

Vat evasion: an experimental approach*

By Luigi Mittone**

Department of Economics and
Computable and Experimental Economics Laboratory (CEEL)
University of Trento

Abstract

This paper analyse the phenomenon of the evasion of indirect taxes. The attention is focused on the insurgence of phenomena of collusion among tax evaders. The paper reports results from several experiments carried out at the Laboratory of Computable and Experimental Economics of Trento.

* In writing this paper I have benefited from the valuable assistance of Marco Tecilla from CEEL, who wrote the software used to run the experiments and participated in all the different phases of the project. I also wish to thank my friend Paul Webley, who helped me with ideas and constructive criticisms. As usual, all responsibility for mistakes or omissions is mine alone.

** Tel. ++39461882213
Fax ++39461882222
mittone@gelso.unitn.it

1. Introduction

Since the seminal paper by Allingham and Sandmo (1972) the theoretical microeconomic approach to tax evasion has almost exclusively treated only personal income tax and, more recently and with fewer examples, profit taxes (e.g. Kreutzer and Lee, 1986; or: Lee, 1997). The evasion of indirect taxes, and more precisely of value added tax (VAT), is an almost unexplored topic for microeconomic theory, and the few papers that have explicitly treated it from a theoretical perspective (e.g. Marrelli, 1984) have done so within the production theory framework, i.e. once again as part of a problem of profit maximisation. None of these works analyse those interesting aspects of VAT evasion tied to the highly social nature of this kind of tax evasion. The social-psychological dimension of tax evasion is not a new topic, and it has been widely analysed from both the theoretical (e.g. Gordon, 1989) and the empirical-experimental perspectives (e.g. Webley, P. Robben, H., Elffers, H. and Hessing, D., 1991; Bosco, Mittone, 1997), but once again this literature refers only to income tax.

The most distinctive characteristic of the evasion of VAT is that it typically involves three actors – the seller, the buyer and the state – whereas in the evasion of income tax the interaction concerns only the taxpayer and the state. The interaction among these three agents may give rise to the following phenomena:

- a) the taxpayer, i.e. the buyer of a given good or service, can evade only if s/he is able to collude with the seller, who should behave as tax collector for the state.
- b) The collusion between the seller and the buyer is facilitated by the mutual advantage accruing to the two agents from the collusion. By colluding, in fact, both agents can reduce their fiscal burdens: the buyer does not pay the VAT and the seller can declare an income lower than the real one because s/he under-reports the amount of his/her business, and consequently must pay less profit tax.
- c) The seller can decide to confiscate the tax yield that she has collected from his/her buyers.

According to point (b) the seller has a double incentive to evade: the first is a market incentive due to the opportunity to be more competitive by selling at prices lower than the gross prices (i.e. VAT included) charged by the other sellers; the second is to reduce the burden of his/her profit tax by hiding the real volume of his/her business. Note that both these incentives for collusion (and therefore for evasion) may be nullified if the seller decides to adopt the strategy described at point (c). For terminological clarity, henceforth I shall define the seller's appropriation of the VAT yield collected from his/her clients as "VAT expropriation".

A second interesting point related to VAT evasion is that the state may introduce incentives intended to induce agents to complain, i.e. forms of reward for agents who report attempts to involve them in collusion. To be effective, the incentives introduced by the state to encourage the reporting

of collusion attempts, by either buyers or sellers, should balance the just described incentives to collude, and they therefore should be carefully planned. On the other hand, many national legislatures (Italy's for example) have serious lawmaking problems with regard to these kinds of incentive for informing on miscreants. How to incentivize the denunciation of collusion attempts will not be treated here, given that it would extend the discussion beyond the scope of this paper.

A final point investigated here regards risky behaviour. In previous experiments carried out on income tax evasion (Mittone, 1999) an interesting recursive phenomenon was observed in every experiment: a sort of "bomb crater" effect. The term "bomb crater" is taken from the practice of soldiers during the first world war to seek refuge in the craters made by bombs that had just fallen. The soldiers believed that it was almost impossible for another bomb to fall in exactly the same place. Similarly, in Mittone (1999) the tax payers evaded immediately after the fiscal audit even if the probability of being detected was totally independent of previous tax audits.

Does the more complex environment of VAT evasion produce different effects on the experimental subjects' attitude toward risk? Or does the bomb crater effect persist even in the VAT context?

The approach chosen here to analyse VAT evasion is an experimental one. The main advantage offered by the experimental approach is that it enables isolation of each of the aspects just described and empirical investigation into the individual roles played by these factors in influencing VAT evasion.

2. The theoretical frame: some considerations

The theoretical aspects to be treated before passing to the experimental investigation are closely related to the solution of questions arising from the just described characteristics of VAT evasion. These questions are the following:

- 1) assuming that the sellers operate in some form of imperfect competition market (i.e. assuming that they can fix their selling price) what is the seller's optimal price-collusion-evasion strategy?
- 2) Which is the optimal collusion-evasion choice for the buyer?
- 3) Does the traditional tax evasion theory fit with the seller's decisional problem of keeping the indirect tax yield collected from his/her buyers?

Although these three questions seem to represent new theoretical topics, more accurate analysis shows that they are all easily manageable within the framework of the traditional Allingham-Sandmo model. In fact, unless we introduce into the collusion mechanism some form of asymmetrical advantage for the agents - for example, some form of reward for the agent that decides to denounce an attempt at collusion by the other agent - the decisional problem is very similar to that of income tax evasion.

