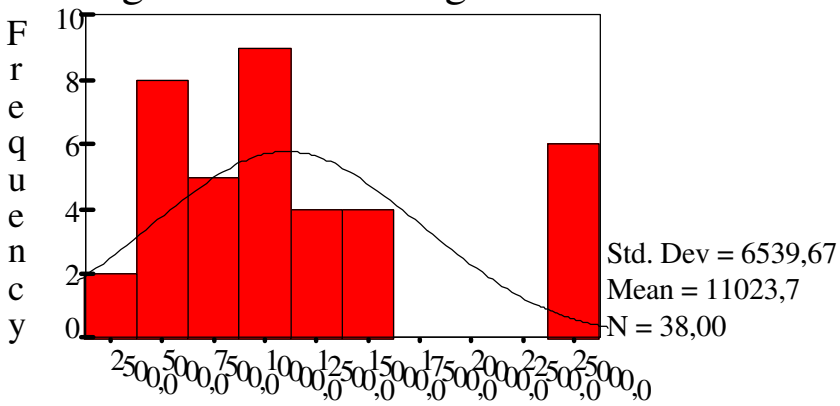
Obviously the participants of the fourth group (group public audit, partial redistribution of tax yield), has received the group C instructions without any assurance of anonymity.

4. A first analysis of results

The 30 of July 1993 the experiment has been realised using a sample so structured:
- group A (total anonymity, no redistribution of tax yield) 16 subjects;
- group B (public audit, no redistribution of tax yield) 14 subjects;
- group C (total anonymity, redistribution of tax yield) 15 subjects;
- group D (public audit, redistribution of tax yield) 15 subjects.

The number of subjects that has decided to evade is 38 (63.3% of the population sample) the average evasion for the entire population is of about 7,000 liras while the average evasion for the evaders' sub-population is of about 11,000 liras. The distribution of the amount of money evaded is reported in fig. 1.

Fig. 1 Evasion histogram



amount of evasion

Looking at fig. 1 it is interesting to notice that there is a jump between the 15,000 liras level and the 24,000 liras level, which is the total evasion level for the heavy workers group. In other words we can observe that the evasion distribution does not follow a continuos pattern and that it seems that it exists a sort of *threshold effect*: those tax payers, belonging to the heavy workers group, that decide to evade more than 15,000 liras directly jump to the total evasion threshold instead of choosing an intermediate level of evasion.

Most of the variables considered by the experiment are dichotomous and at the same time can have some form of dependency with one or more of the other variables. Going back to our hypotheses we could check some basic issues:

Y_{1a}) is moral cost a deterrent for tax evasion?

Y_{1b}) is anonymity a deterrent for tax evasion?

Y_{1c}) is there any statistically significant dependency between the decision to evade and some of the variables considered, like income level, expected audit probability, expected rate of evasion, etc.?)

Y_{1d}) is there any multiple dependency among the decision to evade and moral cost and anonymity or other variables?

Y_2) is the amount of money evaded influenced by the expected audit probability and by the other variables?

Y_3) has the subjective forecast of the audit probability been modified by the presence-absence of moral constraints and in which way?

The Y_1 set of questions requires to solve a basic issue: how can we check the mutual influence of the variables considered? From a very first analysis of the data we discover that moral cost seems to be a real deterrent to tax evasion while anonymity seems to be irrelevant as shown by tables 1 and 2.

In presence of a moral cost 14 people (given a total of 30 subjects) has decided to evade while in absence of any moral constraint 24 (always referred to a sample of 30 subjects) has evaded. Another way to observe the same phenomenon is the following: the 72.7% of the tax payers total population are included in the moral cost group. On the contrary if we look at table 2 we discover that 22 people of the non anonymous group (which is made by 29 subjects) has decided to evade against the 16 of the anonymous group (31 subjects). The chi-square values seem to confirm these considerations allowing us to reject the hypothesis of independence between the decision to evade and the moral constraint, the same is also for evasion and anonymity even if the value of the test (0.05) is weaker than for the former couple of variables and on the border of significancy.

