Income tax evasion and artificial reference points: two experiments

Michele Bernasconi
Dipartimento di Economia
Università dell'Insubria - Varese

and

Luigi Mittone
Dipartimento di Economia
Università di Trento

1. Introduction

It is conviction of many, whether economists or not, that high marginal tax rates tend to encourage taxpayers to cheat on their income. For example, according to Feldstein (1995), «high marginal tax rates may induce taxpayers to take more ‘aggressive’ interpretations of the tax rules (e.g., claiming questionable deductions) or even to evade taxes by understating income or claiming unjustified deductions» (p. 555).

As it is well known, however, this intuition is at odd with the most classical portfolio approach to tax evasion, as originally developed by Allingham and Sandmo (1972) and Yitzhaki (1974). In that model, a taxpayer receives an exogenous income, which she would possibly completely conceal to the tax authorities, but is deterred from such activity by the threat of being caught and convicted to pay a penalty. Assuming DARA (decreasing absolute risk aversion), Allingham and Sandmo (1974) originally showed that, in such a model, the effect of an increase in the marginal tax rate on evaded income is ambiguous when the sanction is proportional to evaded income; lately, however, Yitzhaki (1974) showed that when the penalty surcharge is proportional to evaded taxes, as it is indeed most often case in many countries, the effect is unambiguously negative.

The portfolio approach is very simple, as it treats tax evasion as a pure gambling decision. Subsequent developments have been in the years conducted in various directions. Among others, there have been studies which have (see Andreoni *et al* 1998, for a comprehensive review): endogenized pre-tax income by adding labour supply; extended the basic framework to account for considerations of public expenditure, moral sentiments, public goods; introduced various sources of imperfect information; modelled different forms of strategic interaction (between taxpayers and the tax authority, between taxpayers and tax practitioners, among taxpayers themselves). These developments have indeed documented that, in more general settings than the basic set-up with exogenous income and penalty proportional to evaded tax (henceforth, the ASY set-up from Allingham-Sandmo-Yitzhaki), the simplest prediction of a negative relationship between tax rates and evaded income is no longer unambiguous, but it depends to an increasing degree on the relative size of the various parameters at play.

The empirical literature has for some respects shown an even greater degree of inconclusiveness. In particular, in an early econometric studies from the field, Clotfelter (1983) concluded that higher tax rates tend to stimulate evasion; but his findings were later questioned by some, including, Cox (1984), Slemrod (1985) and Feinstein (1991). On the other hand, experimental studies, designed to essentially mimic the basic ASY set-up, have typically found that high tax rates are associated with greater evasion (see, for example, Friedland *et al.* 1978, Bradley 1987, and Alm *et al.* 1992). Thus, if on the one side some ambiguity of the econometric field studies could perhaps be expected in view of the difficulty to identify definitive comparative static predictions in sufficiently general settings, the experimental findings have been considered most contradictory in regards to the basic portfolio model.

In this paper we report the results of an experiment which is again focused on the simplest ASY set-up, but designed to test for the importance that "reference dependent preference" may have on tax evasion decision, as suggested in a recent paper by Bernasconi and Zanardi (2002).

Specifically, Allingham and Sandmo (1972), Yitzhaky (1974), as well as most of the subsequent generalizations have been conducted within the classical expected utility framework. In expected utility, it is final wealth positions which enter the utility function. Opposing this tenet, however, there is now a vast psychological and sociological literature asserting that an individual's happiness depends, rather than on final states, on a reference level of income against which he compares his wealth position: if this is above the *reference income*, he accounts for a *gain* and experiences *pleasure*; if it is below the reference income, he accounts for a *loss* and experiences *pain* (see Kahneman *et al.* 1999, for a comprehensive account of this literature).

The determination of the reference income is clearly a crucial issue in this literature. According to classical studies including Duesemberry (1949), Adams (1963), Runciman (1966), Berkowitz *et al.* (1987), and the many quoted in Argyle (1999), comparison with others may be an especially important source of income satisfaction or dissatisfaction, since it may produce a sense of inequity, envy, jealousy or relative deprivation.

The distinction between happiness measured in terms of absolute wealth states and differences with respect to reference levels is important, since it is further argued that individuals are far more sensitive to *losses*, than to commensurable *gains*. An implication of this is that a person in the *loss* domain may be willing to accept more risk than he would be willing to run if he were in the *gain* domain. In fact, as assumed by Kahneman and Tversky (1979) in Prospect Theory, the hypothesis is that individual are risk averse in the gain domain, but risk loving in the *loss* domain.

In Bernasconi and Zanardi (2002), Prospect Theory is a applied to a standard ASY set-up and it is shown that a taxpayer's behavior may change depending on whether the disposable income he would obtain if he had paid all his tax liability is higher or lower than the reference income. If it is higher so that the taxpayer is in the *gain* domain, the taxpayer behaves as in the standard expected utility model and, among other things, evades less as the tax rate increases; if, on the other hand, it is lower, the taxpayer sees taxes paid as a *loss*; and responds to increases in the marginal tax rate by evading more.

While the idea of reference income is, we believe, very intuitive, a test of the model based on field behaviour is very complicated, mainly because of the difficulty to determine the actual reference points for real world taxpayers. In the experiment describe in this paper, reference incomes for subjects participating in the experiment are induced artificially. In particular, subjects participating in the experiments are assigned to either one of two groups: a group of "poors" with low income; and a group of "riches" with higher income. We introduce a procedure to determine who is "reach" and who is "poor", by which we assume that two subjects belonging to the two different groups, can nevertheless be thought to have the same reference income. The two groups can thus be viewed corresponding to the groups of *losers* and *gainers* in the reference dependent terminology. We can then study the behaviour of the subjects in the two groups in response to a change in marginal tax rates. Our preliminary findings support the prediction of the reference dependent specification, in that we find that subjects belonging to the group of "poors" respond with more tax evasion as the tax rate increases; whereas the subjects belonging to the group of "riches" respond with less evasion.

