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Effects of Institutional History and Leniency on Collusive Corruption and Tax Evasion

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Abstract

We investigate the effects of an institutional mechanism that incentivizes tax payers to blow the whistle on collusive corruption and tax compliance. We do this through a leniency program. In our experiment we nest collusive corruption within a tax evasion framework. We not only study the effect of the presence of such a mechanism on behavior, but also the dynamic effect caused by the introduction and the removal of leniency. We find that in the presence of a leniency mechanism, subjects collude and accept bribes less, while paying more taxes. We find no evidence that it encourages bribe offers. Our results show that the introduction of the opportunity to blow the whistle decreases collusion and bribe acceptance rate, and it increases the collected tax yield. It also does not encourage bribe offers. In contrast, the removal of the institutional mechanism does not induce negative effects, suggesting a positive spillover effect of leniency that persists even after the mechanism has been removed.

Keywords: Corruption, Institutions, Whistleblowing, Tax Evasion
JEL: C91, D03, D73, H26

1. Introduction

Corruption and tax evasion are among the most pervasive forms of illicit behavior; these practices induce both negative economic and societal externalities (Banerjee, 2016a;

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Slemrod, 2007). Understanding what motivates corruption and tax evasion, and implementing suitable institutional measures to curb their severity has been at the center of the theoretical, empirical and experimental research of the past decade, originating from Allingham and Sandmo's seminal theoretical contribution on income tax evasion (Allingham and Sandmo, 1972).

In this paper we focus on the effectiveness of providing legal immunity to the bribe-giver for whistleblowing as a means to deter collusive bribery. In our experiment, corruption is embedded in a tax evasion framework in which underreporting taxes is only possible through collusive cooperation among tax payers and public officials. We study the exchange of bribes as one explicit collaboration-inducing mechanism. This has previously been found to be effective in sustaining illicit cooperation. Literature highlights the importance of studying the collaborative roots of deviant behavior due to its inherent negative economic and societal externalities (Weisel and Shalvi, 2015).

Our results shed light on the effectiveness of leniency programs as a means to reduce tax fraud and disrupt collusive relationships between public officials and tax payers. We consider a mechanism that offers tax payers a "a safe way out" by blowing the whistle on a corrupt public official and cooperating with auditors. This mechanism resembles a leniency program for tax evasion in which audited tax fraudsters can turn state's evidence. In many countries the introduction of some form of leniency mechanism represents an integral institutional feature aimed at suppressing criminal behavior, including collusion among firms (Buccirossi and Spagnolo, 2006; Abbink and Hennig-Schmidt, 2006; Bigoni et al., 2012). We are interested in examining the effects of a leniency program for tax payers on collusive bribery and tax evasion. We contribute to the corruption and tax evasion literature by demonstrating how collusive tax evasion is affected by the strategic interaction of a tax payer and an intermediary (in our experiment a tax officer), a dimension not present in individual tax evasion.

While most of the economic research on corruption and tax evasion has focused on the deterrence of income tax evasion or its related variants, other forms of tax evasion where taxes are in some way collected through a third party have received little attention; trade, import or custom tax evasion is one such example, as taxes, in the form of custom duties, are collected not by a national revenue service, but by an intermediary customs or duties officer (Banuri and Eckel, 2012). This is particularly true for the case of "corruption within tax evasion." Existing experimental studies have, for example, focused on the role fear of discovery or public disclosure play in deterring tax evasion (Orviska and Hudson, 2003; Bø

et al., 2015).