Tab. 1 Crosstabulation Evasion (EVADISC) by Moral cost (CODMO)

CODMO by EVADISC	non moral cost	moral cost	Row total
has not evaded	6 (20.0)	16 (53.3)	22 (36.7)
has evaded	24 (80.0)	14 (46.6)	38 (63.3)
Column total	30 (50.0)	30 (50.0)	60 (100)

Chi-square = 7.17 sig. 0.007

Tab. 2 Crosstabulation Evasion (EVADISC) by Anonymity (CODAN)

CODAN by EVADISC	non anonymous	anonymous	Row total
has not evaded	7 (24.1)	15 (48.3)	22 (36.7)
has evaded	22 (73.3)	16 (51.6)	38 (63.3)
Column total	29 (48.3)	31 (51.7)	60 (100)

Chi-square = 3.79 sig. 0.05

From this very first analysis should therefore seem that anonymity has not been perceived by the subjects as a deterrent to fiscal evasion, while the moral constraint works as a quite powerful disincentive. The problem now is to make a better test of the validity of this consideration, by controlling that the dependency between these two variables is a "clean" phenomenon and not a spurious one, induced by one (or more) other variable. Before to cope with this problem, that is of central importance for all the further analysis of our data, it is uselful to show some more results.

Going back to the Y_1 set of questions a second interesting issue to explore is the following: do the expected probability to be audited or the income level influence the decision to evade? Also in this case we will use a simple cross-tabulation to explore these questions.

Tab. 3 Crosstab. Evasion (EVADISC) by Expected audit probability (EXPROBF)

EVADISC by EXPROBF	prob. < 0.2	prob. > 0.2 < 0.5	prob.> 0.5	Row total
has not evaded	10 (47.6)	8 (25.8)	4 (50.0)	22 (36.7)
has evaded	11 (63.2)	23 (74.2)	4 (50.0)	38 (63.3)
Column total	21 (35.0)	31 (51.7)	8 (13.3)	60 (100)

Chi-square = 3.27 sig. 0.194

The expected audit probability has been transformed from the 1-7 scale to a 0-1 traditional scale and the continuous variable so obtained has been converted in a three levels variable (expected probability lower equal than 0.2; expected probability included between 0.21

and 0.5; expected probability greater than 0.51; variable EXPROBF). Obviously the possible number of levels and kind of intervals for the conversion of the expected audit probability into a discrete variable can be various and in fact we have also tried a second transformation that keeps constant the number of subjects included in each level (variable EXPROBM), tab. 4 shows the results of this second cross-tabulation.

Tab. 4 Crosstab. Evasion (EVADISC) by Expected audit probability (EXPROBM)

EVADISC by EXPROBM	prob. < 0.19	prob. > 0.20 < 0.31	prob.> 0.32	Row total
has not evaded	10 (50)	4 (20)	8 (40)	22 (36.7)
has evaded	10 (50)	16 (80)	12 (60)	38 (63.3)
Column total	20 (33.3)	20 (33.3)	20 (33.3)	60 (100)