Both the buyer and the seller can consider VAT evasion from the same perspective of income tax evasion because VAT reduces the disposable income exactly as income tax does. The main difference is that the VAT burden is proportional to the price of the good purchased, while income tax

is generally progressively tied to the income level. But this difference does not alter the ingredients of the tax payer problem, which are the same as originally included in the classic Allingham-Sandmo model, i.e. the amount of tax due, amount of the fine to pay if detected, and the probability of being audited.

Another difference between VAT evasion and the traditional theoretical framework of income tax evasion concerns the sellers only. The expropriation of the VAT yield collected by the sellers is linked to the decision to evade profit taxes and can therefore be seen as part of production choices. As anticipated in the introduction, VAT expropriation can be handled within production theory by looking at the literature on profit tax evasion. This topic will not be treated here, because the focus of this paper is on collusion between sellers and buyers and on the effects thus produced on the market dynamic. More precisely, it is assumed here that the sellers are not concerned with production choices and therefore make choices that closely resemble those taken in the income tax environment.

In spite of the apparently traditional setting in which the evasion of indirect taxation should be framed, this is nevertheless an innovative perspective on the actual behaviour adopted by human actors when confronted with an opportunity to break the law. The interest of indirect evasion resides in the quite complex psychological context in which it takes place. As said at the outset, many experiments on the evasion of income tax have shown that the decision to evade is influenced by psychological factors that may profoundly modify the results of the decisional process of the taxpayers. These factors, which depend on the social dimension of the

decision to evade income tax, are even more crucial in a context like that of indirect taxes, where evasion becomes much more explicit than is normally the case in income tax evasion.

Furthermore, the strong psychological impact of indirect tax evasion is a major problem, not only for the buyer, who must obtain the complicity of the seller to be able to evade, but also for the seller, when s/he decides to keep the money collected instead of paying it to the state. In fact, when the seller keeps the money paid as tax, s/he is stealing from both the buyer and the state, and it is therefore reasonable to suppose that awareness of his/her unfair behaviour will be stronger than in the case of income tax.

On the other hand, and this time with regard to the buyer, one can argue that the subjective perception of paying a tax is weaker in the case of indirect taxes than it is in the case of income tax. The relatively weaker psychological perception of the fiscal burden caused by the indirect taxes may be due to the fact that tax payers generally consider indirect tax to be an inseparable part of the price that they are paying for a given good. Conversely, in the case of income tax, tax payers clearly see the amount of money that is being taken away from their income.

The basic theoretical framework used here is a simplified version of Allingham and Sandmo's static model.¹ Taxpayers' choices (by both buyers and sellers) are taken with a view to the expected monetary value that they can extract from evasion, and every choice is independent of previous decisions and subsequent ones. Time independence is ensured by the following assumption:

¹ For more detailed description of the theoretical frame see Mittone, 1999.

H₁) the fiscal authority does not take the past behaviour of the taxpayers into account when determining either the fiscal audit probability or the fee to be applied in the case of evasion.

In order to concentrate only on monetary income, it is useful to introduce a further simplifying assumption:

H₂) the agents' utility depends only on monetary income.

The agents considered here are the buyers and sellers of a given homogeneous good. In order to keep the analytical framework as simple as possible, further elementary assumptions must be introduced:

H₃) the buyers' net disposable income (i.e. the income that the buyers can spend to purchase all the other goods after consumption of the homogenous good) at the end of the reference period Γ is the difference between the price paid for the good in each purchase and its reservation price (i.e., $Y_{\text{buyer}} = \sum_{\gamma} RE_{\gamma} - \sum_{\gamma} (P_{\gamma} + \text{VAT } P_{\gamma})$; with RE_{γ} = reservation price at time γ ; P_{γ} = price of the good bought at time γ ; ($\gamma = 1, \dots, \Gamma$));

H₄) the sellers' total net income Y_{seller} , computed at the end of a given reference period Γ , depends exclusively on the total gross profit extracted from each sale minus the profit tax (i.e., $Y_{\text{seller}} = \Omega_{\Gamma}^{\text{net}} = (\sum_{\gamma} P_{\gamma} - \sum_{\gamma} CT_{\gamma}) (1 - t)$; with: $\Omega_{\Gamma}^{\text{net}}$ = total net profit at time Γ ; CT_{γ} = total

production costs at time γ ; P_γ price of the good sold at time γ ; ($\gamma = 1, \dots, \Gamma$); t = profit tax rate);

Given these assumptions, one can assume that in each period γ the agents compare the sure choice, i.e. they do not collude and benefit from a sure profit, if a seller, or pay the VAT and benefit from a sure net disposable income level if a buyer, with the expected value EV^e obtained respectively from profit tax evasion if a seller and from VAT evasion if a buyer. More precisely, bearing in mind that the agent has only two choices: to collude, or not to collude, and recalling the time independence assumption, if the agent is a buyer we have:

$$EV_{buyer}^e = (1 - \pi) VATP + \pi [\phi(VAT) + VATP] \quad [2.1]$$

where:

π is the probability that VAT evasion will be discovered;

VAT is the VAT rate;

$\phi(VAT)$ is the punishment scheme.²

The buyer's problem, given [2.1], is simply a matter of making a comparison between the value of EV_{buyer}^e and the cost of paying the VAT.