In a related setting, Abbink and Wu (2017) studied whether rewarding self-reports is effective in reducing collusive bribery. They found this mechanism to be effective in some circumstances, especially during repeated interactions. However, they studied different mechanisms with a focus on rewards for reporting. We focus on the shifting risk of exposure between two colluding parties. In our experiment bribe-givers face the following two decisions: one, whether and how much to bribe and, two, how much to declare in tax filings, (the determinant of the consequences of bribery). Christöfl et al. (2017) studied the efficacy of leniency policies. In a setup where two bidders compete for a contract, they looked at the possibility of cooperation with the authorities (principal witness) in combination with a leniency policy that offered reduced fines for cooperation. They found a lower number of bribes when the leniency policy was present even as bribe offers became more profitable for the corrupt bidder. In line with our work, Heinemann and Kocher (2013) studied the effects of regime changes on tax compliance. Focusing on changes in the tax rate, however, they did not consider corruption or reforms that incentivize whistleblowing. By and large the economics of whistleblowing are understudied and have only recently attracted attention (see Spagnolo, 2004; Apesteguia et al., 2007; Spagnolo, 2006; Heyes and Kapur, 2009; Breuer, 2013; Schmolke and Utikal, 2016). In particular, Butler et al. (2017) studied the effectiveness of financial rewards and public scrutiny as motivators for employees to whistleblow on their managers. Their findings indicate that both financial rewards and public visibility increase the likelihood of whistleblowing (see also Bartuli et al., 2016). The recent surge in cases of whistleblowing and the lack of international institutional uniformity to achieve sufficient protection for whistleblowers renders the further study the economics of whistleblowing important (Dyck et al., 2010).

We use a controlled laboratory experiment modeling an income reporting scenario that requires the interaction between two parties, a tax payer and a tax officer, thus opening the door for collusive corruption. Our experimental design employs a collusive bribery game (Abbink et al., 2002) nested in a tax evasion scenario. In this game corrupt tax officers face little to no repurcussions for accepting bribes or for providing assistance to the tax payer who wishes to evade taxes. This mimics a situation where tax authorities do not have the means to sufficiently control the tax officers, for example, due to the institutional environment rendering enforcement of adequate consequences impossible. Excessive monitoring costs are among the reasons why authorities might be unable to detect dishonest officers.

In our basic bribery game without leniency each tax payer receives a fixed income, taxed at a fixed rate, that has to be reported to the authorities (in our case they report to a tax officer). Our design is distinctive, because underreporting requires the cooperation of the tax officer. The tax payer can offer the tax officer a bribe as a reward for his assistance in evading taxes. Tax reports are subject to audits with a known probability.[1] In the basic bribery games, detection of tax evasion during an audit results in a penalty for the tax payer, but not for the tax officer. We extended the basic bribery game to include a leniency mechanism. In order to do this we added an additional stage. The resulting bribery game with leniency follows the same rules, but it has been extended to include a potential audit. During the audit tax payers can report the corrupt tax officer and avoid the pending penalty. In this extended game, the reported tax officer incurs a fine, not the bribing tax payer. This whistleblowing mechanism offers "a safe way out" for the tax payer. The risk of being detected and fined shifts to the tax officer. Since the tax officer now faces the threat of a fine it renders her formally responsible for engaging in collusive bribery.

The goals of this study are twofold: first, we seek to analyze collusive bribery and its drivers under a regime with and without leniency; second, we investigate the effectiveness of the introduction of such a mechanism and the consequences of its removal on collusion, the frequency of bribe offers (and their size), the tax officers' willingness to accept bribes, and overall tax compliance.

Our main results can be summarized as follows: We find that in the presence of a leniency mechanism successful collusion between tax payers and tax officers is less frequent. This is mainly driven by a lower willingness of tax officers to accept bribes. Further, we find no support that leniency for tax payers encourages them to offer bribes, that is, there is no significant increase in the frequency of bribes being offered. Thus, our results suggest that leniency is effective in deterring tax officers from engaging in bribery, which translates into more taxes being collected. Our results regarding the role of institutional changes also highlight the importance of institutional history for the evaluation of policy measures. We show that the introduction of the opportunity to blow the whistle decreases

[1] Our focus is on the effectiveness of a leniency mechanism as a policy intervention. We decided to keep a fixed audit probability instead of implementing an endogenously determined audit probability, e.g. by modeling the tax authority as an additional player. For a theoretical analysis of endogenous audit probabilities see Landsberger and Meilijson (1982) or Raymond (1999). For an experimental treatment see Alm et al. (1993).