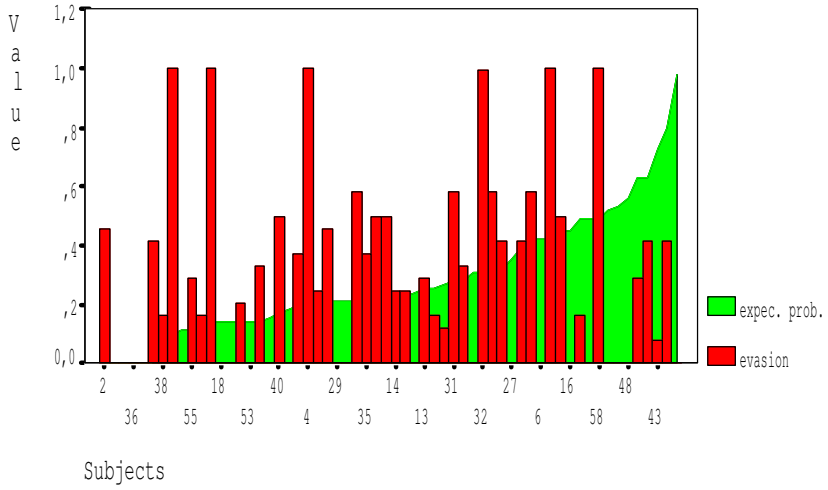
Chi-square = 4.019 sig. 0.134

It is not very easy to give an interpretation of the results illustrated in both table 3 and 4 because the subjects' behaviour tends to change in a quite curious way: the propensity to evade seemes to be similar for those that belong to the two extreme levels (low expected probability and high expected probability) while it raises quite dramatically for the subjects that believe in a moderate probability to be audited. In table 3 we have 11 evaders on a total of 21 subjects for the low probability level while the 8 subjects of the high probability level are exactly divided between evaders and honest tax payers.

In table 4 the low probability level includes the same number of evaders and tax payers, the high probability group shows a limited discrepancy but apparently irrational, because the number of evaders (12) is higher of the number of tax payers (8). On the contrary the intermediate level of both tables shows a quite high percentage of evaders (respectively 74.2% table 3 and 80% table 4).

A similar result is also shown by the graph reported in fig. 1 where it has been plotted the expected probability to be investigated (drawn as an area) and the amount of money evaded by subjects.

Fig. 2 Expected audit prob. and evasion



Looking at fig. 1 we have a confirmation of the phenomenon just observed in tab 3 and 4. We can in fact observe that the amount of money evaded does not seem strictly related to the subjective forecasts to be investigated. Note in particular that six subjects of the heavy workers group have decided to evade the entire amount of tax due and that four of them are divided between the lower part (two of them have forecasted a probability lower than 0.14) and the higher part (two of them believed that the risk to be investigated had a probability higher than 0.42) of the expected probability distribution. How to explain this phenomenon? A possible reason is that the expected probability to be audited is a "poor" variable in influencing the decision to evade and the amount of money evaded (as it is also confirmed by the bad values of Chi-square test in tab. 3 and 4). It is in fact important to underline that the variable that more strongly influences the decision to evade is the risk aversion and not the expected audit probability. This means that it is perfectly rational to evade if the agent has a high expected audit probability but a low risk aversion i.e. if s/he is a risk taker.

On the other hand it is nevertheless interesting to try to find some reason for the quite unexpected distributions of evaders and subjective audit probability. A possible alternative explanation is that who decides to evade tends to make a more careful and "realistic", from a subjective perspective, forecast of the audit risk. This interpretation seems supported by the survey made by the Italian Exchequer that we used to project the experiment. The results reported by Exchequer's survey about the expected audit probabilities (the question to answer was: "which do you believe is the probability that you will be audited by the fiscal police?) are the followings:

less than 1% = 36.8
from 1% to 10% = 22%
from 11% to 30% =18.2%
from 31% to 50% = 11.8%
from 51 to 80% = 5.5%
over 80% =4.5%
missings = 1.3%

If we add the percentages of respondents that believe to have less than 30% chances to be audited we obtain 77, if we look at table 3 we see that the 66.6% of our sample is made by subjects that have an expected audit probability lower than 31%. Therefore the beliefs of the two samples are broadly similar and this is particularly true for subsets comprised between 1% and 30% expected audit probability. These subsets have a cumulative percentage of 40.2% for the Ministry's sample and of 50% for our sample, while the other subgroups show cumulative percentages very different (the lower than 1% subset gather the 36.8% of Exchequer's interviewed against the 10% of our sample; the greater than 31% subset include the 21.8% of Ministry's sample while in our case the subjects included in that subset represent the 33.3% of the entire sample). From these data seems to emerge that between our subjects only those that are included in the 1-31% subset have better approximated a sort of "common sense", a "collective realistic" forecast of the expected audit probability. This consideration is closely related with our Y_3 issue, that is the assumption that moral constraint can modify the audit probability forecast, we shall come back to this point in a while.