As well known, in the very special case when $EV_{buyer}^e = VATP$ the choice of

² I assume that the penalty rate is imposed on evaded tax, an institutional feature common in many developed countries.

the buyer is conventionally assumed, by expected utility theory, to be discriminatory between risk aversion and risk attraction.

Similarly, also the seller's expected value from collusion can be computed in the following way:

$$EV_{seller}^e = (1 - \pi) t\Omega + \pi f(\Omega) \quad [2.2]$$

where:

$f(\Omega)$ is the punishment scheme for the profit tax evasion.

Given 2.2, the decisional problem of the seller is exactly identical to the buyer's problem, i.e. it is a matter of comparison between his/her expected value from collusion and the value of the profit tax that s/he can avoid paying. On the other hand, the decisional task of the seller is somewhat more complex than the one just described. The seller should in fact consider the option to collude not only as a way to avoid to pay the profit tax, but also as a competition device. The problem is obviously how to compute the competitive advantage offered by collusion.

Finally, it is worth noting that the basic decisional frame does not change even when we allow the seller to expropriate the VAT collected. Also in this case, the problem is that of comparison between the expected value from expropriation and the sure value of paying the yield to the state. The main difference in this case is that we can assume that VAT expropriation is no longer a dichotomous variable but that it can be "tuned" by the seller. Nevertheless, the expected value formula does not change, except for the

fact that instead of a “pay not pay” option we need a “how much to pay” option.

3. The experimental design

The context modelled by the experiments discussed here is that of a market of an homogeneous good with the following features:

1. Operating on the market are several sellers and buyers, each characterised by different reservation values. The reservation value for the buyers is depicted by a reservation price, while for the sellers the reservation values are represented by their total production costs;
2. Neither the buyers nor the sellers can alter their reservation values;
3. Each agent (seller and buyer) can close only one transaction (consisting of only one unit of the good) per each time period (round of the game);
4. the experiment is carried out using computers; the experimental subjects interact via a local net;
5. All relevant items of information are given only via the computer screen;
6. Each subject receives a role at the beginning of the experiment – seller or buyer – which does not change throughout the entire experiment;

7. Each subject receives an identification number at the beginning of the experiment so that the subjects' real identities are not known to each other;
8. Each subject receives (via the computer screen) her/his "personal information" i.e. her/his production cost if s/he is a seller, or her/his reservation price if s/he is a buyer;
9. The money reward for the experimental subjects is given by the difference between the actual value of the transaction and its cost of production, or its reservation price, minus the indirect tax;
10. The sellers offer their good at the price that they believe most advantageous, and the buyers can choose to buy from the list of offers shown on the computer screen;
11. Similarly, also the sellers see the list of offers by their competitors;
12. The sellers as well as the buyers can try to collude with a potential partner by clicking on a special button on the screen called "collusion"; when this button is clicked two buttons appear on the screen : "yes" and "no"; a subject who receives a proposal for collusion can accept by clicking on the yes button or can refuse by clicking on the no button;
13. Collusion is always total, i.e. it regards the entire amount of tax due to the state, and it is a private relationship, so that the other players cannot know if a given seller (or buyer) has already agreed to collude with someone else;

14. During the experiment a given number of transactions are monitored by the fiscal authority, and if the subjects have colluded they must pay a fine that will be deducted from their final rewards;
15. The expected value from collusion (i.e. the values of audit probability and of the fine) is the same for both the sellers and the buyers;
16. In correspondence to the equilibrium point the lottery is fair, i.e. the expected value from evasion is equal to the sure choice value;
17. The subjects are informed about the fiscal audit probability and the fine to pay;
18. If the sellers are allowed to expropriate the VAT collected, a special window opens on? the computer screen: the “pay tax yield to the state” window; when the subjects decide to expropriate VAT, they must write only the amount of money that they have decided to pay to the state in the window.

At the end of the experiment the subjects are informed about their final money rewards, which may be worth up to a maximum of 50.000 Italian Liras (about 25 Euros).

The experiments thus designed are very similar to the seminal Chamberlin (1948) experiment, to Vernon Smith’s relatively more recent competitive market experiment (1962), and to the version of these experiments adopted by the Experimental Economics handbook by Bergstrom and Miller (1997). As in these experiments, use of the neo-classical offer-demand model of perfect competition permits the forecasting

of equilibrium prices without collusion and with collusion. It is therefore possible to check whether the behaviours of the subjects conform with the expectations of the model. Furthermore, it allows investigation of issues not strictly related to the economic apparatus anticipated in the introduction. The most important of these topics is that of the emergence of reputation mechanisms, i.e. a willingness to collude that can be interpreted as the commercial “style” of a given subject and which can be helped or hampered by this reputation.

Four experiments have been carried out to date at the Computable and Experimental Economics laboratory of the University of Trento:

- a) experiment α_1 and experiment α_2 – base experiments carried out with 12 experimental subjects each, and assumed as the touchstone for interpretation of the results from the other experiments;
- b) experiment α_3 – the same as experiments α_1 and α_2 but with 24 experimental subjects;
- c) experiment α_4 – intended to investigate the effects produced by allowing the experimental subjects, who played the role of sellers, to keep the money collected as indirect taxes; also in this case 24 experimental subjects were used.

The experimental subjects were undergraduate students recruited by means of announcements on the bulletin board of the Faculty of Economics. Females always made up 50% of the sample. Each experiment lasted 25 rounds.