collusion, deters tax officers from accepting bribes (as reflected in a lower acceptance rate of bribe offers) and increases the tax yield collected; at the same time, it discourages bribe offers. In contrast, the removal of the institutional mechanism does not cause similar effects in the opposite direction, which suggests a positive spillover effect of leniency that persists even after the mechanism has been removed (see also d'Adda et al., 2017). This second phenomenon resembles the so called Echo Effect originally reported in Mittone (2006), which shows that in a tax payment framed experiment, the change of one of the institutional ingredients of the decisional setting, namely the introduction or the removal of fiscal audits, has no impact on tax compliance.

The paper will proceed in three sections. Section 2 describes the experimental design. Section 3 presents the analysis of our empirical results. In Section 4 we discuss our results and present some conclusions.

2. Experimental Design

Both of our institutional setups mimic a scenario where collusive bribery is nested in a tax evasion framework. Taxes are collected through an intermediary, the tax officer. Hence, to successfully evade taxes the tax payer requires the cooperation of the tax officer. For example, the tax collector must "look the other way." We now give a detailed description of the two institutional frames used in our experiment.

2.1. The Bribery Game with and without Leniency

The upper part of Figure 1 illustrates the bribery game (BG).[2] A tax payer (TP) receives an income of 80 Experimental Currency Units (ECU) and has to submit a declaration of his income to the tax authorities. The tax officer (TO), acting as an intermediary, is in charge of processing the tax report. Declared income D is subject to a tax rate of 50%.[3] The TP can decide whether he wants to truthfully declare his full income of 80 or whether he wants to evade taxes, that is, potentially declare a lower income $D \leq 80$. In order to evade taxes, the TP has to convince the TO to collude with him. To that end, the TP can offer a bribe b to the TO that can range from 0 to 30 ECU. The situation we have in mind is one where

[2]The TO only observes the bribe b, but not the declared income D as indicated by the dashed line. The stage below the dotted line is only available in the bribery game with leniency. For the sake of a simpler exposition the tax officer's fixed wage of 50 is not depicted.

[3]Subjects were informed that this tax rate is in line, according to a recent study of Confcommercio, with the mean tax burden in Italy.

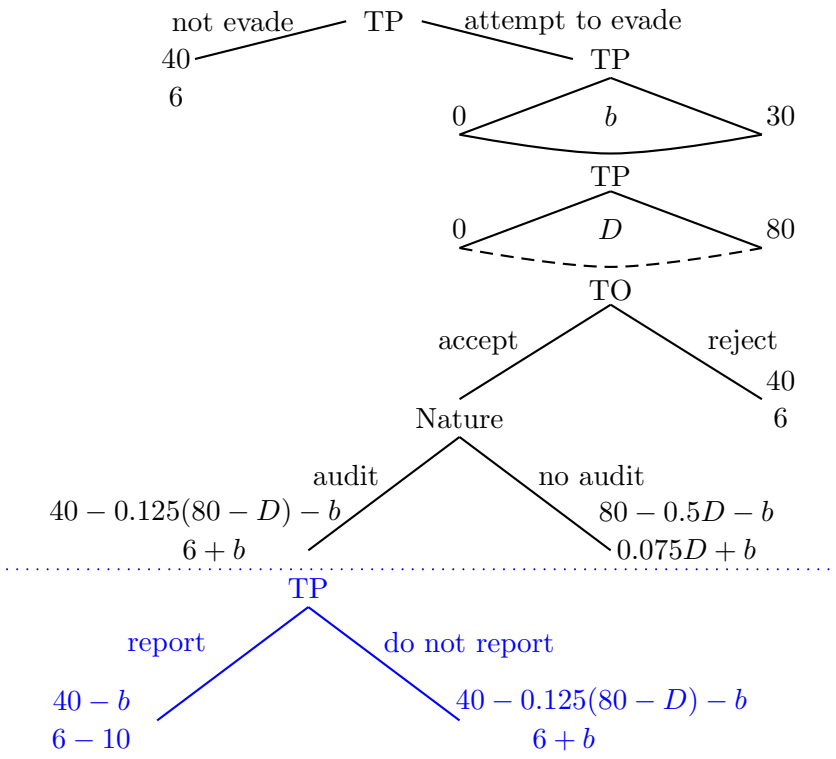

Figure 1: Representation of the bribery game (with leniency).