Looking now at the income level we must remember that we had planned only two income levels, therefore we can use also in this case a 2x2 cross-tabulation that has been reported in tab. 5.

From the analysis of tab. 5 seems that it should exist a quite strong relationship between income and tax evasion: richer subjects tend to evade more than poorer do. More precisely the "heavy workers" subgroup has a 77% tax evasion rate while only 48% of "light workers" has decided to evade.

From the experiment's design we know that our definition of moral constraint lies on the assumption that subjects perceive the (partial) redistribution of the yield of taxation among participants as an equitative device. More precisely we assume that participants dislike the idea

that someone could suffer because of the reduction of the total yield, due to their decision to evade.

Tab. 5 Crosstabulation Evasion (EVADISC) by Income levels (CODRIPO)

CODRIPO by EVADISC	light workers (poor)	heavy workers (rich)	Row total
has not evaded	15 (51.7)	7 (22.6)	22 (36.7)
has evaded	14 (48.3)	24 (77.4)	38 (63.3)
Column total	29 (48.3)	31 (51.7)	60 (100)

Chi-square = 5.48 sig. 0.019

The problem is that another effect produced by redistribution is that the total legitimate income raises, and therefore this changement may be directly interpreted by subjects as an income component, and not as a separate factor. This suspect is also strengthened by the fact that redistribution can be seen as a sort of public good financed by the yield of taxation. As well known (Cowell 1990) the provision of public goods can have a negative effects on evasion when the dimension of the community is not too large[24]. This means that once we assume that the number of tax payers is infinitely large the provision of public goods does not change the level of evasion. On the contrary if the size of the community is relatively small, taxpayer clearly perceives that evasion will decrease her/his consumption level of public goods.

A way to begin to cope with this problem is to produce a further 2x2 cross-tabulation between the decision to evade and the level of income and splitting our sample into two subsets:

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[24] If we suppose that there is a single homogeneous public good, the utility function is: U{C,G}; where G is the level of consumption of public goods. The government budged constraint is the following:

$G \le \frac{\sum_{i=1}^{N} (1-\lambda_i) t Y_i - \phi(\pi)}{\psi(n)}$; where $\phi(\pi)$ is the cost to the government of enforcing the probability of detection π, and $\psi(n)$ is the constant marginal rate of transformation of the private consumption good into the public good. $\psi(n)$ is a non decreasing function of n and satisfies the following conditions (Cowell, 1990): $1 < \psi(n) \le n,\ \lim_{n\to\infty} 1/\psi(n) = 0,\ \lim_{n\to\infty} \psi(n)/n = \overline{\psi} > 0$. The extreme value $\psi(n) = n$ correspond to the case of completely rival goods and $\psi(n) = 1$ corresponds to the case of absolutely non rival goods. For the sake of simplicity we shall further assume that all taxpayers are identical and that people are not satiated with public goods. Given these assumption it is easy to show that the optimal value of evasion is now:

$$\lambda^* = \frac{(1-\pi)U'_C\{Cs\} - \pi P(\lambda)U'_C\{Ca\}}{\pi P'(\lambda)U'_C\{Ca\}} - \frac{U'_G\left[1/\psi(n)\right]}{\pi P'(\lambda)U'_C\{Ca\}}.$$

respectively with or without moral constraint. The results are reported in tables 6 and 7. The most important result showed by table 6 and table 7 is the inversion of light workers (poors) subgroup's percentages. In absense of moral constraint the majority (66.7%) of light workers has decided to evade while in presence of moral constraint the evaders go down to only the 28.6% of total subset. Also heavy workers tend to evade more in conditions of absence of moral constraints but the majority of this subgroup is always clearly made by evaders. On the other hand it is necessary to underline that in absence of moral constraint only one subject of the heavy workers sub-group has refused to evade while in presence of moral constraint six people of this group has decided to pay entirely their taxes. Supposing that subjects has perceived what we consider as a moral constraint only as an increase in their expected legal income or as an increase in their level of consumption of the redistribution-public good, the results seem take to the conclusion that raising the amount of money legaly erneable people tend to reduce their propensity to evade.