The reservation values and the distribution of the reservation values among the subjects for the experiments with 12 subjects are reported in

figures 3.1 and 3.2. The production costs and the reservation values for the experiments with 24 subjects were obtained by the same values used for the experiments with 12 subjects multiplied by 2; therefore the curves are identical but translated towards the right. Thus the equilibrium prices remain the same while the equilibrium quantities increase.

Figs. 3.1 and 3.2 show that the only effect of including VAT is to increase and broaden the range of the equilibrium prices.

Fig. 3.1 Reservation and equilibrium values with 12 subjects (experiments α_1 and α_2)

Sellers	Cost	Buyers	Res. value
3	50	3	200
2	150	2	100
		2	75

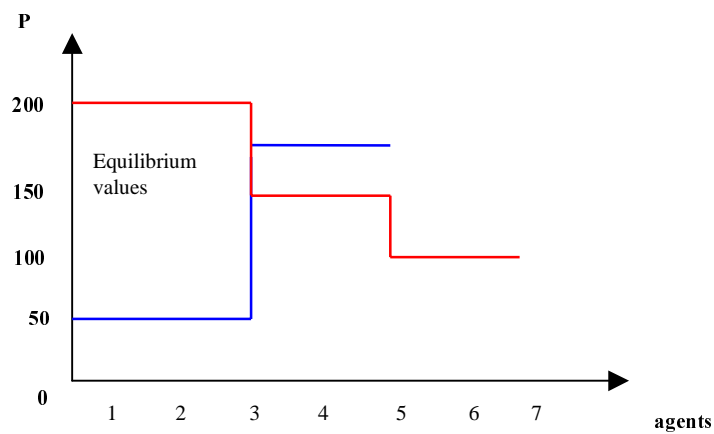
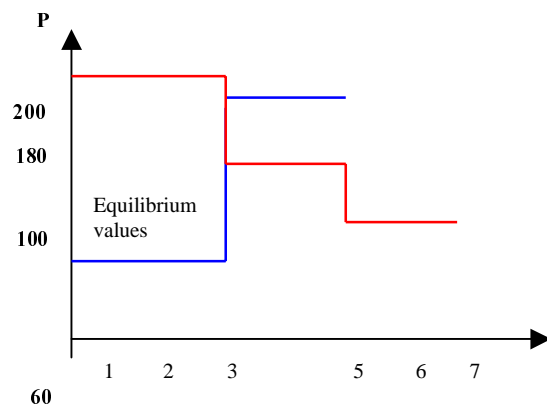


Fig. 3.2 Reservation and equilibrium values with VAT; with 12 subjects (experiments α_1 and α_2)

Sellers	Cost
3	50
2	150

Sellers	Res. value
3	200
2	100
2	75



4

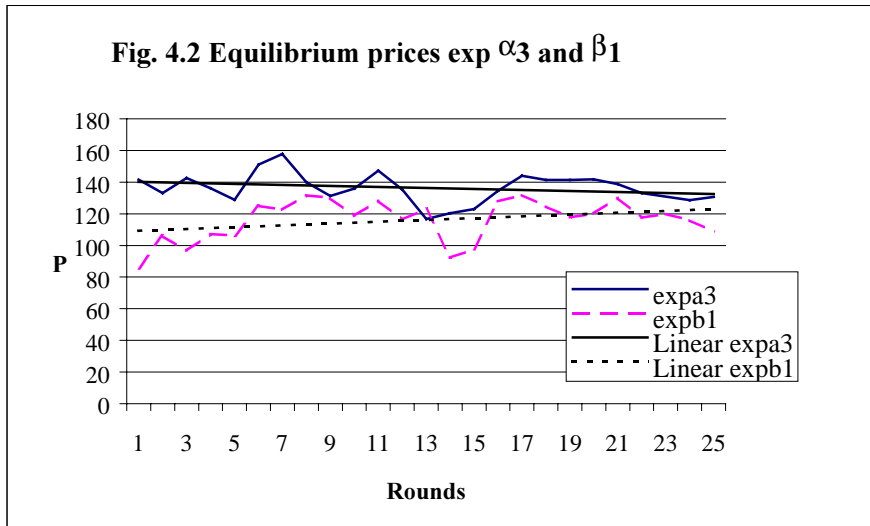
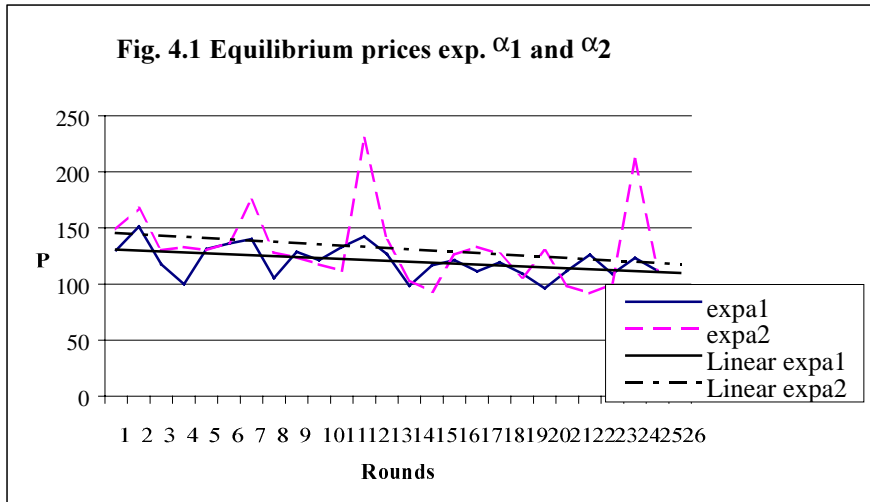
agents

4. The results

To return to the objectives of this research as described in the previous sections, I was interested in the following issues:

- a) analysis of the equilibrium values dynamic – comparison between the equilibrium values (predicted by the theory without evasion) and the observed behaviours;
- b) analysis of the VAT expropriation phenomenon;
- c) testing the “bomb crater” effect observed in the previous experiments on income tax evasion (Mittone, 1999),
- d) the emergence of “reputation” phenomena, i.e. consumer loyalty towards a given seller.