the TP can vastly increase the chance of his false tax declaration not being detected by colluding with the TO who is in charge of processing the report. For simplicity, we assume that it is impossible for the TP to evade taxes without the TO's support. Essentially, declaring less than the full income is only possible if the TO accepts the TP's bribe offer and thereby agrees to collude with the TP, e.g. by manipulating the report. If a bribe is offered, the TO observes the amount that is offered and can accept or reject it. It is important to note that the TO cannot observe the amount of taxes declared prior to her decision. She cannot condition her decision on the amount of taxes evaded.[4] Not informing the TO about the exact amount the TP intends to evade allows us to establish a minimal level of uncertainty regarding the TO's payoffs, which are fully determined (in the absence

[4]For example, imagine a situation where the TO does not know the actual income of the TP, an amount only known to the official tax authority conducting the audits.

of whistleblowing) by the bribe and the amount of taxes declared as described in more detail below. If the TO rejects a bribe, then she refuses to collude with the TP, forcing the TP to truthfully declare his full income of 80. Upon acceptance the TP is able file the original report declaring D.[5] Tax reports are audited by the tax authorities with an exogenous probability of 20%. If an audit detects the unreported amount, the TP has to pay both the evaded amount of taxes $0.5(80-D)$, as well as, an additional fine proportional to the amount of evaded taxes.[6] The fine is set to 25% of the evaded taxes; the maximum fine is 10 ECU. The fine rate of 25% was chosen such that, together with the upper bound (of 30) of bribe payments, the TP can never incur a net loss. Thus, the TP's payoff is his income minus taxes on the declared income D and potentially the bribe and/or fine paid. The TO's payoff consists of three components: a fixed wage of 50 ECU, a 15% commission on the taxes collected, and the amount of bribes accepted.[7]

The bribery game with leniency (BGL) is very similar to the bribery game described above, but with one important variation. In the BGL we add an additional stage to the BG intended to mimic a leniency program for whistleblowing.[8] Decisions in BGL are identical to those in BG, however, following detection of an incorrect tax report during an audit, the TP now has the opportunity to "blow the whistle" by reporting the TO. If the TP chooses to report, he has to correct the false tax report and declare taxes truthfully; he does not incur an additional monetary punishment as the fine is waived. A TO that has been reported, on the other hand, incurs a fine for colluding with the TP to evade taxes. This fine equals the bribe received from the TP plus 10 ECU penalty.

In Appendix A we analyze the one-shot bribery game with and without a leniency mechanism assuming standard preferences based on maximization of one's own payoffs. Under that assumption, attempting collusion (i.e. bribing the tax officer and evading taxes) is always optimal for a tax payer in the bribery game with and without leniency. In

[5]Note that this differs from Abbink and Wu (2017) where the tax officer is not able to pocket the bribe without delivering the corrupt favor of colluding with the tax payer.

[6]Proportional fines are an institutional feature often observed in developed countries (Mittone, 2006).

[7]The introduction of a commission for the TO mimics something existing in reality. In Italy, for example, the tax authority delegates inspections and audits to a private organization (Equitalia) and pays them a percentage of the money collected.