The paper is organised as follows. Next section (section 2) outlines the basic tax evasion model under Prospect Theory. Section 3 presents the experimental set-up and section 4 the results. A brief final section (section 5) summarizes and draws conclusion.

2. The basic ASY set-up and reference dependent preference

In this section we review the basic ASY set-up, emphasizing how the predictions of the standard expected utility model are affected adopting reference dependent preferences. We give here a synthetic presentation of the analysis more fully developed in Bernasconi and Zanardi (2002[1]).

In the standard ASY approach to income tax evasion, there is a taxpayer with income I, which is unknown to the government's tax collector. The taxpayer decides how much income to report, D, knowing that he will have to pay taxes on the reported income at a flat rate t and that, with probability p, his declaration will be audited. If his tax return is audited, all his income will be discovered. The tax on any income found to have been concealed is subject to the higher rate $t(1+s)$, where s is a strictly positive penalty surcharge. Formally, the taxpayer's problem is to choose D so as to maximise his expected utility (EU):

$$EU \equiv (1-p)\cdot u(I-tD) + p\cdot u(I-tD-t(1+s)E) \quad (1)$$

where $E \equiv I-D$ is evaded income.

Denoting with Y_{na} and Y_a the post-tax income in the case respectively of not an audit and in the case of an audit, that is $Y_{na} \equiv I-tD$ and $Y_{na} \equiv I-tD-t(1+s)E$, the first order and second order conditions for an interior maximum are:

FOC: $$EU' \equiv -(1-p)\cdot u'(Y_{na}) + s\cdot p\cdot u'(Y_{na})=0 \quad (2)$$

SOC: $$H \equiv [(1-p)\cdot u''(Y_a)+ s^2\cdot p\cdot u''(Y_{as})] < 0 \quad (3)$$

Since $u(\cdot)$ is concave, the condition is satisfied in an interior if at E=0, $(1-p-ps)>0$; this says that whenever the expected return per dollar of evaded taxes is strictly positive, a risk-averse taxpayer will always under-report his income. As it is known (see e.g. the classical paper by Skinner and Slemrod 1985), this is also a prediction which has been often criticized in the literature. The problem is in particular that the actual fiscal parameters of most countries are such that $(1-p-ps)>0$, which according to the prediction would indeed imply that *all* taxpayers evade

[1] There is a major simplification in the present discussion from the more proper application of Prospect Theory to tax evasion given in Bernasconi and Zanardi (2002). In particular, in the present analysis we abstract from the non-linear transformation of probabilities adopted by Prospect Theory, which however may important to explain other unsatisfactory predictions of the standard expected utility model not dealt with in details in this paper.

part of their income. In the present paper we will abstract from this prediction and focus only on the comparative static implications of the model[2].

Various predictions can be derived in regard to the effect of a change of parameters of the problem on the taxpayer's decision to cheat. For example, intuitive predictions which can be easily derived are that increasing respectively the probability of audit p and the penalty surcharge s lead to an increase in reported income. For some other predictions it is necessary to make some further assumptions on the attitude towards risk of the taxpayer. Consider for example the effect of a change of pre-tax income I on evaded income E:

$$\partial E/\partial I = 1 - \frac{t(1+s)\rho(Y_{as}) - [\rho(Y_{as}) - \rho(Y_{na})]}{t(1+s)\rho(Y_{as}) - t[\rho(Y_{as}) - \rho(Y_{na})]} \tag{4}$$

where $\rho(x) = -\frac{u''(x)}{u'(x)}$ is the Arrow-Pratt index of absolute risk aversion. The sign of this effect is in general ambiguous, but assuming DARA ($\rho'(x)<0$), the effect is positive.

Similarly, for the effect of a change of the tax rate t, we have:

$$\partial E/\partial t = \frac{t}{H} \cdot (1-p) \cdot u'(Y_{na}) \cdot [D \cdot (\rho(Y_{as}) - \rho(Y_{na})) + (1+s) \cdot (I-D) \cdot \rho(Y_{as})] \tag{5}$$

In general, the effect is indeterminate; under DARA, however, the effect is unambiguously negative and hence the discussion of the introduction[3].

Consider now how the introduction of reference dependent preferences affect the above analysis. The essence of reference dependent preference is that well-being, rather than on final wealth states, depends on *distances* from a neutral reference point. In Kahneman and Tversky's Prospect Theory, this is expressed by a value function $v(\cdot)$, defined in terms of *gains* and *losses* and having two important properties:

a) diminishing sensitivity, which says that an individual is risk averse in the domain of gains, but risk loving in that of losses: $v''(x) < 0$ and $v''(-x) > 0$, for $x \geq 0$ (where $v''(\cdot)$ denotes the second derivative);

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[2] In this regard, we note however two points. Firstly, we recall that various studies (including Alm *et al.* 1992, Erard and Feinstein 1994, Bernasconi 1998) have shown how a typical argument developed by the literature on cognitive psychology, namely the fact that people tend to overweight small probabilities of extreme events, can correct the condition for the interior solution in a direction more consistent with empirical evidence. Secondly we emphasize that a fuller application of Prospect Theory to the present ASY set-up also adopts the over-weighting of small probabilities. As already noted, we abstract from such feature of Prospect Theory in the following presentation.

[3] As already noted, recall that for the firm prediction of a negative effect is necessary both DARA and a penalty system in which sanction is proportional to evaded tax. In a system in which the sanction would instead be proportional to evaded income (as in the original Allingham and Samdo 1972) the indeterminacy would remain also under DARA.

b) loss aversion, which says that losses with respect to the reference point are more painful than corresponding gains are satisfying. This means that the value function at distance x from the reference point in the loss domain is steeper than the value function at distance x from the reference point in the gain domain, which implies that the value function has a kink at the reference point (see Figure 1 below).