Tab. 6 Crosstabulation Evasion (EVADISC) by Income levels (CODRIPO) controlled by CODMO = 1 moral constraint

CODRIPO by EVADISC	light workers (poors)	heavy workers (riches)	Row total
has not evaded	10 (71.4)	6 (37.5)	16 (53.3)
has evaded	4 (28.6)	10 (62.5)	14 (46.7)
Column total	14 (46.7)	16 (53.3)	30 (100)

Chi-square = 3.45 sig. 0.063

Tab. 7 Crosstabulation Evasion (EVADISC) by Income levels (CODRIPO) controlled by CODMO = 0 no moral constraint

CODRIPO by EVADISC	light workers (poors)	heavy workers (riches)	Row total
has not evaded	5 (33.3)	1 (6.7)	6 (20.0)
has evaded	10 (66.7)	14 (93.3)	24 (80.0)
Column total	15 (50.0)	15 (50.0)	30 (100)

Chi-square = 3.33 sig. 0.068

The problem is that this phenomenon is in contrast with the fact that rich subjects has always an higher evasion rate than poor ones have. Furthermore poor subjects tend to raise their evasion rate proportionally more that rich ones do when the moral constraint is removed.

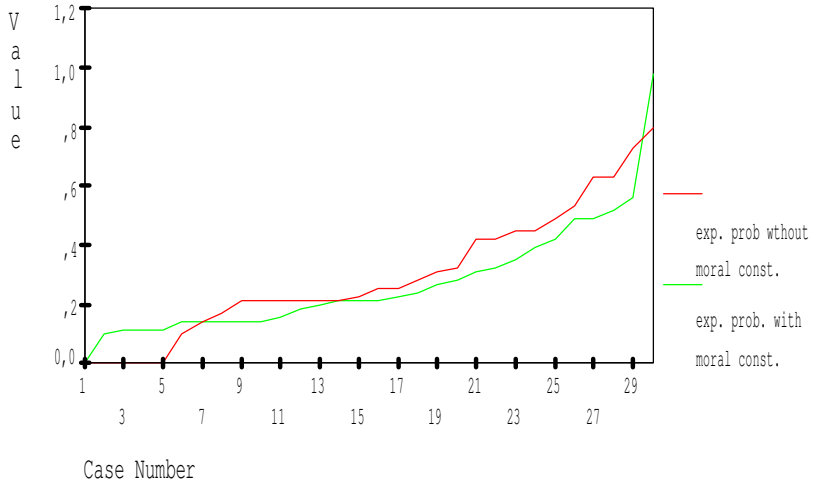
Summarizing we haven't any strong argument to conclude that the tax yield redistibution has been perceived only as an income effect or has been correctly (from the point of view of our assumptions) interpreted by subjects. Therefore we need a more careful analysis of the data and probably we should need also more information, i.e. we should have submitted a more complex questionnaire to our subjects.

Before to go deeply in the statistical analysis it is useful to complete this first overview by considering our last issue, that is the existence of any influence exerted by moral constraint on the subjective forecast of audit probability.

A first approach to this problem is to plot the expected probability distributions respectively for the group with moral constraint and for the group without moral constraint.

Looking at fig.2 we can see that the two groups' trends are very similar, even if it seems that there is a light tendence to be more pessimistic in absence of moral constraint than in the sample where there was a moral constraint. In particolar it is worth noting that only one subject of the no moral constraint group has forecasted a zero probability against five subjects of the morally constrained one. This tendency should therefore contradict our H_4 hypothesis.

Fig. 3 Expected audit prob. distributions



To better check this last consideration and to verify if it exists any form of influence on the expected probability level exerted by the decision to evade it is useful to compute, as usual, a cross-tabulation between CODMO and EXPROBF. In tab. 8 and 9 we have reported the results of such cross-tabulation, referred respectively to the non-evaders and to the evaders sub-populations of our sample.