To analyse the first two topics, it is useful to plot the equilibrium values (i.e. the average prices) obtained from the experiments. Figures 4.1 and 4.2 report the observed average prices obtained respectively from experiments α_1 and α_2 and from experiments α_3 and β_1 .



On examining the figures one notes that the average prices are well approximated by the equilibrium values computed using the supply-demand theory. Some few exceptions to this general result are be found in rounds 12

and 24 of experiment α_2 and in rounds 1, 3, 14 and 15 of experiment β_1 . It is worth noting that the “anomalous” prices recorded in experiment α_2 are almost certainly due to some “error” committed by subjects carrying out their own business,³ while the anomalies registered in the prices of experiment β_1 are the result of a general tendency.

All the anomalous prices recorded in β_1 fall below the expected equilibrium prices, but this can be explained as a consequence of the more general price tendency recorded in this experiment. On looking at the total average prices computed without (by eliminating) the anomalous values we find that in experiment α_1 and α_2 they are very close (respectively $\alpha_1 = 120.7$ and $\alpha_2 = 117$ Italian Liras), while the same average prices computed and “cleaned” by eliminating the anomalous prices for experiments α_3 and β_1 (i.e. the 24 subjects experiments) show a sensible difference (respectively $\alpha_3 = 136$ and $\beta_1 = 101,9$ Italian Liras).

It is difficult to obtain statistical confirmation of the difference between the two experiments, because one cannot rule out that the individual values are interrelated; that is, one cannot exclude with certainty that the observations are independent. Therefore the most common statistical tests used to check whether two samples of data belong to the same population cannot be used. The only sure way to overcome the dependence of the observations problem is to run many sessions of the experiment collecting a large number of data. Another but less statistically rigorous way to try to

³ E.g. during round 24 subject “5” reported a loss of 525 Italian Liras because s/he agreed to pay 500 Italian Liras for a good that for her/him had a value of 75 Italian liras. Similarly, in round 12 experimental subject 6 reported a loss of 400 Italian Liras because s/he bought for 500 Italian Liras a good that for her/him had a value of 100 Liras.

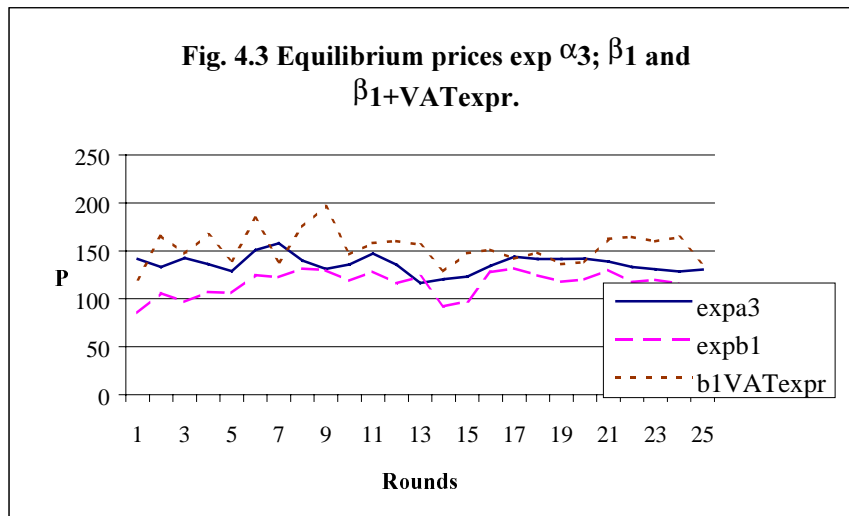
overcome this problem is to assume independence between the observations (which in our case is obviously a very weak assumption as we are treating time series data) and then using a dependent samples non parametric test, like the Wilcoxon signed ranks, or the Mann-Whitney test. The results from these tests must therefore be read with many cautions and have only a generically descriptive significance. On the other hand some of the decisions taken by the subjects should be really independent from their past behaviours as each round is for many aspects independent from the other. For example the decision to collude should be independent from the past decisions to collude unless we imagine that the subjects (but only the sellers) use collusion as a competitive device.

The values of the Wilcoxon test computed for the (outliers free) data from experiments α_1 and α_2 are shown in tab. 4.1 and do not allow rejection of the null hypothesis (i.e. it is not possible to state that the samples do not belong to the same statistical population), while the Wilcoxon test computed for the experiments α_3 and β_1 allows rejection of the null hypothesis (i.e. one can state that the samples do not belong to the same statistical population with an asymptotic significance of 0.000). An identical conclusion can be obtained also from the Mann-Whitney test.

