

Firms' tax evasion: an experimental approach*

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Abstract

The aim of this work is to analyze tax evasion as a factor that potentially affects internal control of firms as an application of the Chen and Chu's model (2005). For this purpose an experimental approach was employed. Treatments varied whether agents were assumed to be risk-neutral or risk-averse. According to the gift-exchange game (Fehr et al., 1993) results show a positive relationship between wages offered by principal and efforts provided by agents. In general, higher wages lead to more costly effort provision. However, when evasion and risk aversion are introduced in the analysis efforts are considerably lower suggesting that, when uncertainty plays a role, individuals are less willing to cooperate for the wealth of the firm.

1) Introduction

Tax evasion and the existence of shadow economies are a commonplace of life around the world. However, only the past few decades have economists paid attention to this phenomenon partly reflecting the increasing size of fiscal deficits in most of the countries in the world (Tanzi and Shome, 1993).

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Among the different factors that served to increase the size of shadow economy during the last decades of the 20th century, Schneider and Enste (2000) mention: the increasing size of the tax burden and social security payments; the level of regulation in the official economy (e.g. labor markets); the forced reduction of weekly working time (e.g. from full time to part time employment); the introduction of premature retirement; and the increasing rate of unemployment. There are also other important factors that influence the choice to evade tax or not. Johnson et al. (1998), for example, emphasize that the level of corruption has a positive correlation with the increase of the illegal sector. The economic psychology literature places emphasis on tax morale, individual perception of fairness of the tax system, as well as the tendency of taxpayers to mimic behaviour of other successful tax dodgers as important causes of the shadow economy. Torgler (2003) argues that differences in cultures and social norms also play an important role in explaining attitudes to evasion and shows that countries with similar fiscal systems exhibit different levels of tax compliance. Finally, there is a large literature that focuses on the decline of civic duty and loyalty toward the governments as a relevant cause of the increased size of shadow economies (see, e.g., Smith, 1992; Orviska and Hudson, 2002).

The economic impact of the underground economy on an economy is serious. One of the main effects of a large black economy is both the size of the tax burden and its inequality between contributors and non contributors which has important consequences for income redistribution. This may exacerbate the disparities between social classes: high social security contributions and tax rates will affect mainly those taxpayers who are easily monitored by tax authorities (e.g. employees), generating a reduction in consumption and savings. Shadow economies may also distort labor market activities and economic competition affecting economic growth and preventing the success of fiscal policies. It may create an incentive to increase the burden of indirect taxation (with evident consequences on low income households) and generates a significant loss of tax revenues and therefore less provision of public goods and services. Finally, according to Slemrod

(2004) corporate tax evasion opportunities are likely to cause a distortion in the allocation of resources. They may create financial subsidiaries and lead enterprises to locate operations in a tax haven to disguise evasion.

Given all this it is not surprising that tax evasion represents a key issue for many economic systems (e.g. the Italian economy) and that over the years it has been considered a priority for the fiscal policies adopted by Governments.

Since the literature has been mainly focused on tax evasion of individuals, the purpose of this study is to consider information about the different individuals' objectives in reaching firm's profit maximization in a context of tax evasion. As noted by Joulfaian (2000, p.1) "...empirical studies of tax evasion...have generally ignored businesses and primarily focused on individual tax compliance with the personal income tax...". Therefore a contribution to this area of research may be timely.

The analysis is inspired from a study conducted by Chen and Chu (2005) and it is focused on the inefficiency generated by the impact of tax evasion on firm's internal control (i.e. the distortion of manager's efforts). Given the difficulties in field data collection in the case of tax evasion, this issue is analyzed using an experimental approach.

Laboratory experiments represent nowadays an important source of data for economists. One of the advantages is that they can create situations that have never and might never exist in a field. Experiment aims are not to reproduce faithfully a formal model or reality, but to create a design able to offer the opportunity to learn something useful and to answer the questions that motivate the research. Usually their designs are quite simple compared to the real world, and even simpler than (relevant) formal models.

Therefore, although they are subject to some limitations since they are based on hypothetical scenarios (consequently casting doubts on the external validity of the results), they seem to be useful to provide information about individuals' behaviour towards tax evasion. In addition,

considering the problem this study wants to analyze, experimental approaches can be considered a legitimate method of investigation.

The study is organized as follows. The next section presents a description of published economic models of firms' tax evasion. It is followed by a brief introduction to the principal-agent laboratory experiments. Section 4 shows the experimental design. Section 5 analyzes the results for which a discussion is provided in Section 6. Finally, a brief concluding paragraph presents some implications of the study.

2. Background literature

The economic literature on tax evasion initiated by Allingham and Sandmo (1972)² for a long time has been mainly focused on individual tax evasion. However during the last two decades of the 20th century, economists increased their attention on firms' tax evasion, considering separately these phenomena and their consequences.

Previous studies on firms' tax evasion analyze the relationship between the decision to evade taxes and the level of production that maximizes the profits of a firm. During the final years of the 20th century an important debate on this topic developed in several volumes of the *National Tax Journal*³ and the *Journal of Public Economics*.⁴ In particular, the literature is divided into two schools of thought: those who emphasize the separability between the decisions related to the level of output (of a profit - maximizing firm) with the amount of income concealed (see for example Marrelli and Martina, 1988; Cremer and Gahavari, 1993; Yaniv, 1995); and those who tend to explain to what extent tax evasion influences the optimal level of production (examples are Kreutzer and Lee, 1986; Wang, 1990; Lee, 1998).

² Allingham and Sandmo (1972) introduced the taxpayer as a gamble (TAG) model which is considered in the literature the benchmark economic approach for tax noncompliance.

³ See, for example, Kreutzer and Lee (1986), Kreutzer and Lee (1988), Wang and Conant (1988), Yaniv (1995) and Lee (1998).

⁴ Examples are Marrelli (1984), Marrelli and Martina (1988), Virmani (1989) and Cremer and Gahavari (1993).

In general, the peculiarity and validity of the separability hypothesis is strictly connected with the assumption that the probability of being caught by tax authorities and the fines imposed on the firms are exogenously fixed and can be known *ex ante* by the firms. However, under alternative formulations (e.g. assuming the penalty and the probability of detection to be endogenously determined) the separability result may be refuted. Despite the level of research this area has experienced there are still ongoing discussions on this topic (see, for example, Cowell and Bayer, 2006; Lee, 2006).

One of the most important criticisms of models based on the separability concept is related to the lack of consideration for the internal structure of the firm (i.e. the hierarchical system of employees). For several years the economic literature has considered firms as ‘black boxes’ operating in markets in order to maximize profits (Jensen and Meckling 1976, p.3). One of the limitations of these ‘black boxes’ can be found in the lack of consideration of the different individuals’ objectives in reaching the separability result. In particular, as stated by Jensen and Meckling (1976), ‘the theory of the firm’ for a long time has ignored some relevant aspects of corporations, such as the separation of ownership and control. When corporate governance is viewed as an agency relationship, asymmetric information (i.e. moral hazard and adverse selection) problems may arise. Therefore managerial efficiency problems may affect corporate governance.

Comparing these considerations, the pre-existing literature on firms’ tax evasion assumed management and control are not distinct aspects of a firm. In other words, the owner of the firm does not delegate the tax reporting task to the manager. This assumption can be reasonable for small firms (i.e. closely-held businesses), but for large companies (i.e. publicly-held businesses) it is less so. The latter, in fact, usually assign the operations of the corporation (e.g. accounting operations) to an agent. This creates the problem of ‘social responsibility’ of corporations and consequently exacerbates the conflicts of interests in the principal-agent relationship.