Thus, assuming a reference dependent specification, the taxpayer's problem is that of choosing D so to maximize the expression:

$$p \cdot v(I\text{-}tD\text{-}R) + p \cdot v(I\text{-}tD\text{-}t(1+s)E\text{-}R) \tag{6}$$

where R represents the neutral reference point. Obviously, the determination of the reference point is a crucial aspect of this model, and we leave its discussion to the next section on the experimental design. Here we summarize the predictions of the model in terms of the implied differences from the standard expected utility specification.

Using the notation $y_{na} \equiv I\text{-}tD\text{-}R$ and $y_{as} \equiv I\text{-}tD\text{-}t(1+s)E\text{-}R$, the first order and second order conditions for interior solutions are:

FOC: $- (1\text{-}p) \cdot v'(y_{na}) + s \cdot p \cdot v'(y_{as}) = 0$ (7)

SOC: $H \equiv (1\text{-}p) \cdot v''(y_{na}) + s^2 \cdot p \cdot v''(y_{as})] < 0$ (8)

Note the similarity of these conditions with respect to the expected utility specification. We emphasize, however, that full similarity in predicted behavior is not in general guaranteed; but it depends on the relationship between the reference point R and the disposable income $I(1\text{-}t)$, that the taxpayer would obtain paying all his tax liability.

Consider firstly the case in which the latter is greater than the reference (that is $(1\text{-}t) \geq R$), so that the taxpayer is at certainty in the concave domain of the value function (see Figure 2.1a). We call this as the *gain* case. This case is indeed quite similar to the expected utility model. In particular, the condition for interior solution is $1\text{-}p\text{-}ps > 0$, which is identical to the expected utility case. In addition, if the taxpayer's evasion is such that he remains in the gain domain even if caught (that is $y_{as}>0$, see again Figure 1a), then the comparative static predictions are also identical.

Fig. 2.1 - Tax evasion with reference dependent preferences

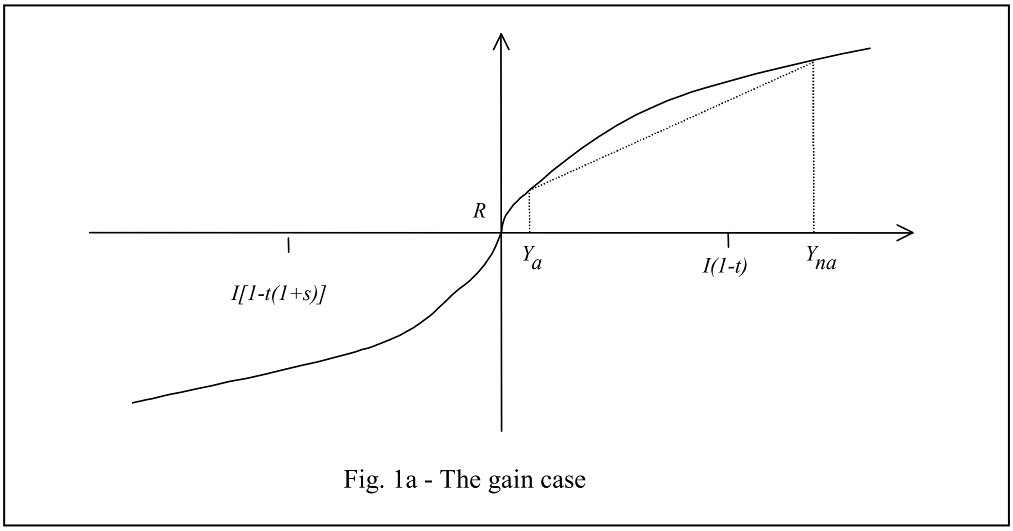


Fig. 1a - The gain case

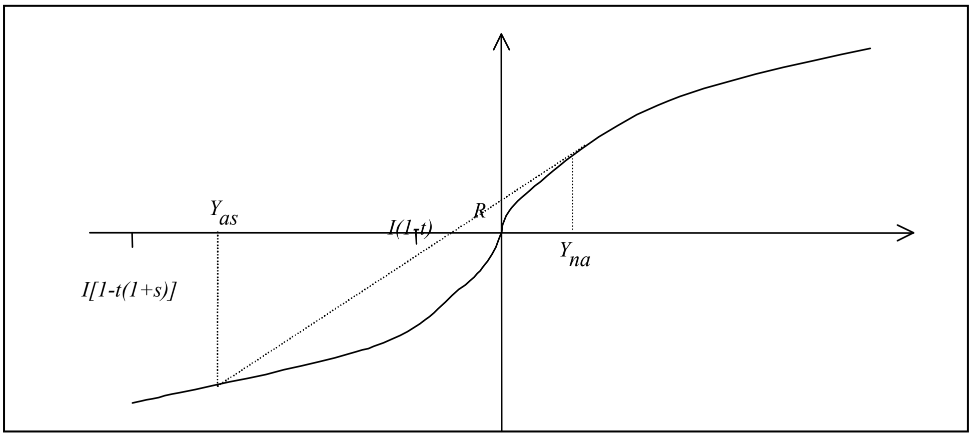


Fig. 1b - The loss case

Formally, this can for example be shown for the predictions of the effect on evaded income E of a change in I and t, simply substituting in equations (5) and (6), respectively, $v(y_{na})$ for $u(Y_{na})$ and $v(y_a)$ for $u(Y_a)$:

$$\partial E/\partial I = 1-\frac{t(1+s)r(y_{as})-[r(y_{as})-r(y_{na})]}{t(1+s)r(y_{as})-t[r(y_{as})-r(y_{na})]} \qquad (9)$$

and

$$\partial E/\partial t = \frac{t}{H}\cdot(1-p)\cdot v'(y_{na})\cdot[D\cdot(r(y_{as})-r(y_{na}))+(1+s)\cdot(I-D)\cdot r(y_{as})]$$

(11)

where $r(x) = -\frac{v''(x)}{v'(x)}$ can be viewed as the analogue of the Arrow-Pratt index for *v*. Thus, if the individual is DARA in the *gain* domain (*r'(x)<0*), then ∂*E*/∂*I* is positive and ∂*E*/∂*t* is negative, as under the expected utility framework.