**Tab 4.1 Wilcoxon signed ranks and Mann-Whitney Test Statistics:
experiments α_1 - α_2 (outliers free) and α_3 - β_1**

	exp α_1 - α_2	exp α_3 - β_1
Wilcoxon Z	-1.201	-4.292
Asymp. Sig. (2-tailed)	.230	.000
Mann-Whitney U	257.000	48.000
Asymp. Sig. (2-tailed)	.529	.000

A generalized price reduction therefore seemed to be the main effect produced by allowing the subjects to expropriate VAT. A possible explanation for this phenomenon is that the sellers decided to systematically expropriate VAT, considering this option as a way to reduce their productions costs and therefore allowing them a more “aggressive” price competition. In fig. 4.3 the average VAT expropriation values per round have been added to the average prices to check whether the just described intuition was correct.



The VAT expropriation + price line demonstrates quite clearly that at least one of the sellers in experiment β_1 decided in every round to expropriate the tax yield collected by her/his buyers. The new line approximates the average price line computed for experiment α_1 , and the VAT expropriation + price level is almost constantly higher than the average price recorded in experiment α_1 . On the other hand, it is to be noted that the VAT expropriation does not modify the average prices dynamic in a way coherent with the “real” price dynamic of experiment α_3 . In fact, if we compute the Wilcoxon signed ranks test we discover, always remembering the statistical limits of this test when applied to time series data, that the two data sets still seemingly belonged to different statistical populations.

Tab 4.2 Wilcoxon Signed Ranks Statistics: experiments α_3 and β_1 +VAT expropriation

	α_3 - β_1 +VAT exp
Wilcoxon Z	-4.238
Asymp. Sig. (2-tailed)	.000

The price-VAT expropriation strategy implemented by the sellers in experiment β_1 makes it difficult to reach firm conclusions about the psychological constraint that the VAT stealing should produce if it is perceived as a damage caused to the welfare of the other participants in the experiment. In fact, by offering prices lower than those offered in α_3 the sellers of experiment β_1 implicitly shared with the buyers the advantage provided by the opportunity to expropriate the VAT. Furthermore, and conversely to the case of collusion, they alone run the risk of being punished by the fiscal audit, so that their behaviour can paradoxically be seen as “altruistic” because they share the advantage offered by VAT expropriation (through a reduction of the prices) without imposing the risk of paying a fine. On the other hand, we cannot rule out that this strategy was only a matter of price competition, and therefore that no psychological complication really arose in conditioning the decision to expropriate the VAT yield.

The third and fourth questions raised at the outset concerned the emergence of the reputation effect, and the existence of a “bomb crater” effect, also in the VAT evasion context. The reputation effect can be

analyzed by looking at tab 4.3, which reports the results from experiments α_1 and α_2 .

Table 4.3 shows that “lock in” phenomena between sellers and buyers are quite common. For example, in experiment α_1 subject 2 (seller) and subject 7 (buyer) closed 7 contracts out of a total of 16 (43.75 %) closed by subject 2; and in experiment α_2 subject 1 (seller) and subject 7 (buyer) closed 8 contract out of a total of 17 (47.06%).

Another interesting aspect of the competition strategy regards the collusion proposal as a non-price competition tool. Tab. 4.4. reports the number of collusions proposed and realized respectively by the sellers and by the buyers. It seems from the results obtained from the first experiment (α_1) that the sellers used the collusion proposal as a way to attract the buyers. Out of a total of 79 collusion proposals 46 were made by sellers and only 33 by buyers. On the other hand, this result is completely different from the one obtained from experiment α_2 , where the buyers made 47 collusion proposals out of a total of 65.

It seems therefore that the collusion proposal was interpreted by the experimental subjects as a competitive mechanism on the supply side, or as a way to save money by evading VAT on the demand side. It is worth noting that these two different interpretations of collusion in the two experiments seem to show that some form of internal coordination among the experimental subjects may arise. In other words, one can hypothesize that the task of proposing collusion becomes mainly a matter of a given role (seller or buyer) in accordance with some spontaneous selection of behaviors during the first stages of the game. In other words it seemed that

at the beginning of the game the players, through a sort of spontaneous coordination, decide to attribute the role of proposing collusion to the sellers or to the buyers, then this role remains assigned till the end of the experiment. To check this hypothesis one should analyze the initial rounds of each experiment to see whether the dynamic of the collusion proposals follows a different pattern in the initial stages of the experiments.

Tab. 4.3 Reputation effect experiments $\alpha 1$ and $\alpha 2$

Experiment $\alpha 1$		(number of transactions)							
Buyers		5	6	7	8	9	10	11	tot
Sellers	0	2	3	5	4	2	6	3	25
	1	2	6	4	3	0	2	1	18
	2	2	2	7	0	2	2	1	16
	3	3	0	2	4	6	3	2	20
	4	5	2	2	1	4	0	6	20

%		5	6	7	8	9	10	11
	0	8.00	12.00	20.00	16.00	8.00	24.00	12.00
	1	11.11	33.33	22.22	16.67	0.00	11.11	5.56
	2	12.50	12.50	43.75	0.00	12.50	12.50	6.25
	3	15.00	0.00	10.00	20.00	30.00	15.00	10.00
	4	25.00	10.00	10.00	5.00	20.00	0.00	30.00

Experiment $\alpha 2$

(number of transactions)

Buyers	5	6	7	8	9	10	11	tot
Sellers 0	1	3	1	8	3	1	3	20
1	1	1	8	0	2	0	5	17
2	6	4	3	0	5	3	0	21
3	3	2	1	2	2	5	1	16
4	3	7	2	1	4	1	4	22