Tab.8 Crosstabulation expected audit prob. (EXPROBF) by moral constr. (CODMO) controlled by EVADISC = 0 no evasion

CODMO by EVADISC	no moral constraint	moral constraint	Row total
prob. lo. eq. 0.20	3 (50)	7 (43.8)	10 (45.5)
prob. gt. eq. 0.21 lo. eq. 0.5	2 (33.3)	6 (37.5)	8 (36.4)
prob.gt. eq. 0.5	1 (16.7)	3 (18.8)	4 (18.2)
Column total	6 (27.3)	16 (72.7)	22 (100)

Chi-square = 0.06 sig. 0.9662

The results showed by both tables do not allow any strong conclusion, the chi-square tests do not allow to reject the hypothesis of independence between the variables considered and the expected audit probability distribution seems quite similar for both the sub-groups (with or without moral constraint) and for both sub-populations (evaders and non-evaders).

Also in this case it should be therefore necessary to have a supplement of data to reach some reasonable conclusion.

Tab. 9 Crosstabulation expected audit prob. (EXPROBF) by moral constr. (CODMO) controlled by EVADISC = 1 evasion

CODMO by EVADISC	no moral constraint	moral constraint	Row total
prob. lo. eq. 0.20	5 (20.8)	6 (42.9)	11 (28.9)
prob. gt. eq. 0.21 lo. eq. 0.5	15 (62.5)	8 (57.1)	23 (60.5)
prob.gt. eq. 0.5	4 (16.7)		4 (10.5)
Column total	24 (63.3)	14 (36.8)	38 (100)

Chi-square = 3.85 sig. 0.1454

5. Multiple analysis

In previous sections we have performed simple two dimensions analysis to investigate the possible relationships between our variables, a further step in the statistical analysis is to try to verify if it exists some form of multiple relationships among the variables considered by the experiment.

In our specific case we can imagine a quite complex interaction among the variables considered by the experiment. Recalling our hypotheses we would investigate the existence of some form of multiple relationship between the decision to evade, the amount of money evaded and the following variables:

a) the income level;

b) the moral constraint (yield redistribution);

c) anonymity;

d) expected probability to be audited;

e) expected rate of evasion;

f) regret about someone else evasion.

We shall start to investigate these relationships by assuming to ignore the amount of money evaded, in other word we shall imagine that the decision to evade is a sort of *two-steps* process: first the subject decide to evade or to pay and then s/he decides the amount of money to evade. Our task is therefore to estimate a model with a dichotomic instead than a continuos dependent. As well known one of the most used statistical technique in these cases is the logistic regression analysis[25] that we have used to estimate the following model:

EVADIS = f(EXPROB, CODMO, CODAN, INCOME, REGRET, EXPEVAS)

where:

EVAS = amount of money evaded (continuous variable);
EXPROB = expected audit probability (continuous variable);
CODMO = moral constraint (dummy variable);

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[25] As well known (Amemiya, 1985) the logistic regression analysis or *logit model* is defined by $P(y_i = 1) = F(x'_i\beta_0)$, with i =1,2, ...,n where $\{y_i\}$ is a a set of dichotomous independent variables, β_0 is a vector of unknown constants and F is a known function. In logit models F(x) is equal to $\lambda(x) \equiv \frac{e^x}{1+e^x}$ that is a distribution function similar to the normal distribution but characterised by a much simpler form.

CODAN = anonymity (dummy variable);
INCOME = income level (dummy variable);
REGRET = disappointment to know that someone has evaded;
EXPEVAS = expected rate of evaders.

The assumptions for the model are basically the same ones just discussed in the previous sections, however a short comment is required to justify the inclusion in the model of REGRET and EXPEVAS. Both these two variables are expected to be proxies of the perceived social attitude towards evasion that, as seen in the theoretical analysis, should play an important role in the decision to evade. More precisely a high regret to know that someone has evaded should be a proxy of a very strong moral attitude, while a high expected rate of evasion should go in the opposite direction, signalling the belief that the prevailing social attitude is in favour of evasion.