Different predictions arise when *R>(1-t)*, so that the taxpayer cannot remain with certainty in the *gain* domain even if he reports all his income. We call this situation as the *loss case.* It is depicted in Figure 2.1b. Notice, in particular, that since *R>(1-t)*, y_a will also be in the *loss* domain of the value function whichever decision the taxpayer will do. Given that in the *loss* domain the value function is convex, this also mean that for an interior solution to exist in this case, y_{na} be in the *gain/concave* domain[4].

Consider now how the comparative static predictions of a change in *I* and *t* modify in this case. First of all, for the former effect (see equation 9), since $v''(y_{as})$ is positive in the loss domain, $r(y_{as}) < 0$, and hence ∂*E*/∂*I* becomes negative. This prediction that in *loss case* an increase in pre-tax income brings about less evasion, may surprise at first. It has, however, a natural interpretation: since in the *loss* case evasion essentially occurs in order to ensure to the taxpayer to obtain an income at least as great as the reference, it follows that when pre-tax income increases, there is less need to evade and evasion decreases (contrary to the EU/*pure gain* case). Regarding this prediction, we also note that while some of the earliest empirical studies have generally reported a positive relationship between evasion and income, in a more recent and very thorough investigation, Feinstein (1991) didn't report any clear relationship between the two variables.

Consider now the effect of a change in the tax rate *t*. To this end, re-write equation (10) as:

$$\partial E/\partial t = \frac{t}{H} \cdot [(1-\pi) \cdot v''(y_{na}) - s\pi(D + (1+s)(I-D))v''(y_{as})] \qquad (11)$$

Given that in the *loss* case $v''(y_{na})$ is negative and $v''(y_{as})$ positive, it is immediate that ∂*E*/∂*t* is now positive.

[4] Note also that this is only a necessary condition for interior solution. For sufficient conditions, one should instead consider further restrictions on the value function; in the following comparative exercise we more simply assume that conditions for interior solution exist and are satisfied.

Thus, in the *loss* case, the effects on evaded income of both an increase in the pre-tax income and in the tax rate are reversed with respect to the standard expected utility/*gain* case. In the remaining part of the paper we describe an experiment designed to provide some preliminary evidence on the predictions of this reference dependent specification.

3. The experimental design

Two experimental sessions have been carried out, each with 20 participants recruited by means of posters put up on the bulletin boards of the Faculty of Economics of the University of Trento. Both the experimental sessions have been built on three series of three rounds each and shared some common features.
At the beginning of each experimental session the participants are requested to draw a ticket from a box. Accordingly with the colour of the ticket drawn – 50% of the tickets are white and 50% are black –the subjects receive a different starting endowment for each series of rounds that can be of 150 euro-points or of 300 euro-points. The starting endowments are then changed in real money at the end of the experiment, by using a converting scale that can produce a maximum earning of 25 euros, depending on the performance of the player during the fiscal game.

The participants were informed about the two levels of the initial endowments and the random assignment of the roles allows to introduce an artificial effect of reference point in the game. The assumption made by the experimental design is that the participants use the 150-300 euro-points scale as a base for their reference point. The subjects that draw a "low endowment" ticket assume a role of losers when compared with those that drawn a "high endowment" ticket that assume the role of winners.

The device then used in the experiment to reinforce the salience of the "artificial reference point" consists in assigning a work to each participant. The work must be done at the beginning of each series of rounds. The experimental subjects that extract a "high" endowment ticket must perform an heavier duty, while those that have a "low" endowment ticket must do a lighter work. The work assigned to the participants was to input in the computer some data to build a complete data set. A quite strong emphasis has been put on this stage of the experiment with the aim to increase the salience of the relationship between the amount of the starting endowment and the mix randomness-effort of the rewarding mechanism.

The tax rate at the beginning of both the experiments, i.e. for all the three rounds of series 1, is of 10%, then it raises at 20% in the second series of rounds. In experiment 1 the tax rate remains constant (i.e. 20%) also in the third series, while it rises at 30% in experiment 2. Another difference between experiment 1 and experiment 2 is that in experiment 1 the roles of the participants are switched in the third series of rounds, the "heavy" (and richer) workers become "light" (and poorer) workers and vice-versa. In experiment 1 the roles of the participants is exchanged because we would check the effects produced by a modification of the artificial reference point. The hypothesis to test is related to the role played by the artificial reference point, more precisely we expect that a modification of the reference point should produce some form of "inverse effect" in the tax evasion propensity.

The fiscal audits procedures used in the two experiments are slightly different and quite complex. In both the experiments we informed the participants that in each round there was a 30% probability to be audited and that the fine for a tax evasion was computed by adding the amount of the tax evaded to a penalty, which was equal to the amount of the tax evaded times three. This means that the final amount of the fine paid was four times the value of the tax evaded. To avoid the insurgence of effects due to past experiences of fiscal audits – like the so called "bomb-crater effect" (Mittone 2002) – the subjects have been informed on the results from the fiscal audits only at the end of the experiment.