Based on these considerations, the contribution of contract theory to firm tax evasion is of great interest and, in particular, the seminal paper of Chen and Chu (2005). They present a formal analysis of the agency dilemma in a context of tax evasion. Specifically, they underline the generated loss of internal control and inefficiency in production when a principal (owner of the firm) and an agent (manager of the firm) engage in evasion.

The Chen – Chu model considers and compares three situations. Starting from the assumption that the owner of the firm is honest the study details optimal contracts when the principal evades taxes (and can incur a penalty) but the manager is not responsible for evasion and the alternative situation in which both are liable for evasion. The scenarios analyzed lead to the conclusion that if the manager is not punishable for evasion and he/she is compensated exactly with the same wage he/she receives when there is no tax evasion, there is not a distortion in his/her efforts, the principal maximizes profits and decides the level of income to declare to the tax authorities irrespective of the output realized (and consequently of the agent's efforts). It is possible to conclude that there is a separability result. However, the third situation shows that when the manager becomes liable for evasion the principal has to remunerate the agent with a risk premium (in order to give him/her the incentive to report a lower share of profits) regardless of whether the latter is caught or not. An efficient contract should guarantee the principal bears all the risks for the agent. Nevertheless, the contract cannot be based on an illegal action and the different states of the world related to tax evasion. This generates incompleteness and prevents an efficient sharing of risks, causing a distortion of the manager's efforts and of the incentives he/she receives in order to participate in tax evasion. In particular, the situation casts doubt on the separability result. If, for example, the manager has an increasing absolute risk aversion utility function (i.e. his/her risk aversion increases with income), the principal has to pay to the manager a high risk premium when his/her wage is large. As a result, the principal will try to discourage the agent from increasing output and the manager will provide low efforts and will be under compensated relative to the first two scenarios.

Therefore, it is possible to conclude that evasion influences the decisions connected with production. Furthermore, the example above shows the *trade - off* between the efficiency loss of internal control and the gain from evasion. Unlike the case of individual tax evasion the owner of a firm can decide to not evade taxes even if positive gains are expected from the illegal action because he/she has to consider the costs due to the efficiency loss of internal control. These considerations lead to the conclusion that small enterprises might be more likely to engage in tax evasion. Likewise, it can be argued that, other things equal, in countries in which cheating opportunities are less widespread the percentage of closely-held businesses and self-employed workers should be smaller than in 'dishonest' countries.

In this context, interesting results have been achieved by Crocker and Slemrod (2005). The Crocker – Slemrod model examines the optimal incentive compensation contract when the firm evades taxes and both the principal and the agent are risk-neutral. The study is based on the assumption that the manager owns private information (which is unknown to the principal) regarding the level of allowable reductions of taxable income (i.e. there is asymmetric information). The analysis focuses on the adjustment of the contract (with the aim to offset the incentives of increasing sanctions against tax evasion) under different enforcement policies: the penalties can be imposed on the shareholder (principal), on the Chief Financial Officer (CFO-manager) or both. The authors reach the conclusion that if penalties are imposed on the manager rather than on the shareholders they are more efficient in reducing the level of concealed income. The intuition here is that when there is asymmetric information a sanction imposed on the shareholders affects the CFO only indirectly through the *second - best* compensation contract. Consequently, a sanction that is directly applicable on the CFO appears more efficient in reducing tax evasion because it exacerbates the conflict (i.e. the different interests) between the principal and the manager when they participate in the illegal action.

The above discussion suggests that contract theory introduces relevant aspects in the principal-agent problem that can be considered a key starting point in any attempt to enrich the analysis of corporate income tax evasion providing suggestions for new models. Chen and Chu (2005) underline, for instance, other sources of inefficiency of internal control. Examples are the use of control instruments (for both the purpose of monitoring the agent's efforts and evading taxes⁵) and the *trade - off* between increasing the level of completeness of the contract and the probability of being detected. In addition, they emphasize the relevance of the manager's extortion and the role of reputation in the relationship. Crocker and Slemrod (2005) address the difference of time horizon between the CFO's tax report and the completion of an audit (as an extra source of conflict of interest). Another interesting aspect they recommend for inclusion in the analysis is the consequence of public disclosure of the firms' taxable income and tax payment.

3. A brief description of the principal-agent laboratory experiments

The available analyses on game theoretic models of principal-agent approach have been mainly focused on the determinants of wage and effort decisions in the bargaining process of agency dilemma (see, for example, Guth et al., 1998; Charness, 2004; Fehr and Schmidt, 2007). In general, most of the studies in the literature find a strong positive relationship between the wage selected by the employer (principal) and the effort level chosen by the employee (agent). Specifically, if workers feel they are receiving a fair deal (i.e. they obtain a higher wage), they seem more likely to provide higher level of effort. According to Charness (2004, p.666), self – interested workers 'never sacrifice to help the employer when a low wage is intentional.' The idea that fairness is important in such a context has also been underlined by the 'gift-exchange' model analyzed by Akerlof (1982), in which the principal offers employment to a worker (as an offer to 'exchange gifts') and his effort

⁵ Examples are the use of receipts to customers or the practice of overstating costs of production.

level provides the size of the reciprocal gift. Other authors state that reciprocal altruism⁶ (see, for example, Rabin, 1993) and social forces (see, for example, Fehr et al., 1998) play a major role in this context. However, although these studies find that effort level tends to be higher at higher wage, they do not establish if this result is a consequence of trust and reciprocity. These elements seem to be very important since individuals are inclined to respond in kind. According to Guth et al. (1998) reciprocity relies on a sequential interactive decision process in which there is a party moving second that ‘reciprocate’ the party moving first (which chooses an action that makes sense only when it is reciprocated). Some experimental studies show, for example, that workers respond more negatively when the wage reduction is voluntarily chosen by the management than when the wage reduction is a consequence of the lower wealth of the business (i.e. Kahneman et al., 1986). Therefore, it is possible to conclude that the different perceptions of fairness seem to affect the agent’s performance when the choice of the effort level voluntary occurs. In particular, workers will not behave in the interest of the firm if they feel they are unfairly treated.

The experiment that will be presented further below, adapts the Charness (2004) experiment, using a simulated labor market and different treatments (depending on whether evasion occurs or not), in which wages are determined by a principal (owner of the firm) according to a linear remuneration scheme.⁷ As the aim of this study is to investigate the impact of tax evasion on the internal control of firms, the analysis uses a different elaboration of the model provided by Chen and Chu (2005), and three hypothetical scenarios are compared.⁸ In particular, it is considered a benchmark situation in which there is no evasion and other two scenarios in which the principal evade taxes and receive

⁶ Reciprocal altruism refers to the idea that people when behave in a certain manner take into consideration the actions and intention of others.

⁷ Assuming linear remuneration contracts, the manager’s compensation is a function of a fixed wage component defined (*ex ante*) before production takes place, and a flexible transfer (i.e. a ‘bonus’) to be made (*ex post*) after production is observed (by the owner of the firm), using a certain parameter which measures the intensity of the incentive to the manager to produce the output. Linear contracts are commonly used in the ‘real world’ (e.g. in agriculture) and have the peculiarity of being self-enforcing since they are designed for the parties to have economic incentives to honor them under all contingencies.