These are the results obtained by the logistic regression:

-2 Log Likelihood 53.542
Goodness of Fit 53.787
Model Chi-Square 25.317 6 (df) 0.0003 (signific.)

Variable	B	S.E.	Wald	df	Sig	R	Exp(B)
EXPROB	1.7981	2.0168	0.7948	1	0.3726	0.0000	6.0381
INCOME	1.6300	0.7423	4.8222	1	0.0281	0.1892	5.1041
CODMO	-1.4477	0.8030	3.2501	1	0.0714	-0.1259	0.2351
CODAN	-1.4896	0.7385	4.0682	1	0.0437	-0.1619	0.2255
REGRET	-2.0500	1.1806	3.0153	1	0.0825	-0.1135	0.1287
EXPEVAS	1.8000	1.4227	1.6006	1	0.2058	0.0000	6.0496
Constant	1.0222	1.0838	0.8895	1	0.3456		

The model has an 80% overall percentage of correct prediction, more precisely 63.64% of the non-evasion observed cases have been correctly forecasted by the model and 89.47% of the observed evaders have been correctly predicted. The Wald statistics[26] informs that only the coefficients for INCOME and CODAN seem to be significantly different from 0 using a significance level of 0.05. On the border of significancy are the coefficients for CODMO and REGRET while EXPROB and EXPEVAS should be removed from the model.

[26] Wald statisticis (Wald, 1943) is computed as the square of the ratio of the coefficient of a variable to its standard error, for a more rigorous definition see Amemiya (1985) p.142. It is necessary to underline that a limit of this test is that it has been designed to work with large samples of data which is not exactly our case.

Looking at the R statistics[27] we have a confirmation of what we have just seen, in particular the most influential variable in the model should seem INCOME immediately followed by CODAN, CODMO and REGRET. Finally it is worth noting that the signs of the parameters are all coherent with our assumptions.

If we exclude from the model EXPROB and EXPEVAS we obtain the following results:

-2 Log Likelihood			56.196				
Goodness of Fit		52.629					
Model Chi-Square			22.662		4 (df)	0.0001 (significant.)	
Variable	B	S.E.	Wald	f	Sig	R	Exp(B)
REGRET	-1.6570	1.0206	2.6359	1	0.1045	-0.0898	0.1907
CODAN	-1.4571	0.7029	4.2977	1	0.0382	-0.1707	0.2329
CODMO	-1.8563	0.7477	6.1632	1	0.0130	-0.2298	0.1563
INCOME	1.7401	0.7222	5.8048	1	0.0160	0.2197	5.6977
Constant	2.2178	0.8035	7.6188	1	0.0058		

The overall percentage of correct prediction of the model has fallen to 75% and both the Wald and R statistics signal that REGRET should be removed by the model. This result could induce to conclude that in the decision to evade the only really influencial factors are the amount of money given to the subjects and both the moral and the anonymity constraints.

However a different conclusion can be reached if we carry on a stepwise regression using the *likelihood-ratio* test instead of Wald statistics as selection criteria to drop variables from the model. The likelihood-ratio test is computed by dividing the likelihood of each of the possible reduced forms of the base model by the likelihood for the full model. Applying this selection the resulting best model is the following:

-2 Log Likelihood			61.224				
Goodness of Fit		61.682					
Model Chi-Square			17.635		3 (df)	0.0005 (significant.)	
Improvement			4.930		1 (df)	0.0264 (significant.)	
Variable	B	S.E.	Wald	df	Sig	R	Exp(B)

[27] T statistic is a measure of the contribution of individual variables to the regression. The equation for the R statistic used by our software (SPSS) is:

$$R = \pm\sqrt{\left(\frac{Waldstatistic - 2K}{-2LL_{(0)}}\right)}$$

where K is the degrees of freedom for the variable. The denominator is -2 times the log likelihood of a model that includes only the constant. The value of 2K is a measure for the number of variables in the model, obviously if Wald is lower than 2K R=0.