The fiscal audits procedure in experiment 1 took place at the beginning of each round, by asking to each participant to draw from a box a ticket labelled with a code number that the subjects should input in the system through the computer screen – therefore each subjects did 9 drawings of code numbers during the whole experiment –. The subjects were informed that each code was connected to a dichotomous variable that could have the value "investigated" or "non-investigated". The software did the rest of the job by linking automatically the participants' tax choices to the code number and eventually to the fiscal audit. At the end of the experiment the subjects were informed on their auditing "story" and on the amount of fines possibly paid.

In experiment 2 the structure of the fiscal audits has been kept substantially unchanged, the only modification introduced was at the beginning of the experiment when we shown to the participants 14 tickets labelled "non investigated" and 6 tickets labelled "investigated". The tickets were put into 180 envelopes marked with a number code and immediately stuck. Successively each participant, at the beginning of each round, must drawn one of these envelopes from a box and input the code number in the computer screen. Like in experiment 1 also in experiment 2 at the end of the game the participants were informed on their fiscal audit story and could control the correspondence between the fiscal audits carried out and the number codes, by opening the envelopes and looking at the tickets.

The more complex audit procedure used in experiment 2 has been introduced to increase the salience of the random dimension of the fiscal audits to check if a stronger psychological stress on the "real" randomness of the game could play any difference in the results.

Summarising the whole experiment works in this way:

a) each subject is assigned to a computer;
b) the experimenters read the instructions of the game together with the subjects;
c) the subjects drawn a ticket from a box and are assigned to the heavy (richer) workers group or to the light (poorer) workers group;
d) the participants do their work;
e) the number codes (or the closed envelopes with the tickets) for the fiscal audits are drawn from a box by each participant at the beginning of each round;
f) the subjects input the code number in the computer screen and then choose to pay or to evade (totally or partially) their taxes, following the information shown on the computer screen;
g) at the end of the experiment the participants are informed on their fiscal auditing story and receive their monetary reward.

During the entire length of the experiment none can communicate with the other participants. Questions are allowed only at the beginning of the experiment and immediately after the reading of the instructions.

The structure of the two experimental sessions is the following:

Experiment 1

- “standard” fiscal auditing procedure;
- three series of 3 rounds each;
- 20 participants divided into two groups: 10 “heavy” workers (initial endowment 300 euro points) and 10 “light” workers (initial endowment 150 euro points);
- switching of the roles at series 3, the heavy workers become light workers and vice-versa;
- initial tax rate: 10% of the initial endowment for the first series of rounds then 20% till the end of the session.

Experiment 2

- “complex” fiscal auditing procedure;
- three series of 3 rounds each;
- 20 participants divided into two groups: 10 “heavy” workers (initial endowment 300 euro points) and 10 “light” workers (initial endowment 150 euro points);
- initial tax rate: 10% of the initial endowment for the first series of rounds then 20% for the second series of rounds, finally 30% for the third series of rounds.

4. The results

A first picture of the results obtained from experiment 1 is reported in tab. 4.1 and in tab 4.2. Both tables 4.1 and 4.2 shown the percentage of tax evaded by each single player and the group average per each series of rounds.