⁸ It has been decided to exclude from the analysis the situation in which the principal evade taxes and receives a penalty and the manager is not responsible for evasion since this situation would have not added much to the results (i.e. the relationship between wage and effort) expected from a scenario in which both parties are honest.

a penalty and the agent is respectively ‘indirectly’ and ‘directly’ liable for evasion.⁹ Specifically, the second scenario considers a situation in which the agent does not directly receive a penalty from the tax authorities, but he/she may lose all (or part) of the incentive he/she would obtain after production is realized given the fact that the principal can use this income to pay his/her fine. This hypothetical scenario, which could be that of a firm which, after being caught, faces bankruptcy, is not considered by the Chen and Chu model. It has been added into the analysis for comparison with the more common situation in which the manager is ‘directly’ liable for evasion and receives an additional amount of income (i.e. a ‘risk premium’) for the risk of being detected by the tax authorities (i.e. a possible fine). In addition, it serves to emphasize the consequences of introducing uncertainty into the principal-agent relationship.

The Charness study, as well as previous experiments in this area, does not analyze the principal-agent relationship in a context of tax evasion. Therefore this study can be considered the first one to address tax evasion as a causal attribution of different outcomes in an exchange situation. In general, according to the literature, if intuitively, it is possible to expect that this reciprocity model¹⁰ will reflect the prediction that kindness (i.e. effort level) is proportional to the size of the gift (i.e. the wage); on the other hand, when the risk of evasion exacerbates the unequal repartition of payoffs between the economic agents, it can be predicted that the effort level of the manager will be lower than that in a situation in which there is honesty. This is in accordance with Fehr and Schimdt (1999), which develop the notion of self-centered inequality aversion and state that individuals generally dislike inequalities, but they care more about this when they are in a relative disadvantageous situation (i.e. they have a lower payoff if compared to others). Furthermore, according to Charness (2004), exogenous wages would be not considered as gifts, thus the effort

⁹ From now on ‘principal’ and ‘owner’ will be used interchangeably. The same will be done for ‘agent’ and ‘manager.’

¹⁰ The experimental design (described in the following section) provides the interaction between an agent and a principal in a sequential structure.

choice should be influenced by the causal attribution, and the effort/wage relationship should vary across treatments.

4. Experimental design

Participants were students recruited by posting notices at the Universities of Florence and Siena (Italy) in December 2008 and January 2009. A total of 48 subjects participated to the experiment: 24 were named ‘owner’ and the other 24 had the ‘manager’ designation. Average earnings were 10 euros for about 60 minutes of time.¹¹

There were, in general, 8 owners and 8 managers in a session with 10 periods. The experiment was run using computer-aided game designed for this specific purpose and considering a between – subject design (that varies levels of the focus variable across subjects).¹² Owners and managers all met in a room. After a brief introduction to the experiment, roles were randomly assigned to participants and remained anonymous until the end of the game. Furthermore, owners and managers were matched only once in order to avoid problems of reputation-formation.

The experiment was performed as follows. At the first stage owners chose an incentive coefficient (between 0 and 100, inclusive), which was assigned to the paired managers. Once received the incentive coefficient, each manager was asked to choose an effort level (between 0.1 and 1.0, inclusive), that appeared on the screen of the principal. All participants were allowed to calculate the payoffs obtained for each incentive coefficient/effort choice. Then, if, in the third stage, owners confirmed the offered incentive coefficient (chosen at the first stage), payoffs were calculated. On the other hand, if they changed the incentive coefficient, a new stage took place. In this case managers were called to accept (agreement) or reject (strike) the final incentive coefficient and

¹¹ Instructions are available from the authors on request.

¹² That is, each owner and manager was only in one experiment. This design was employed in order to avoid problems of uncontrolled nuisances since subjects cannot be influenced by a learning strategy developed in previous sessions.

consequently to pay the level of effort chosen at stage two.¹³ The combination of incentive coefficient and effort level in each period determined monetary payoff for each pair of subjects that were cumulated at the end of the game. However, if in the final stage the manager refused the incentive coefficient offered by the paired owner both did not receive any income (adding no benefits to the total payoff).

The outcomes were calculated according to different functions for each treatment considered. Each owner received an initial endowment of 120 in each period. According to the pre-existing principal-agent experimental literature, it was assumed that the parties were risk-neutral. A basic framework¹⁴ was used as a benchmark for a comparison with other two treatments in which evasion was considered. In particular, when there was no tax evasion, the monetary payoffs of the parties were calculated according to:

$$\pi_o = (120 - w) * e, \quad (1)$$

$$\pi_m = w - C(e), \quad (2)$$

where O represents the *owner*, M the *manager*, e denotes the manager's effort, w is the wage given by the linear scheme $w = a + be$ ¹⁵, in which a is the fixed wage component equal to 20 and b is the flexible wage component (defined between a minimum of 0 and a maximum of 100, inclusive),¹⁶ and $C(e)$ is the cost of effort, a function increasing in e . The latter is expressed by the relation:¹⁷

¹³ A comparison across treatments is, therefore, allowed considering the pairs incentive coefficient/effort at stages one and two.

¹⁴ This framework was used by Charness (2004) and it is replicated here in order to allow comparisons. However, it is not considered, as it is done by the author, any additional fixed cost to be subtracted by the manager's payoff.

¹⁵ In order to simplify the analytical treatment of the payoff functions and in contrast with what is usually done in the economic literature of principal-agent models it was decided to omit the manager's productivity, such that the incentive coefficient is given by an integer (i.e. b) rather than a percentage (to be multiplied for the manager's productivity). In addition, taxes were excluded from the owner's payoff, since they were not relevant for the aspects this study wants to analyze.

¹⁶ The values of the fixed and flexible wage component were defined according to Charness (2004). In particular, the author considered a fixed wage chosen by an employer or alternatively by an external process that varies between 20 and 120 (inclusive). According to this, it is assumed that with a minimal effort level the manager earns at least a wage

<i>Effort</i>	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1
<i>Cost</i>	0	1	2	4	6	8	10	12	15	18

It is important to note that according to these functions the owner's return is large (low) the larger (lower) the level of efforts and the lower (higher) the incentive coefficients are.¹⁸

Before proceeding with the experiment, the payoff functions as well as the relationship between efforts and costs were shown to participants. They were allowed to run some practice periods without payment to ensure that they understood the payoff and the game mechanism. In order to make sure subjects were not influenced by ethical considerations (i.e. moral constraints), at the beginning of the game it was decided not to inform them that they were involved in an experiment on tax evasion.

The same treatment was maintained throughout the entire session, although each treatment differed about the payoff-generating mechanism. In particular, when evasion was considered into the analysis and in the case in which the manager was 'indirectly' punished for evasion the payoffs were calculated according to:¹⁹

$$\pi_o = (120 - w) * e + p(be) - p(20 + M), \quad (3)$$

$$\pi_m = w - C(e) - p(be), \quad (4)$$

of 20 (assuming $b = 0$ and $e = 0.1$), and, when b reaches its maximum level ($b = 100$), with the maximum effort level ($e = 1$), the manager earns a wage of 120.

¹⁷ This functional form was used by Fehr et al. (1998) and Charness (2004). It guarantees that effort costs are increasing in e and that profits are non-negative. In addition, it ensures that higher levels of effort generate greater joint income.

¹⁸ For example, at $b = 10$, efforts of 0.1 gives (Owner, Manager) material payoffs (9.9, 21); and efforts of 0.5 yields (47.75, 19). At $b = 50$, efforts of 0.1 gives (Owner, Manager) material payoffs (9.5, 25); and efforts of 0.5 yields (37.5, 39).