[8]In the BG, punishment can be viewed as asymmetric as only tax payers are running the risk of being fined. In BGL, however, leniency shifts this risk, at least partially, towards the tax officer creating a situation that might be perceived as more symmetric. See also Engel et al. (2013) for a discussion of symmetric vs asymmetric punishment regimes.

the bribery game with leniency the tax payer always reports the tax officer in equilibrium, resulting in a higher bribe acceptance threshold on the side of the tax officer. As a result, optimal bribe offers are higher when leniency is in place. Recall that the tax officer is only able to observe the bribe, but not the amount declared in taxes; her exact acceptance threshold also depends on her beliefs about the amount of taxes evaded by the tax payer. Since this negatively affects her payoff, the threshold is increasing in her belief regarding the amount of taxes evaded. As a consequence there are many equilibria involving different levels of tax compliance by the tax payer and beliefs by the tax officer. For example, there is one equilibrium in which the tax payer declares zero taxes and the tax officer correctly anticipates that the total declared taxes will be zero.

2.2. Treatments

One can think of the introduction of a leniency mechanism as a stylized situation where tax authorities decide to invest in establishing control mechanisms that allow for better monitoring of public officials. This allows them to enforce legal consequences not only on tax payers, but also on corrupt tax officers, for example, via improved monitoring. We mimic transitions of that type by employing not only static treatments where exactly one regime is present for the whole duration of the experiment, but also dynamic treatments involving a regime change from one to the other. This allows us to study both the effectiveness of either setup in isolation, as well as, how subjects react to a change in either direction. We are interested in whether the transition from a scenario without the opportunity to blow the whistle to a situation in which this is feasible can break collusive behavior established during a earlier periods. If that is the case, then this would provide strong evidence that such a measure can serve as a tool to reduce collusive corruption and tax evasion in a world where the absence of such a mechanism is the status quo.

In our experiment subjects repeatedly played the bribery game and/or its extended version (with leniency) over the course of a total of 20 rounds. We ran four different treatments. In treatment *NoLEN*, participants play the bribery game without leniency for 20 rounds. In treatment *LEN*, subjects instead play the bribery game with leniency for 20 rounds. These two treatments allow a between-subject comparison of the role that leniency plays with respect to collusive bribery and tax compliance. In addition, these treatments represent a benchmark for treatments *NoL-L* and *L-NoL* in which institutional shocks occur. These treatments were designed to study the effects of institutional transitions, e.g. potential spillover effects from one regime to another, since in those treatments the

rules of the game change unannounced midway through the experiment after round 10. In particular, in treatment *NoL-L* subjects start with the basic bribery game and are then transitioned into an environment in which reporting the tax officer becomes feasible. Treatment *L-NoL* captures the same dynamics, but in reverse order; first the option to report is available and is then abolished after round 10. These two treatments involve a regime change that allows us to analyze the effectiveness of both the introduction and the removal of leniency relative to a "status quo," that is, the regime present during the first block of 10 rounds. Table 1 summarizes the four treatments.

Table 1: Overview over the treatments and number of subjects assigned to each treatment.

Treatment	Round 1-10	Round 11-20	Tax Payers	Tax Officers
NoLEN	BG	BG	30	10
LEN	BGL	BGL	36	12
NoL-L	BG	BGL	66	22
L-NoL	BGL	BG	42	14

2.3. Experimental Procedures

The experiment was conducted at the Cognitive and Experimental Economics Laboratory at the University of Trento. A total of 268 undergraduate students (46% females) participated in the experiment, each in exactly one treatment. Table 1 shows the distribution of subjects over the four experimental treatments. Sessions consisted of 20 rounds followed by an incentivized risk-elicitation task (Holt and Laury, 2002) and a demographic questionnaire.