Tab. 4.1 - Experiment 1 - Percentage of tax evaded, individual players

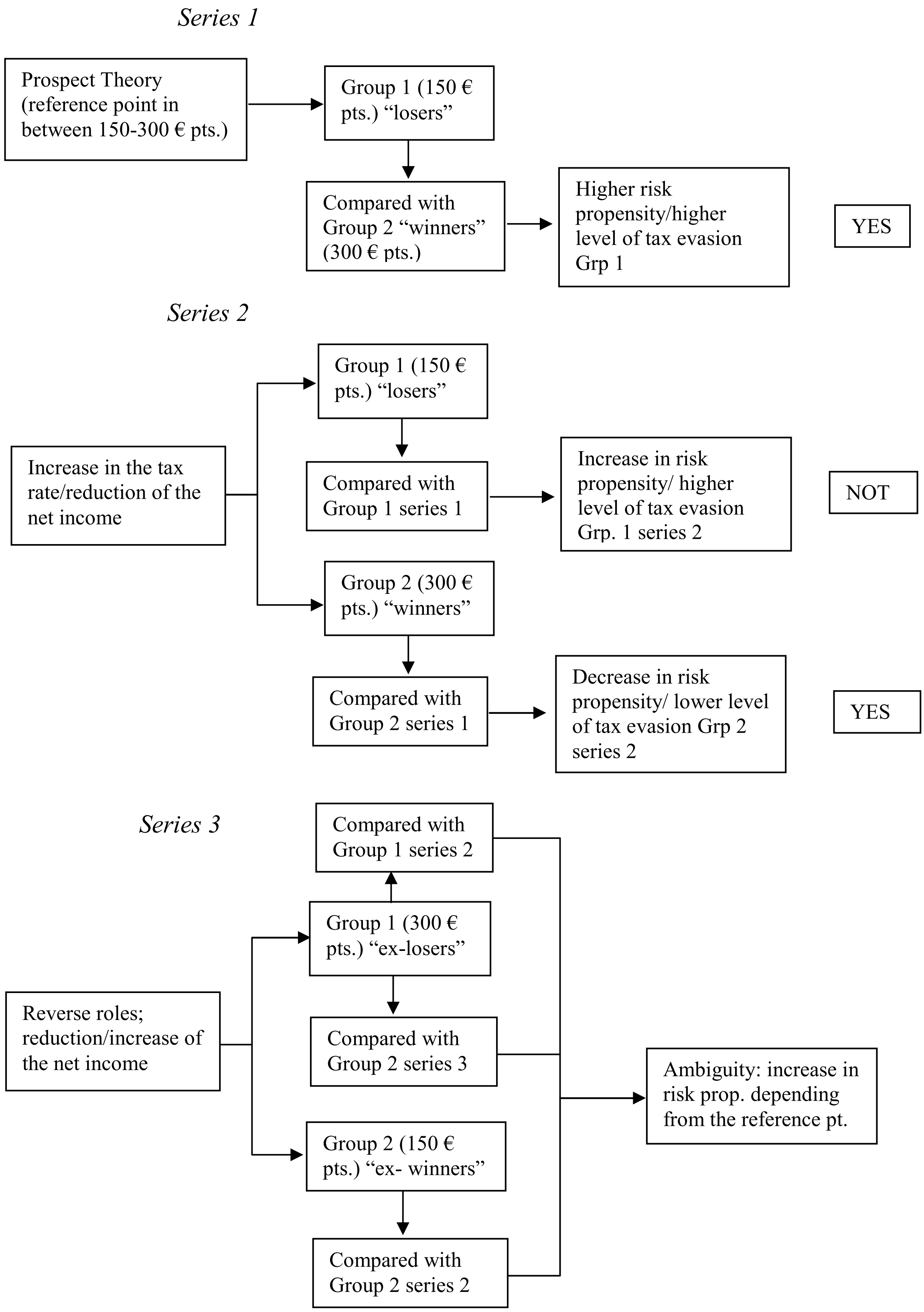
Player	Group	Round1	Round2	Round3	Round4	Round5	Round6	Round7	Round8	Round9
		Euro pts. 150 Rate 10%			Euro pts. 150 Rate 20%			Euro pts. 300 Rate 20%		
0	1	15	15	15	30	30	30	60	60	60
1	1	15	15	0	0	30	30	60	60	60
2	1	0	15	15	0	30	29	0	0	60
3	1	10	5	15	0	10	0	60	0	0
4	1	0	0	0	0	0	0	0	0	0
11	1	13	5	15	18	2	30	60	22	43
12	1	7	13	0	5	30	15	20	45	58
15	1	15	15	15	30	30	30	60	60	60
16	1	5	0	15	20	25	30	30	60	20
19	1	10	15	0	30	20	20	0	60	50
% tax evaded		**71.67%**			**67.84%**			**70.00%**		
		Euro pts. 300 Rate 10%			Euro pts. 300 Rate 20%			Euro pts. 150 Rate 20%		
5	2	23	20	15	40	30	40	10	10	15
6	2	10	10	20	55	55	40	0	0	0
7	2	20	30	0	50	0	20	0	0	0
8	2	20	20	0	50	45	45	20	20	30
9	2	0	25	25	50	55	60	27	27	30
10	2	28	10	10	50	60	40	25	30	30
13	2	0	0	0	60	60	60	30	30	30
14	2	25	0	0	0	0	0	15	15	15
17	2	25	18	30	45	55	60	30	28	30
18	2	0	0	30	60	60	60	20	25	30
% tax evaded		**60.00%**			**39.29%**			**54.67%**		

Tab. 4.2 - Experiment 2 - Percentage of tax evaded, individual players

Player	Group	Round1	Round2	Round3	Round4	Round5	Round6	Round7	Round8	Round9
		Euro pts. 150 Rate 10%			Euro pts. 150 Rate 20%			Euro pts. 150 Rate 30%		
0	1	15	12	15	0	30	30	45	0	45
1	1	10	5	0	20	15	10	30	40	30
3	1	6	13	12	30	25	30	45	45	45
9	1	0	10	15	20	30	25	40	40	35
10	1	5	8	0	30	30	30	45	45	45
12	1	10	5	10	30	30	30	45	45	5
13	1	10	0	5	25	25	25	35	40	30
15	1	5	0	0	10	10	0	10	0	0
16	1	0	0	0	20	20	20	0	0	0
17	1	10	0	0	10	8	5	10	0	15
% tax evaded		**66.42%**			**48.60%**			**60%**		
		Euro pts. 300 Rate 10%			Euro pts. 300 Rate 20%			Euro pts. 300 Rate 30%		
2	2	30	20	15	40	30	35	60	90	70
4	2	30	30	30	30	60	60	90	60	90
5	2	0	0	0	30	30	30	60	60	60
6	2	0	0	30	0	0	30	30	30	30
7	2	30	0	30	60	30	0	60	90	90
8	2	0	0	0	40	40	0	80	0	90
11	2	29	29	29	59	59	59	89	89	89
14	2	30	30	30	60	60	60	90	60	90
18	2	15	30	30	60	60	60	90	90	90
19	2	5	5	30	60	30	30	45	90	80
% tax evaded		**71.18%**			**49.83%**			**35.06%**		

There are two ways to analyse the results reported by tab. 4.1 and tab. 4.2, the first way is to look to the data "vertically" i.e. by confronting the data between the groups while the second way is to look at the differences within each group during the experiment. A possible scheme to carry out this analysis, starting from experiment 1, is reported in fig. 4.1. Looking to the scheme the first comparison is only vertical because the participants have not yet a story. Using the Prospect Theory approach the participants belonging to group 1 (low starting endowment) should feel in a "losers" position if compared with their mates of group 2 (high starting endowment). Defining respectively the members of group 1 as losers and the members of group 2 as gainers means to assume that the reference point is somewhere between 150 € pts. and 300 € pts. On the other hand independently from the precise position of the reference point there are few doubts that the participants should "posit" themselves in the loss or in the gain region if they belong respectively to the first or to the second group.

Fig. 4.1 Experiment 1 Hypothesis to test



Accordingly with this premise and going back to fig. 4.1 in series 1 (i.e. at time zero) the members of group 1, as losers, should evade more than the members of group 2 because the Prospect Theory assumes an higher risk propensity for those belonging to the region of losses. Looking to tab. 4.1 this hypothesis seemed confirmed because the average percentage of tax evaded in series 1 by the participants to group 1 is higher (71.7) that the percentage of group 2 (60.0).