¹⁹ Expressions (3) and (4) are obtained respectively from:

$$\pi_o = (1 - p)(120 - w) * e + p[(120 - w) * e + be - (20 + M)] \text{ and}$$

$$\pi_m = (1 - p)(w - C(e)) + p(a - C(e)).$$

where w , e and $C(e)$ are defined as in the first treatment, p is the audit probability (assumed to be equal to 0,3), $p(be)$ is the flexible wage component, which is added to the principal's payoff and detracted from the manager's payoff with probability p , and the last term in the left-hand side of the owner's payoff represents the penalty faced when evasion is detected (that is given by the amount evaded, 20, plus a fine which is assumed to be $M = 3*20$).²⁰

When the manager was 'directly' liable for evasion the monetary payoffs were given by:²¹

$$\pi_o = (120 - w) * e - PR - p \left(20 + \frac{1}{2} M \right), \quad (5)$$

$$\pi_m = w - C(e) + PR - p \left(\frac{1}{2} M \right), \quad (6)$$

where w , e , $C(e)$, p , and M are defined as described in the previous treatments, PR is the risk premium the manager receives in order to under-report profits and the fine is equally divided between the parties (i.e. each agents pays an amount $\frac{1}{2} M$ when evasion is detected, although the owner faces an additional cost for evasion given by the amount evaded, 20).

In all cases, the wage offered to the manager (by choosing the incentive coefficient) was subtracted by the initial endowment of the principal. When the experiment was concluded participants were paid privately. If psychological aspects are important (i.e. reciprocity and fairness), it can be predicted to find deviations from pure money maximization results, in which managers always select the minimum effort level.

²⁰ The values of the probability of being detected from the tax authorities and the fine were chosen according to previous studies on individual's tax evasion (see, for example, Bernasconi and Mittone, 2003).

²¹ Expressions (5) and (6) are obtained respectively from:

$$\pi_o = (1 - p) \left[(120 - w) * e - PR \right] + p \left[(120 - w) * e - PR - \left(20 + \frac{1}{2} M \right) \right] \text{ and}$$

$$\pi_m = (1 - p) \left(w - C(e) + PR \right) + p \left(w - C(e) + PR - \frac{1}{2} M \right).$$

5. Results

It was expected that the level of efforts varied across treatments and in particular it was lower in the case in which evasion was considered. However, assuming risk neutrality and consequently that the manager was fully insured for the risk of evasion, the risk premium in the third treatment was given by:

$$PR = p \frac{1}{2} M, \quad (7)$$

which led, with the appropriate substitutions, to the following payoffs:

$$\pi_o = (120 - w) * e - p(20 + M), \quad (8)$$

$$\pi_m = w - C(e). \quad (9)$$

Comparing equations (2) and (9), the relationship between wage and effort in the third treatment would have not added much to the results expected from the first treatment. For this reason, it was decided not to run an experiment using this scenario and to compare the second treatment with a new situation in which the manager was still ‘indirectly’ liable for evasion but it was assumed to be risk-adverse.

The payoff scheme was, thus, given by:

$$\pi_o = (120 - w) * e + p(be) - p(20 + M), \quad (10)$$

$$\pi_m = (1 - p)(\sqrt{w}) + p(\sqrt{a}) - C(e), \quad (11)$$

where w , e , p , M and $C(e)$ are defined as described above (see section 4), and the condition (11) represents an additive function of the agent's utility of income²² minus the disutility of his/her effort.

Therefore, results are referred to the following treatments: Treat1, in which there is no evasion; Treat2, in which there is evasion, the manager is 'indirectly' liable for evasion and risk-neutral; and Treat3, in which there is evasion, the manager is 'indirectly' liable for dodging taxes and is risk-adverse (see Table 1).

Table 1: Summary of the experimental design

Treatment	Description	N. of participants
Treat1	No-evasion	16
Treat2	Evasion, manager 'indirectly' liable and risk-neutral	16
Treat3	Evasion, manager 'indirectly' liable and risk-adverse	16

According to predictions, results (see, Table 2 and Figure 1) indicate that efforts are higher in the first two treatments than in the third one (on average they are almost three times the values of efforts in Treat3). The increase of effort over time is higher in Treat1 (25%) than in the second treatment (11.1%), while the decrease of effort in Treat3 is almost 41.2%.

The difference between average effort of the first two treatments is minimal until the sixth period (see Table 2), but it seems to increase more towards the end of the session. The highest effort is recorded in the 7th period in Treat1 (0.75), in the 9th period in Treat2 (0.85), and in the 1st period in Treat3 (0.34).

²² The square root guarantees that the agent's utility function is increasing in income and concave (that is the agent is risk-adverse).

In the first stage of the experiment, average offered incentive coefficient (see, Table 2 and Figure 2) increases in Treat1 (75.33%), in Treat2 (96.35%) and to a larger extent in Treat3 (the average incentive coefficient offered in period ten is more than twice the level offered in the first period). By taking into account the difference between the average incentive coefficient offered in period one and the highest offered average incentive coefficient in all the treatments, the increase is larger in Treat3 (almost three times the value offered in the first period) than in the other two treatments (more than twice the value offered in period one for Treat2, and 79.3% for Treat1). Average incentive coefficient reaches its maximum level in Treat2 (i.e. the total average values are: 54.05 for Treat1, 54.63 for Treat2, and 45.86 for Treat3). The highest value is recorded in the 9th period for Treat1 and Treat2 (respectively given by 67.25 and 69.88), and in the 2nd period for Treat3 (58.50).

Table 2: Incentive coefficient offered by owners vs agents' effort by period

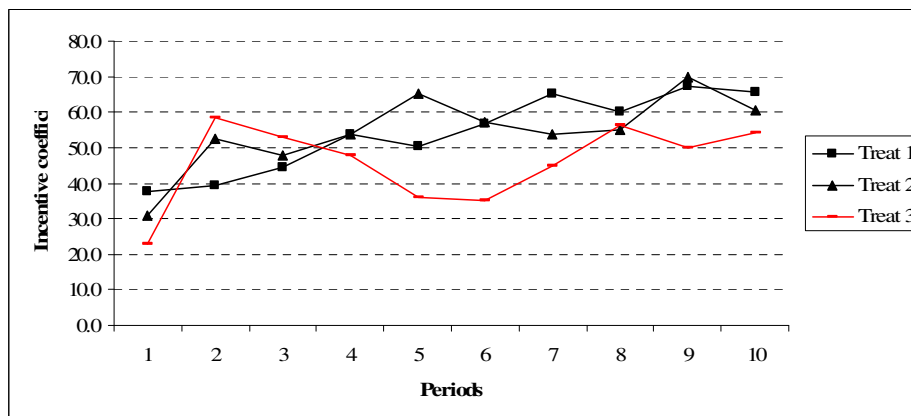
Period	No evasion		Manager 'indirectly' liable and risk-neutral		Manager 'indirectly' liable and risk-adverse	
	Effort	Inc. Coeff	Effort	Inc. Coeff	Effort	Inc. Coeff
1	0.56	37.50	0.63	30.75	0.34	22.75
2	0.64	39.50	0.60	52.38	0.29	58.50
3	0.60	44.25	0.60	47.88	0.33	52.88
4	0.66	53.88	0.69	53.88	0.23	47.88
5	0.60	50.38	0.69	65.13	0.26	36.13
6	0.63	56.63	0.66	57.25	0.30	35.13
7	0.75	65.25	0.58	53.88	0.23	44.88
8	0.69	60.13	0.53	54.88	0.25	56.38
9	0.64	67.25	0.85	69.88	0.21	50.00
10	0.70	65.75	0.70	60.38	0.20	54.13
Average	0.65	54.05	0.65	54.63	0.26	45.86

Note: the table considers average values of effort and incentive coefficient (offered at stage one of the experiment) by period in all treatments.