EXPEVAS	2.7530	1.2732	4.6753	1	0.0306	0.18421	5.6893
INCOME	1.3831	0.6451	4.5967	1	0.0320	0.1815	3.9871
REGRET	-2.0797	0.9585	4.7077	1	0.0300	-0.1853	0.1250
Constant	-0.3122	0.7747	0.1624	1	0.6870		

The overall percentage of correct prediction for this model is 78%, the value of the model chi-square test allows to reject the null hypothesis that the coefficents for the exogenous variables (excluded the constant) are 0, and finally all the coefficients' signs confirm our theoretical premises. From these results, and admitting that REGRET and EXPEVAS are true proxies of the perceived social attitude toward evasion, we could conclude that each individual's *ethical system* has influenced the decision to evade or not more than the artificial constraints introduced by the experiment. This conclusion is not surprising because the design of the experiment did not allow to exclude the effects played by subjective, psychological factors embodied in the cultural story of our subjects. The important point is that both REGRET and EXPEVAS can be interpreted as alternative to CODMO and CODAN reinforcing the conclusion that the moral factors really play an important role in determining the decision to evade.

Changing now our dependent dichotomous variable with the amount of money evaded we can run a traditional OLS regression using the first reduced model:

EVAS = f(REGRET, CODMO, CODAN, INCOME)

where: EVAS = amount of money evaded (continuous variable).

These are the results obtained:

EVAS = - 1286.82 - 3588.85 REGRET - 2885.51 CODMO - 2490.52 CODAN +
(- 1.415) (- 1.723) (- 1.570)
+ 7241.68 INCOME
(4.521)

Standard error = 6071.72
R^2 = 0.38
F = 7.68
S.E. = 6071.72
(the bracketed values are t statistics)

The significancy of the t statistic is good only for INCOME and immediately down the border of acceptability for CODMO (0.09) while all the other variables should be removed from the model, nevertheless also in this case the signs of the explicative variables confirm our general assumptions. The coefficient of multiple correlation is quite low, only 38% of the variance of the

dependent is explained by the model. The F statistic is significant and therefore allows us to reject the independence hypothesis.

The model has a quite weak explicative power, nevertheless the starting hypotheses and the results just obtained with the logistic regressions seem broadly confirmed, even if in this case it is CODMO instead than REGRET that plays the starring role as a deterrent to evasion. Finally it is worth signalling that in this case the second reduced model used in the logistic regressions, that is EVAS = f(EXPEVAS, REGRET, INCOME), gives slicely worst results if compared with the former one[28].

The last model here considered regards our final issue, that is the cognitive process that determines the expected audit probability. Recalling our original hypothesis the expected audit probability should be influenced by the existence of some form of moral pressure, therefore a possible model to explore this topic is the following:

EXPROB = f(REGRET, CODMO, CODAN, EXPEVAS)

The results obtained by the regression show that only REGRET has some influence in determining the value of EXPROB while all the other variables are not significantly related to the dependent. A model that includes only the constant and REGRET has been estimated giving an $R^2 = 0.14$ and and F statistics = 9.84 (sig. 0.007).

6. Conclusions

The results emerged by the experiment seem to confirm most of the theoretical starting hypotheses and show one major unexpected phenomena. More precisely from the two variables analysis we have seen that only one of the two moral constraints considered has influenced the behaviour of our subjects and that the amount of the reward given has played the role of the more influencial factor. This consideration is in part weakened by the multivariate analysis that has shown that the moral constrant (the redistribution of the tax yield) seems to be less important than other cultural factors not directly checkable by the experiment. The most important between the

[28] The R^2 falls down to 0.34, variable EXPEVAS is not significant and REGRET is on the border of acceptability.

unforecasted results emerged is in fact that more than the *artificial* moral constraints introduced by the experiment, it has been a sort of *natural*, cultural constraint that has worked as a deterrent against evasion.

A final consideration regards the static nature of this experiment that represents a serious limit for the context examined. The decision to evade is in fact a typically dynamic problem because taxes must be payed every year and because audits generally are extended to more fiscal declarations. It should be therefore very interesting to carry on a similar experiment but in a repetitive form.

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