Moving to series 2 means to introduce a "history" in the game, therefore there is the possibility to make time series comparisons within the same group. The increase of the tax rate introduced in series 2 reduces the net income after tax and this modification, always accordingly with Prospect Theory, should increase the risk propensity of the losers from one hand while should decrease the risk attitude of the gainers. Looking to the results from the experiment one can notice that the Prospect Theory's forecast is correct in the case of the gainers and wrong in the case of the losers.

Finally the third series of rounds introduces a change in the relative positions of the players. Therefore the problem is to understand if the reference point changes, as a consequence of the reversal of the relative positions, or if it remain the same and the subjects shift their perspective accordingly. Accepting the first assumption, i.e. admitting that the subjects are psychologically influenced by their histories and make a re-positioning of the reference point there is no way to arrive to a definite forecast for their behaviours. An example of these psychological effect could be the raise of a sense of past "poverty" (or respectively of "richness") and this feeling can influence the choice of the reference point after the income change. This could mean that the subjects consider not the income earned at each series of the experiment but the whole amount of € pts. obtained during the entire length of the game.

On the other hand if we accept the assumption of that the subjects maintain their relative position towards the same reference point, i.e. assuming that they are not psychologically influenced by their histories – intending for "histories" the belonging in the past to a given group (losers or gainers) – and that they do not move from the losses (gains) sector. If this is the case those who have an increase in income should reduce their propensity to evade (losers) while, but as a consequence of the reduction in the level of income, the gainers should reduce the tax evasion. The results from experiment 1 seemed not confirming this second hypothesis.

Looking now to the results of experiment 2 and using the same structure of analysis the results from series 1 are not coherent with the Theory predictions because the percentage of tax evaded by group 1 (losers) is lower than that of group 2 (gainers). Similarly the Theory is not confirmed if we look to the comparison between the results from series 1 and 2 of the losers because the percentage of tax evaded reduces while the Theory's forecasts were of an increase. On the other hand for the gainers group the Theory is confirmed with a constant reduction of the amount of tax evaded for the whole experiment.

It is important to underline that the considerations till here done do not regard the statistical significance of the differences between the series/groups. As well known there are problems to compute a statistical test on differences between samples when the samples are in some way correlated. Here we could assume that the individual choices during the experiment have been done separately because the participants did not know if they have been investigated or not until the end of the whole experiment. Due to the ignorance of the results of the past decisions one can imagine that each individual choice in time is not correlated with the past ones. On the other hand this is an assumption that we cannot be sure is true because some form of interdependence in the choices could have arisen during the game. In particular when we assume that the "history" of the game has an influence on the positioning of the reference point.

In spite of these considerations we have nevertheless computed a Mann-Whitney test which results are reported in tab.4.3 and in tab. 4.4.

Tab. 4.3 – Experiment 1 – Mann Whitney Test

Man-Whitney test Exp1		Group1			Group2		
		Srs1	Srs2	Srs3	Srs1	Srs2	Srs3
Group1	Srs1	-	0.704	0.888	0.338	-	-
	Srs2	0.704	-	0.820	-	0.017	-
	Srs3	0.888	0.820	-	-	-	0.217
Group2	Srs1	0.338	-	-	-	0.035	0.604
	Srs2	-	0.017	-	0.035	-	0.129
	Srs3	-	-	0.217	0.604	0.129	-

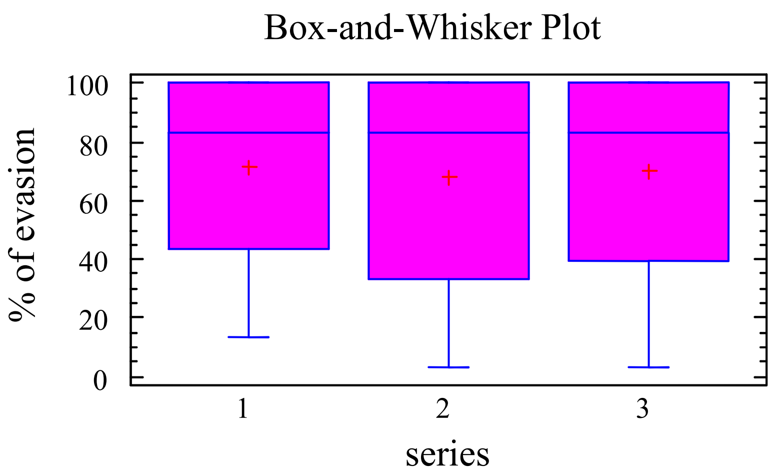
Srs = series

Tab. 4.4 – Experiment 2 – Mann Whitney Test

Man-Whitney test Exp2		Group1 Srs1	Group1 Srs2	Group1 Srs3	Group2 Srs1	Group2 Srs2	Group2 Srs3
Group1	Srs1	-	0.061	0.456	0.585	-	-
	Srs2	0.061	-	0.393	-	0.808	-
	Srs3	0.456	0.393	-	-	-	0.057
Group2	Srs1	0.585	-	-	-	0.058	0.005
	Srs2	-	0.808	-	0.058	-	0.067
	Srs3	-	-	0.057	0.005	0.067	-