Figure 1: Average effort by period



Figure 2: Average incentive coefficient by period



Note: average incentive coefficients refer to those offered at stage one of the experiment.

In general, all treatments show a positive relationship between incentive coefficients offered by owners at stage one of the experiment and efforts (see Table 3 and Figure 3). Efforts are distributed such that subjects seem not to act with the purpose of pure money-maximization (by selecting the minimum effort level) showing, in general, a contingent willingness to cooperate for the common welfare (choosing higher effort level with a higher incentive coefficient).

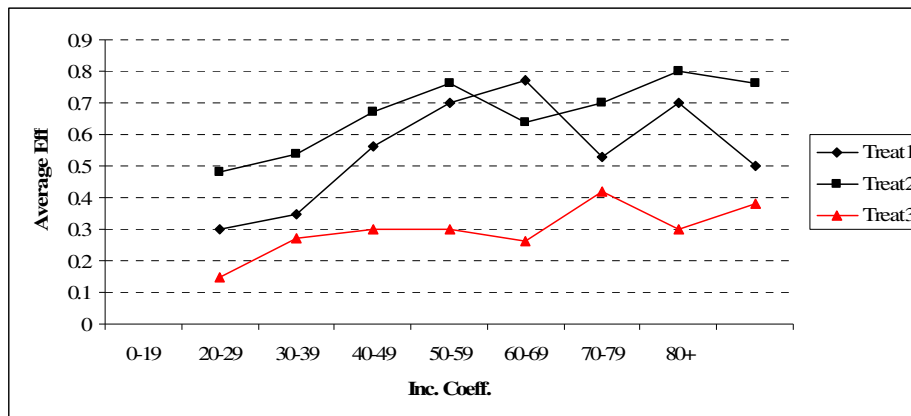
Table 3 presents a summary of the data in each treatment, aggregated by incentive coefficient brackets so that each cell includes at least 10 observations. Detailed results are reported in Appendix 1.

Table 3: Average effort by incentive coefficient bracket and treatment

	Treat1	Treat2	Treat3
Inc. coeff. bracket	Effort	Effort	Effort
0-19	0.30 (15)	0.48 (3)	0.15 (17)
20-29	0.35 (11)	0.54 (8)	0.27 (13)
30-39	0.56 (13)	0.67 (8)	0.30 (7)
40-49	0.70 (20)	0.76 (32)	0.30 (2)
50-59	0.77 (12)	0.64 (20)	0.26 (9)
60-69	0.53 (2)	0.70 (3)	0.42 (4)
70-79	0.70 (4)	0.80 (4)	0.30 (3)
80+	0.50 (3)	0.76 (2)	0.38 (25)
Average	0.55 (80)	0.67 (80)	0.30 (80)

Note: the table reports the level of effort offered by managers in the second stage of the experiment. The number of observations in each cell is illustrated in parentheses. Incentive coefficients refer to those offered at stage one of the experiment.

Figure 3: Incentive coefficient vs average effort



Note: the values of incentive coefficient are those offered by owners in the first stage of the experiment.

As shown by the table, in the lowest incentive coefficient bracket average effort is considerably lower in Treat3 than in the other treatments. Comparing the 0-19 and the 80+ brackets, it can be seen that average effort increases by 66.6% in Treat1, by 58.3% in Treat2, and in Treat3 the increase is more than twice the level of average effort in bracket 0-19. However, at the highest incentive coefficient bracket (80+), effort levels in Treat3 are no higher than the other two treatments, although positive reciprocity would lead to the prediction of a large gap. The highest average effort level is recorded in the 50-59 bracket for Treat1 (0.77), in the 70-79 bracket for Treat2 (0.80), and in the 60-69 bracket for Treat3 (0.42).

The distribution of chosen effort and offered incentive coefficient is similar in the first two treatments, while it is more asymmetrical for Treat3 (see Figures 4-5). As shown by Figure 4, in Treat1 the effort level with the highest number of observations (mode) is 0.9, in Treat2 is 1, and in Treat3 is 0.3. Furthermore, according to Figure 5, in Treat1 and Treat2 the intermediate incentive coefficient bracket 40-49 is the range more frequently chosen in the data-set (respectively 40% and 25% for the first two treatments), while in Treat3 is the incentive coefficient bracket 90+ (22.5%).

Analyzing results from Tables 2 and 4, incentive coefficients offered by owners in the third stage of the experiment are usually lower than in the first one for Treat1 and Treat2, while they follow almost the same pattern in Treat3 (see Figure 6). In particular, the total average incentive coefficient decreases in the third stage by 17.4% in Treat1 and by 32.9% in Treat2, while it increases by 8.1% in Treat3. In addition, as it can be seen from Figure 7, values are in general higher in Treat3.

By comparing the average payoffs by period, these are higher in the first two treatments than in Treat3 (see Table 5). Specifically, Treat1 and Treat2 seem to show an equal share of payoffs between principals and managers (the total average payoffs for principals and managers are respectively 40.01 and 39.95 for Treat1 and 22.81 and 25.27 for Treat2). However, in Treat3 managers' payoffs are always higher than those of principals.

Figure 4: Effort by treatment

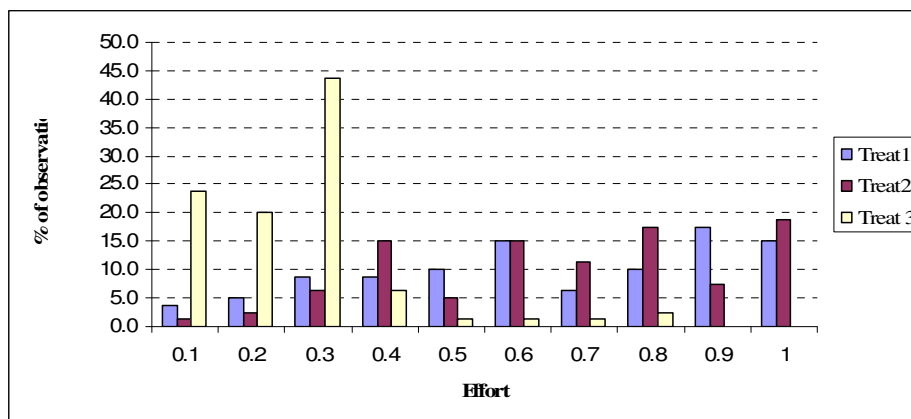
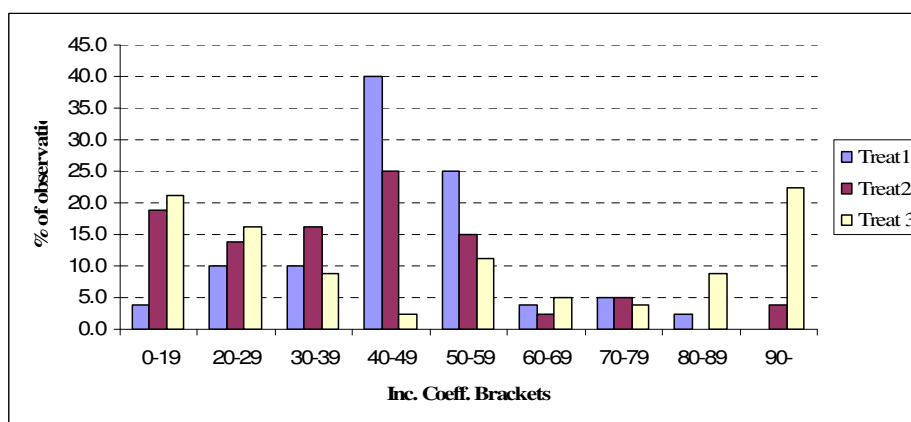