Subjects were randomly assigned either the role of a tax payer or the role of a tax officer. Participants were randomly matched in groups of four that consisted of one tax officer and three tax payers; each tax officer was assigned three tax payers to interact with simultaneously. There was no direct interaction between different tax payers in the same group. Groups remained fixed throughout the 20 round experiment. Subjects were informed that the number of rounds was predetermined, but were not informed about the exact number of rounds.[9] In each period subjects played the bribery game with or without leniency, depending on the treatment. For treatment *NoLEN* and treatment *LEN* no institutional

[9] We choose not to announce the number of rounds to avoid potential end-game effects.

change occurred. In treatments *NoL-L* and *L-NoL* the participants were informed about a change in the institutional setting after the 10th round via an announcement on screen that provided a detailed description of the new institutional environment. We emphasized that there would be no additional change of the institution until the end of the experiment. In the instructions before beginning the experiment, the participants had been informed that the existing institution may be subject to change, but no information was provided regarding the nature of the change.[10] Thus, we use both within- and between-subject variations of the institutional setting to study the effect of leniency on corruption and tax compliance. Since initial tax declarations were not observable by the tax officer, we also elicited the tax officer's beliefs about the amount of taxes evaded by each of the tax payers offering a bribe. Beliefs were elicited in each round after the tax officer's decision to accept or reject a bribe offer, but before any feedback regarding the outcome of the current round was provided. At the end of each round tax officers were informed about whether they were reported, how much they were fined (if at all) and how much they earned from the tax yield collected. Tax payers received information regarding whether their bribe was accepted, whether they were audited and how much (if at all) they were fined.

To make tax evasion more salient in the laboratory setting, we introduced a third party that incurs a monetary damage as a result of tax evasion. All participants were informed that the total tax yield collected would be used to finance future research of doctoral students at the University of Trento.[11] Tax evasion in the experimental laboratory translates into an actual social welfare loss outside the lab (Eckel and Grossman, 1996; Lambsdorff and Frank, 2010).

Each players final payoff was the sum of all his or her earnings over the 20 rounds, plus his or her earnings from the risk-elicitation task. The total was then converted to Euro at a rate of 100 ECU = €0.7. All participants were paid their final payoff, plus an additional show-up fee of €3 in cash at the end of the experiment. On average, a session lasted about 60 minutes and subjects earned €12 excluding the show-up fee of €3.

[10] Subjects in treatments *NoLEN* and *NoL-L* were provided with identical information at the start of the experiment. The same holds for subjects in treatments *LEN* and *L-NoL*. In particular, participants assigned to treatment *NoLEN* and *LEN* were informed about the possibility of a change although, ultimately, they would not experience one.

[11] This is a common procedure in tax evasion experiments. It is done in order to link tax evasion to a negative externality. For examples see Fortin et al. (2007) or Coricelli et al. (2010).

3. Results

An important feature of our experiment is that tax evasion is nested within a corruption framework that requires collusive behavior for tax evasion to be successful. We believe that this additional layer of interaction is important to help us to better understand unethical behavior in situations in which cooperation is necessary. This interaction has the potential to increase the impact of behavioral factors such as psychological costs and uncertainty on tax compliance and the willingness to engage in collusive bribery.

We structure our analysis as follows. First, we will discuss the effectiveness of leniency on collusive agreements between public officials and tax payers. Next, we will break down the behavior of tax payers and public officials individually. We employ a very cautious approach in our data analysis. Following our design, we regard the behavior of one group (consisting of one public official and three tax payers) averaged over all rounds, or over all rounds in the first and second part, respectively, as one independent observation. This allows us to conduct between- as well as within-subject comparisons.

3.1. Collusive Behavior

One of our main objectives is to study the effectiveness of a leniency mechanism as a means to hinder collusive corruption.

In line with our primary interest of studying the effectiveness of leniency on collusive arrangements, our experimental design allows us to approach this question from two perspectives:

1. Is collusion generally different in an environment where leniency exists?
2. How does an institutional change from an environment with or without leniency to an environment without or with leniency affect collusive behavior?
3. Do socio-demographic variables like gender, age, etc. influence collusive behavior and tax compliance, given the different institutional landscapes used in our experiment?

To address these two questions, we compare the rate of collusion between *NoLEN* and *LEN*, between *NoLEN* and *NoL-L*, and between *LEN* and *L-NoL*, respectively. We define collusion as the successful exchange of bribes in return for the avoidance of taxes.