%	5	6	7	8	9	10	11
0	5.00	15.00	5.00	40.00	15.00	5.00	15.00
1	5.88	5.88	47.06	0.00	11.76	0.00	29.41
2	28.57	19.05	14.29	0.00	23.81	14.29	0.00
3	18.75	12.50	6.25	12.50	12.50	31.25	6.25
4	13.64	31.82	9.09	4.55	18.18	4.55	18.18

Tab. 4.4 Collusion: experiments $\alpha 1$ and $\alpha 2$

Experiment $\alpha 1$	Player	Number Transactions	Number Collusion	Collusion Proposal
Sellers	0	25	4	12
	1	18	3	6
	2	16	3	9
	3	20	3	7
	4	20	2	12
Total sellers		99	15	46
Buyers	5	14	0	3
	6	13	2	4
	7	20	2	5
	8	12	4	9
	9	14	0	2
	10	13	1	2
	11	13	6	8
Total buyers		99	15	33

Experiment $\alpha 2$	Player	Number Transactions	Number Collusions	Collusion Proposal
Sellers	0	20	0	0
	1	17	0	1
	2	21	2	3
	3	16	2	3
	4	22	7	11
Total sellers		96	11	18
Buyers	5	14	0	10
	6	17	1	3
	7	15	0	1
	8	11	0	0
	9	16	5	11
	10	10	2	10
	11	13	3	12
Total buyers		96	11	47

It is more difficult is to investigate the attitude toward risk displayed by the experimental subjects. The difficulty arises mainly from the fact that the fiscal audits were randomized so that each subject could be audited in different rounds of the game. On average, when a tax audit is carried out 3 to 4 transactions are investigated in experiments with 12 subjects, and 7 to 8 transactions in experiments with 24 subjects, which means that whenever an audit is performed about 50-60% of the subjects are checked. The aggregated results can therefore be used to test the bomb crater effect, even though one may expect it to be less marked than in the income tax experiments, where all the subjects were investigated simultaneously (Mittone, 1999). Figure 4.4 shows one of the plots obtained from the experiments on income tax evasion for the sake of comparison. Figs. 4.5,

4.6, 4.7 and 4.8 give the graphs from experiment α_1 , α_2 , α_3 , and β_1 respectively.