Figure 5: Incentive coefficient by treatment



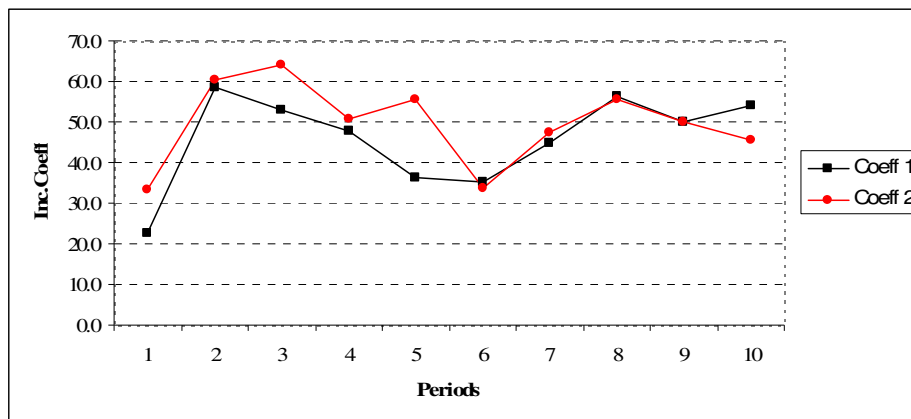
Note: the values of incentive coefficient are those offered by owners in the first stage of the experiment.

Table 4: Incentive coefficient offered by owners in the third stage by period

	Treat1	Treat2	Treat3
Period	Inc. Coeff.	Inc. Coeff.	Inc. Coeff.
1	36.13	40.13	33.38
2	38.50	34.38	60.38
3	46.13	45.25	64.00
4	43.50	29.25	50.63
5	48.75	37.00	55.38
6	43.50	38.63	33.63
7	51.00	48.50	47.50
8	43.75	29.75	55.38
9	46.00	34.00	50.13
10	49.25	29.38	45.63
Average	44.65	36.63	49.60

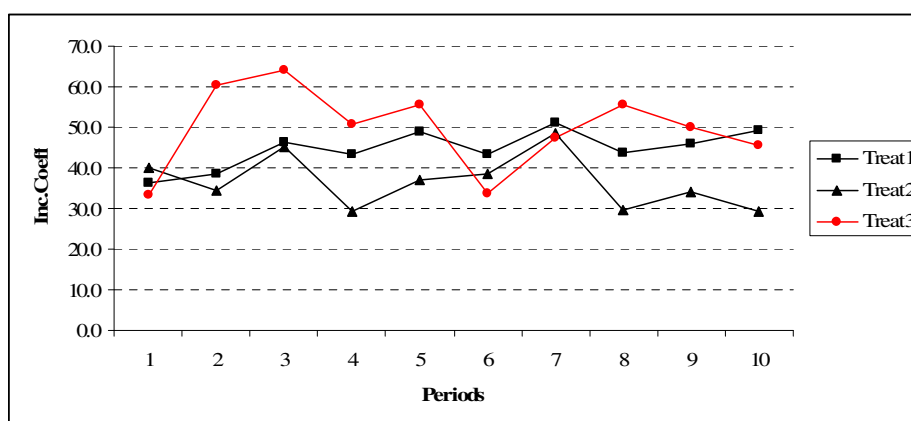
Note: the table considers average incentive coefficient offered by owners at stage three of the experiment.

Figure 6: Average incentive coefficient by period in Treat3



Note: the values of average incentive coefficient (by period) are those offered by owners in the first and third stage of the experiment for Treat3, namely Coeff1 and Coeff2, respectively.

Figure 7: Average incentive coefficient by period for all treatments



Note: values are referred to average incentive coefficient by period offered by owners in the third stage of the experiment.

Table 5: Average payoffs by period

Period	No evasion		Manager ‘indirectly’ liable and risk- neutral		Manager ‘indirectly’ liable and risk- adverse	
	Principal	Manager	Principal	Manager	Principal	Manager
1	35.93	35.60	30.75	27.00	2.79	2.92
2	34.99	33.14	23.75	29.24	2.95	3.40
3	39.99	39.59	15.56	22.06	5.42	3.01
4	42.62	40.53	19.30	21.20	-1.08	3.95
5	39.96	40.50	31.33	29.25	1.54	3.47
6	40.41	39.41	29.90	30.33	4.65	2.55
7	45.21	47.10	19.22	31.78	-0.72	3.90
8	38.38	37.84	18.60	25.86	1.22	3.79
9	41.16	40.73	16.39	15.48	-2.55	4.04
10	41.46	45.11	23.34	20.51	-6.62	3.82
Average	40.01	39.95	22.81	25.27	0.76	3.49

Note: the table reports the average managers’ and principals’ payoffs by period.

As it can be seen from Figures 8-9, over time average principals' and managers' payoffs increase in Treat1 (by 15.4% and by 26.7%, respectively), decrease in Treat2 (by 24.1% and by 24.03%, respectively), and follow an opposite direction in Treat3 (if over time average principals' payoffs decrease becoming negative, managers' payoffs increase by 30,8%). Furthermore, highest average payoffs are recorded in Treat1.

Considering the total number of strikes by period (see Table 6), these are higher in Treat2 (9) than in the other two treatments (2). In particular, the highest number of strikes is recorded in the 9th period in Treat2.