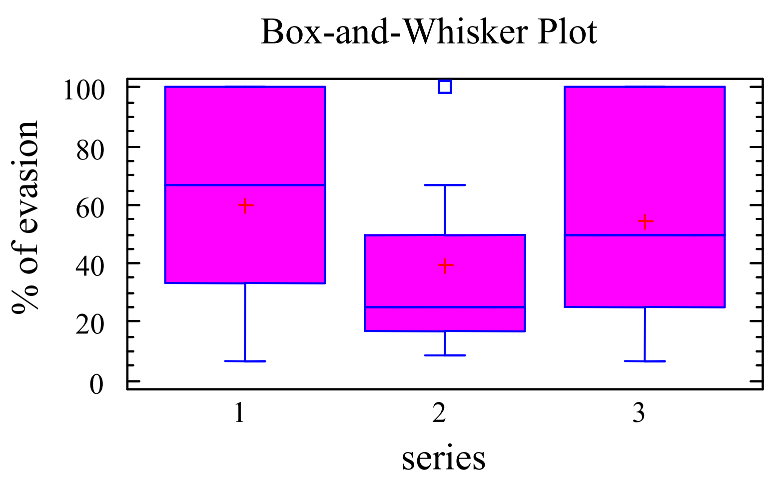
Looking to the results of the Mann Whitney test from tab. 4.3 it seemed that the behaviours of the losers group (first 150 € pts. then 300 € pts.) during the first experiment (i.e. comparing between series) are not significantly different. A similar conclusion can be drawn also from the examination of the box and whisker plots reported in fig. 4.2. Looking to the graphs one can notice that the distributions of the percentage of tax evaded in the three series have almost the same median (the lines into the boxes) and a very similar averages (the small crosses within the boxes). More in general the size of the boxes (which include the 50% of the observations) and the length of the whiskers (which include the 95% of the observations) are very similar.

Fig. 4.2 - Experiment 1 - percentage of tax evaded by group (€ pts. 150 then 300)



Going back to tab. 4.3 and looking to the gainers group (first 300 € pts. then 150 € pts.) the results of the Mann-Whitney test seemed that the percentage of evasion between series 1 and series 2 is significantly different. Similarly but accepting a lower level of significance (87% instead then 95%) also the behaviours in series 2 and series 3 are significantly different. A confirmation of these results come also in this case from the box and whisker plot of fig. 4.3. Looking to the graphs it appears very clear that there is an higher concentration of behaviours in the low values of the distribution during series 2 while both series 1 and 3 shown a lower level of concentration and values nearer to the top of the distribution.

Fig. 4.3 - Experiment 1 - percentage of tax evaded by group (€ pts. 300 then 150)



Computing the Mann Whitney test between groups instead than between series one can notice that the only significant difference is between group 1 and 2 of series 2 while for the other series there are no significant differences between the two groups.

Coming to the results from the Mann Whitney test computed for the second experiment we should accept the null hypothesis for all the series of group 1 (i.e. it seemed that the differences between the series of the group of the losers are not significantly different). On the contrary there are significant differences between series 1 and 3 for the gainers group and the significance level of the test is very near to the 0.05 also for series 1 with series 2 and for series 2 with series 3. It seemed therefore that the gainers behave in a quite different way for the whole experiment. These results are shown also from the graphs in fig.4.4 and 4.5.

Confronting the percentage of tax evaded between the two groups the only significant difference is between group 1 and 2 in series 3.

Fig. 4.4 - Experiment 2 - percentage of tax paid by group (€ pts. 150)

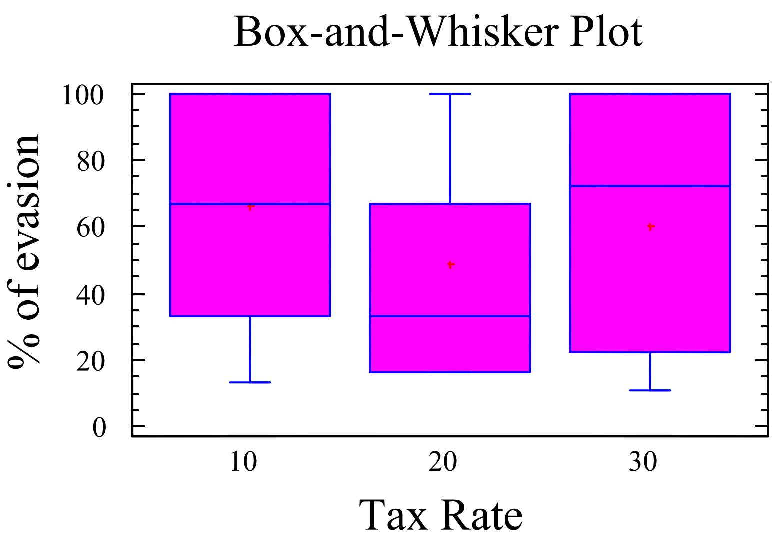
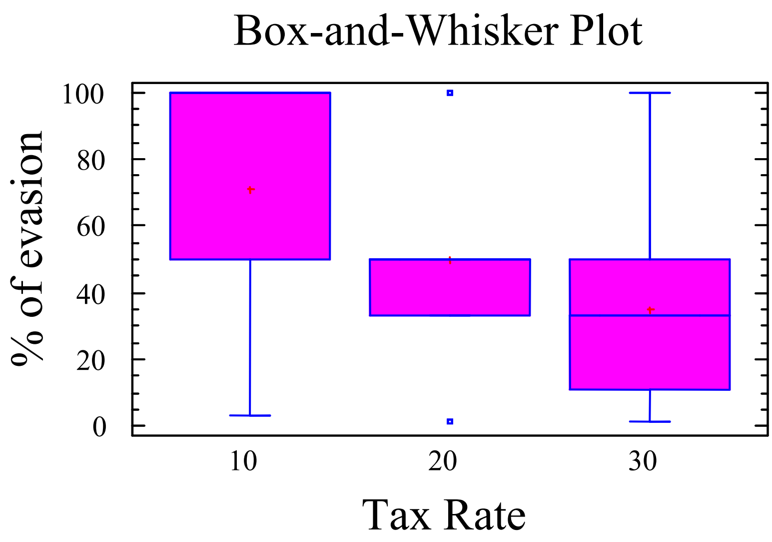


Fig. 4.5 - Experiment 2 - percentage of tax paid by group (€ pts. 300)



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