Fig. 4.4 Experiment on income tax evasion

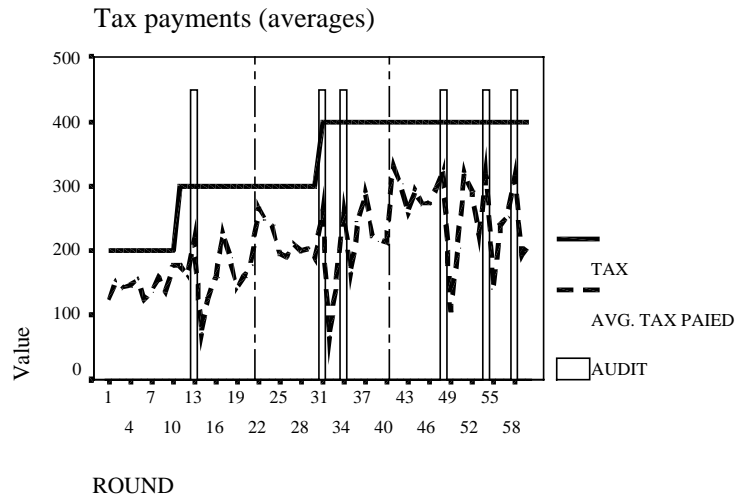


Fig. 4.5 Collusions, proposals and fiscal audits

experiment a1

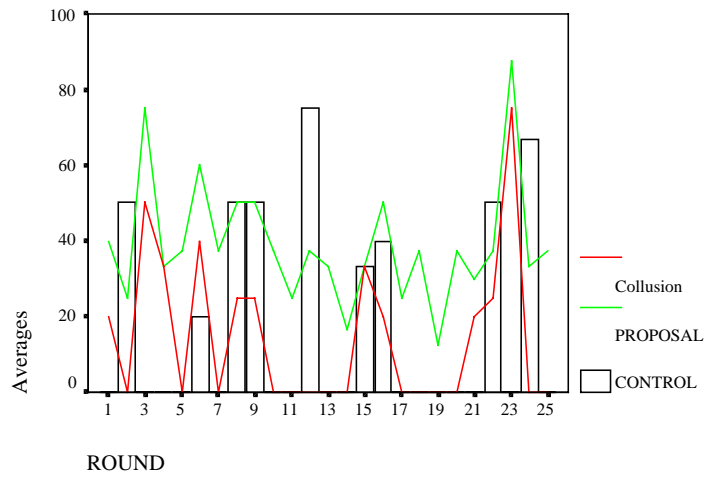


Fig. 4.6 Collusions, proposals and fiscal audits

Experiment a2

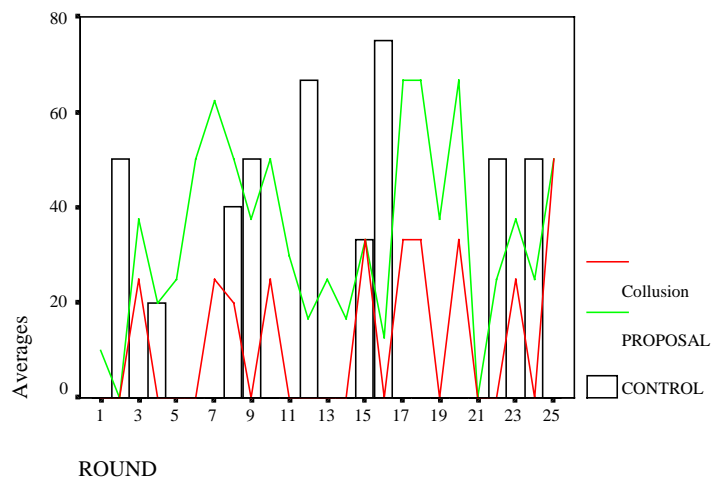


Fig. 4.7 Collusions, proposals and fiscal audits

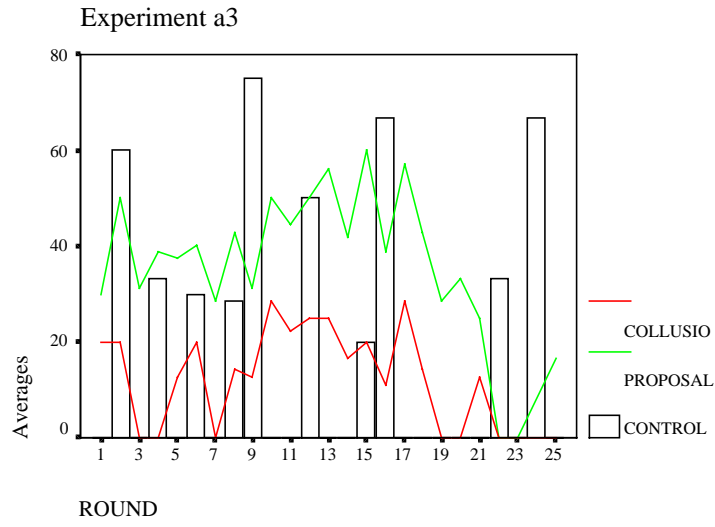
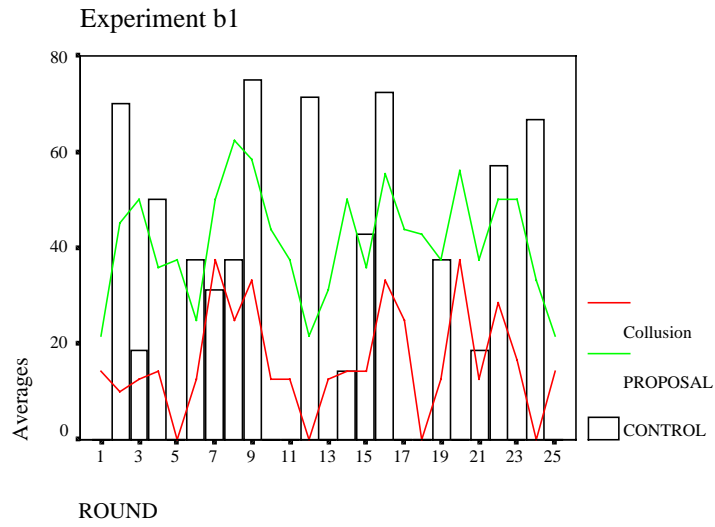


Fig. 4.8 Collusions, proposals and fiscal audits



All the graphs shown in figs. 4.5; 4.6; 4.7; 4.8 report whether the subjects have been audited (variable “control”); whether they have proposed collusion (variable “proposal”); and whether they have actually colluded (variable “collusion”). Fig. 4.4 shows the results from one of the income tax evasion experiments and reports the amount of tax due (variable “tax”), the amount of tax actually paid by the subjects (variable “avg. tax paid”), and whether the subjects have been audited (variable audit).

One notes from the figures that the bomb crater effect is present and very strong in all the experiments, albeit with different degrees of regularity. The different degrees of magnitude and regularity are probably due to the fact that in the VAT evasion experiments the subjects audited were always different.

Finally, it is worth noting that the degree of success of collusion proposals may act as an incentive for further attempts to collude.

5. Preliminary conclusions

The results from the experiments carried out thus far have not yet been completely analyzed, and it is therefore not possible to reach firm conclusions. Nevertheless, some phenomena seem to emerge quite clearly from the data. The first result is that the opportunity to expropriate VAT produces noticeable effects on the equilibrium prices and is seen as an opportunity by both the sellers and the buyers to modify their bargaining strategies.

The second result is that the individual choices regarding collusion and risk may be very different, but at the same time it seems that some form of social consensus, at least on who must suggest collusion, emerges spontaneously in the experimental subjects.

References

- Bergstrom, T. C., Miller J. H. (1997) *Experiments with Economic Principles* The McGraw-Hill Companies, Inc.
- Bosco L. Mittone L. (1997). "Tax evasion and moral constraints: some experimental evidence". *Kyklos*. vol. 50. fasc. 3. 297-324.
- Gordon J. P. (1989) "Individual morality and reputation costs as deterrents to tax evasion" *European Economic Review* 33. 797-805
- Marrelli M. (1984). "On Indirect Tax Evasion". in: *Journal-of-Public-Economics*; 25(1-2). November 1984. 181-96.
- Mittone L. (1999), *Psychological constraints on tax evasion: an experimental approach*, PhD Thesis, Bristol University, Bristol.
- Webley P., Robben H., Elffers H. and Hessing D.(1991) *Tax Evasion: An experimental Approach*. Cambridge University Press.