Figure 8: Average principals' payoffs by period

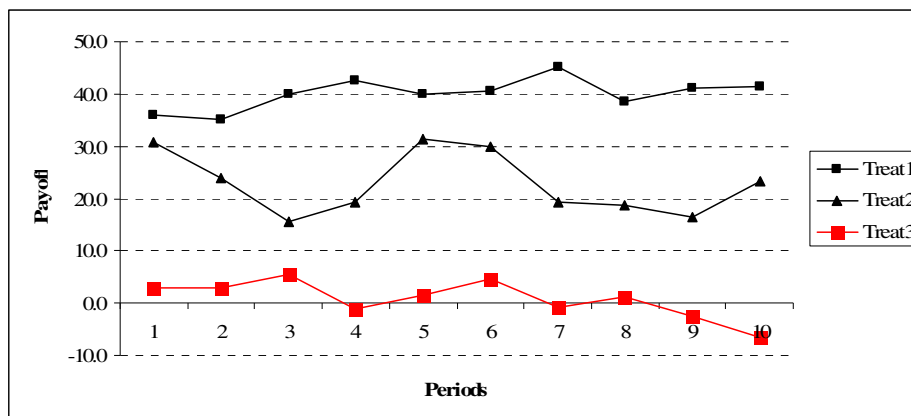


Figure 9: Average managers' payoffs by period

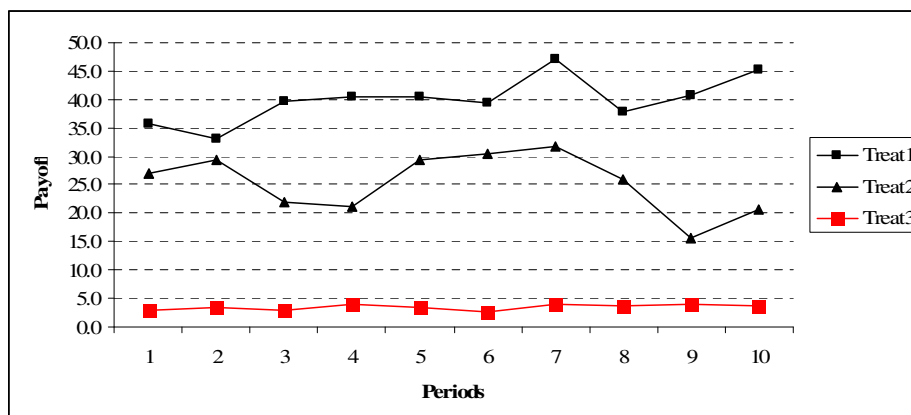


Table 6: Strikes by period

	Treat1	Treat2	Treat3
Period	N. of strikes	N. of strikes	N. of strikes
1	0	0	1
2	1	0	0
3	0	2	0
4	0	2	0
5	0	0	0
6	0	0	0
7	0	0	0
8	1	0	0
9	0	3	0
10	0	2	1
Tot. strikes	2	9	2
Tot. Subjects	16	16	16
Tot. pairs	8	8	8

Note: the number of strikes refers to the number of times a manager rejects the offered incentive coefficient in the final stage.

6. Discussion

According to the pre-existing experimental literature of principal-agent (Charness, 2004; and Fehr et al., 1998), results of all treatments indicate a positive relationship between effort and wage (obtained by choosing incentive coefficient), which is significant in Treat1 (at the 1% level) and to a lower extent in Treat3 (at the 10% level), although it is not significant in Treat2 (see Table 7).

Incentive coefficients, efforts and payoffs are, in general, higher in the first two treatments than in Treat3 providing evidence that the structure of the experimental design good predicted individuals' behaviour when evasion and risk aversion were introduced in the analysis and that the latter lead to a suboptimal efficiency. In other words, it can be argued that when uncertainty plays a role in agency dilemma, individuals are less willing to spend effort in order to increase production and principals' welfare.

Table 7: OLS regression results: effort vs incentive coefficient

Independent variable	Effort (Dependent variable)					
	Treat1		Treat2		Treat3	
	Coefficient	t-statistics	Coefficient	t-statistics	Coefficient	t-statistics
Incentive Coefficient	0.0077***	3.86	0.0018	1.53	0.0008*	1.84
Constant	0.29***	3.19	0.58***	11	0.22***	7.98
<i>F</i> -statistics	14.93 (0.000)		2.35 (0.129)		3.37 (0.07)	
<i>R</i> -squared	0.16		0.02		0.04	
<i>Adj R</i> -squared	0.14		0.01		0.02	

Note: regression results using OLS in Stata. Number of observations: 80. ***significant at 1% level; ** significant at 5% level; *significant at 10% level. The table also reports the *F*-statistics, the R^2 and the *Adj R*² for the goodness of fit of the model. The p-values for the *F*-statistics are reported in parentheses.

Given these considerations, it is not surprising that reciprocity and fairness seem to matter more for the first two treatments than for Treat3. According to Charness (2004), reciprocity is a ‘learned phenomenon’ that is stronger when considering a homogeneous population. As it can be seen from Table 3, although in the third treatment the values of incentive coefficient offered by principals may appear large, they usually lead to low effort level if compared with the other two treatments. Specifically, an incentive coefficient of 80 (or more) leads to an average effort level that is further below that offered in Treat1 and Treat2. This may be attributed to nonreciprocal considerations which lead agents not to behave in the interest of the firm (Charness, 2004), giving support to the prediction of loss of internal control. In addition, comparing Tables 2 and 4, in Treat3 average incentive coefficient offered by principals in the third stage of the experiment are considerably higher than in the first one, even if their differences tend to diminish near the end of the session (see Figure 6). A possible explanation can be given by the fact that principals tend to respond to an initial lower level of effort provided by agents increasing the incentive coefficient in the first and third stage of the experiment. Nevertheless, since the level of effort decreases over time (see Figure 1), principals react maintaining (from the sixth period) the value of the incentive coefficient offered in the third stage close to that at stage one.

In contrast, participants seem to develop a learning-strategy in Treat1 and Treat2 as made evident by deadline effects (see Figures 2 and 7) and the occurrence of highest incentive coefficient and effort in the next-to-last period. In particular, it seems that managers understand (since they decrease their offered effort from period seven - see Table 2) that principals in the third stage of the experiment tend to reduce incentive coefficients offered at stage one. As a result, agents offer a lower level of effort leading principals to boost again the values of incentive coefficient in order to obtain higher gains toward the end of the game.

Considering the experimental payoff structure, results show that outcomes reach an equitable distribution in the first two treatments. This may be due to the assumption of risk neutrality of the parties, providing that, although evasion is considered in the analysis, when individuals are risk-neutral they behave in a similar manner in the two alternative treatments. However, payoffs are lower in Treat2 than in Treat1, but this can be a consequence of the functional forms chosen for the payoff-generating mechanism.

A possible concern in principal-agent experiments is represented by repeat-game effects. In particular, one explanation of costly effort provision and higher level of incentive coefficient can be respectively that agents and principals are attempting to develop a reputation. Although the design of the experiment would try to rule out individual reputations, it could still be possible that subjects would try to develop one. This can be checked by testing for changes in subjects' choices over time. In particular, if reputation were important it should be expected the level of effort and the difference between incentive coefficients offered at stage one and three of the experiment to decrease near the end of the session. Regression results (see Table 8) using OLS (Ordinary Least Square) show that average effort decreases (by 0.013) with time in Treat3 at a statistically significant rate (at the 1% level) and follows an increasing pattern in the other two treatments although it is not statistically significant for Treat2.

Table 8: OLS regression results: average effort by period

Independent variable	Effort (Dependent variable)					
	Treat1		Treat2		Treat3	
	Coefficient	t-statistics	Coefficient	t-statistics	Coefficient	t-statistics
Period	0.012**	2.51	0.01	1.04	-0.013***	-3.99
Constant	0.58***	19.25	0.59***	9.94	0.33***	16.38
F-statistics	6.29		1.09		15.92	
	(0.036)		(0.326)		(0.004)	
R-squared	0.44		0.12		0.66	
Adj R-squared	0.37		0.01		0.62	

Note: regression results using OLS in Stata. Number of observations: 10. ***significant at 1% level; ** significant at 5% level; *significant at 10% level. The table also reports the F -statistics, the R^2 and the Adj R^2 for the goodness of fit of the model. The p -values for the F -statistics are reported in parentheses.

Table 9 shows that the values of the difference between incentive coefficients offered in the first and third stage of the experiment (defined as ' $Coeff1 - Coeff2$ ') tend to increase over time in all treatments.

Table 9: Difference between incentive coefficients offered at stage one and three of the experiment

Period	Treat1	Treat2	Treat3
	(Coeff1-Coeff2)	(Coeff1-Coeff2)	(Coeff1-Coeff2)
1	1.38	-9.38	-10.63
2	1.00	18.00	-1.88
3	-1.88	2.63	-11.13
4	10.38	24.63	-2.75
5	1.63	28.13	-19.25
6	13.13	18.63	1.50
7	14.25	5.38	-2.63
8	16.38	25.13	1.00
9	21.25	35.88	-0.13
10	16.50	31.00	8.50

As it can be seen from Table 10, the increase is statistically significant in Treat1 and Treat2, and to a lower extent in Treat3 (at the 10% level).

Table 10: OLS regression results: ‘Coeff1 – Coeff2’ by period

Independent variable	‘Coeff1 - Coeff2’ (Dependent variable)					
	Treat1		Treat2		Treat3	
	Coefficient	t-statistics	Coefficient	t-statistics	Coefficient	t-statistics
Period	2.37***	5.27	3.23**	2.67	1.61*	2.23
Constant	-3.67	-1.31	0.2	0.03	-12.61**	-2.81
F-statistics	27.79		7.14		4.96	
	(0.000)		(0.028)		(0.056)	
R-squared	0.77		0.47		0.38	
Adj R-squared	0.74		0.40		0.30	

Note: regression results using OLS in Stata. Number of observations: 10. ***significant at 1% level; ** significant at 5% level; *significant at 10% level. The table also reports the *F*-statistics, the R^2 and the Adj R^2 for the goodness of fit of the model. The p-values for the *F*-statistics are reported in parentheses.

According to these considerations, it seems that in Treat3 managers attempt to develop a reputation. In order to test the robustness of these results, it was decided to run two additional regressions considering pooled values of effort and ‘*Coeff1 - Coeff2*’ by period in all treatments (see Table 11). Results suggest a positive relationship between these variables and the time coefficients; however the relationship is insignificant for effort and significant for ‘*Coeff1 - Coeff2*.’ Therefore, the presence of a substantial time trend (see Figure 1 above) and the comparison across regressions seem to confirm reputation effects in Treat3. These results also strengthen the conclusion that when there is evasion and managers are risk-adverse they are more likely to behave in opportunistic way in order to maximize their utility.

Table 11: Pooled OLS regression results

Independent variable	Effort (Dependent variable)		'Coeff1 - Coeff2' (Dependent variable)	
	Coefficient	t-statistics	Coefficient	t-statistics
Period	0.003	0.24	2.40***	3.19
Constant	0.50***	6.42	-5.35	-1.14
F-statistics	0.06 (0.812)		10.17 (0.003)	
R-squared	0.00		0.26	
Adj R-squared	-0.03		0.24	

Note: regression results using OLS in Stata. Number of observations: 30. ***significant at 1% level; ** significant at 5% level; *significant at 10% level. The table also reports the F -statistics, the R^2 and the Adj R^2 for the goodness of fit of the model. The p-values for the F -statistics are reported in parentheses.

Table 2 shows that the average incentive coefficients chosen by principals vary much across periods. In particular, they show a significant trend upward over time. As the average incentive coefficient chosen at stage one of the experiment tends to be always above the empirically optimal incentive coefficient (50) almost in all treatments (only Treat3 from period four to seven shows values below the optimal level) it can be argued that principals had a good knowledge of how agents would have reacted and understood that higher effort level would have been expected with higher incentive coefficient choices. This result is in contrast with findings of Charness (2004) in which wages were always below the optimal level, even if employers chose nonminimum wages (guaranteeing the efficiency of the experiment).

7. Conclusions

This study considers information about individuals' behaviour in a context of corporate tax evasion. In particular, in order to investigate the relevance of tax evasion on the loss of internal control (i.e. the distorting effect of tax evasion on the provision of manager's effort) a laboratory experiment was conducted at the Universities of Florence and Siena (Italy).

The experiment, based on an adapted and developed elaboration of the Chen and Chu (2005) model, includes three different treatments: one in which there is no evasion, and other two treatments in which there is evasion and the manager is respectively 'indirectly' and 'directly' liable for evasion. It was expected that the level of efforts varied across treatments and in particular that it was lower in the cases in which evasion was considered. However, as commonly done in the standard principal-agent experimental literature, assuming risk neutrality and consequently that the manager was fully insured for the risks of evasion, the relationship between wage and effort in the third treatment would have not added much to the results achieved in the first treatment. For this reason, it was decided to compare the second scenario with a new treatment in which the manager was still 'indirectly' liable for evasion but risk-averse. According to previous findings in the literature (see, for example, Fehr et al., 1998; Charness, 2004), results show in general a positive relationship between effort chosen by agents and wage offered by principals. However, in the third treatment the introduction of risk aversion and evasion decisions leads individuals to choose a lower level of effort than in the other two treatments, providing evidence that when agents bear part of the risk for evasion they are less willing to cooperate for the wealth of the firm. According to this, reciprocity and fairness seem to matter more in the first two treatments. When subjects, in fact, are considered risk-neutral they tend to behave in a similar manner and try to push choices towards a fair distribution of payoffs, although these are always lower in the second treatment than in the first one. Results also illustrate that reputation effects seem to play a role in the third treatment giving support to the idea that, under uncertainty (generated by evasion) risk-averse individuals tend to show opportunist behavior in order to maximize their utilities. Finally, the fact that findings seem to confirm the expected predictions and participants with the role of 'principals' well understood the game mechanism (by frequently choosing higher level of incentive coefficients) seem to provide evidence that the experiment was properly designed. However, since the number of observation is limited, results must be interpreted with caution. Further improvements can be made by increasing

the sample size and performing additional experiments. Moreover, a comparison of the results shown and that obtained by considering the situation in which the manager is 'directly' liable for evasion and risk-averse could strengthen the conclusion reached. This can be object of further research, since to the knowledge of the author there are no studies of this topic.

Appendix 1

Distribution of incentive coefficient and effort

Table A1. 1: Incentive coefficient/effort pairs by incentive coefficient bracket (Treat1)

Inc. Coeff. bracket	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1	Tot	%
0-19	1			2							3	3.75
20-29	1	2	3			1		1			8	10
30-39			1	2	2		1	1	1		8	10
40-49		2	2	2	3	4	2	4	7	6	32	40
50-59					3	4	2	2	4	5	20	25
60-69	1					1			1		3	3.75
70-79			1			1			1	1	4	5
80-89				1		1					2	2.5
90-											0	0
Total	3	4	7	7	8	12	5	8	14	12	80	
%	3.75	5	8.75	8.75	10	15	6.25	10	17.5	15		

Table A1. 2: Incentive coefficient/effort pairs by incentive coefficient bracket (Treat2)

Inc. Coeff. bracket	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1	Tot	%
0-19		1	2	9					2	1	15	18.75
20-29		1	1	2	3	2				2	11	13.75
30-39			1	1	1	4		4		2	13	16.25
40-49						5	4	6	3	2	20	25
50-59	1					1	2	2		6	12	15
60-69							2				2	2.5
70-79							1	2	1		4	5
80-89												0
90-			1							2	3	3.75
Total	1	2	5	12	4	12	9	14	6	15	80	
%	1.25	2.5	6.25	15	5	15	11.25	17.5	7.5	18.75		

Table A1. 3: Incentive coefficient/effort pairs by incentive coefficient bracket (Treat3)

Inc. Coeff. bracket	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1	Tot	%
0-19	10	4	3								17	21.25
20-29	1	2	9	1							13	16.25
30-39	2	1	3					1			7	8.75
40-49			2								2	2.5
50-59	1	1	7								9	11.25
60-69			3					1			4	5
70-79			3								3	3.75
80-89	1	1	1	3	1						7	8.75
90-	4	7	4	1		1	1				18	22.5
Total	19	16	35	5	1	1	1	2			80	
%	23.75	20	43.75	6.25	1.25	1.25	1.25	2.5				

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