We first analyze the effect of leniency in absence of institutional history by comparing treatments *NoLEN* and *LEN*. To that end, we calculated the collusion rate as the proportion of successful illicit agreements relative to all rounds in which paying a bribe and evading

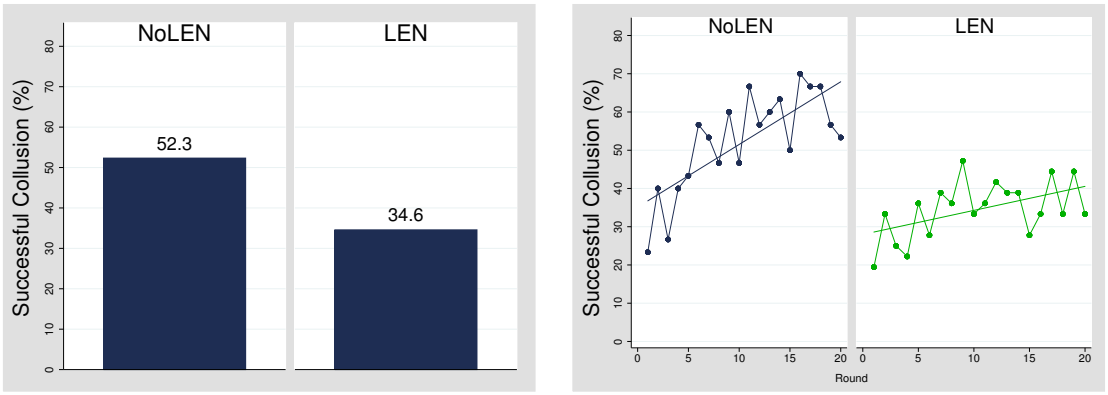

Figure 2: Average collusion in *NoLEN* and *LEN*.

taxes was possible for each group. Figure 2 shows the average collusion rate for each treatment as well as the evolution of the average collusion rate calculated for each round. In the *NoLEN* treatment, the average collusion rate per group was 52.3%. In contrast, in the presence of a leniency mechanism in *LEN* the incidence of collusion was only 34.6%. This difference is significant according to a Mann-Whitney-Wilcoxon test ($N = 22$, $z = 2.1448$, $p = 0.0320$), indicating that collusion is less frequent in *LEN* than in *NoLEN*. Additionally, the right panel of Figure 2 suggests that collusion is increasing over the course of the experiment in both treatments. To check whether this is indeed the case we calculated the average collusion rate for the first and second half of the experiment for each group separately. In the first part of *NoLEN* the average collusion rate is 43.7%; it rises to 61% in the second half of the experiment. This difference is significant according to a Wilcoxon Signed Rank test ($N = 10$, $z = -2.6711$, $p = 0.0076$). In *LEN*, the collusion rate is 31.9% in the first half and 37.2% in the second half, respectively, with the difference not being significant (WSR, $N = 12$, $z = -1.2183$, $p = 0.2231$). With respect to the first question, we find less collusion when a leniency mechanism is in place compared to when it is absent. Moreover, we find that collusion increases significantly over time in the *NoLEN* treatment, while there is no significant increase in *LEN* when leniency is in place.

Next, we turn to our second question regarding the effect of an institutional change on collusion. Treatment *NoL-L* allows us to study the effect of the introduction a leniency mechanism into a setting in which corrupt behavior has already been able to thrive in the absence of leniency. There is some evidence that fear of being reported has a deterrent effect which might decrease the tax officer's acceptance rate (Engel et al., 2013; Abbink et al.,

2014). On the other hand, we are able to study whether a period in which leniency was implemented affects behavior even after it was removed, for example, because a successful relationship is harder to build after developing mistrust in earlier periods. In treatment *L-NoL* subjects start under a regime with leniency, which was removed halfway through. Following the same logic, one would expect low acceptance rates in the first part when facing the bribery game with leniency but an increased acceptance rate as a result of the removal of the mechanism in the second part of treatment *L-NoL*.

The left panel of Figure 3 shows the average rate of collusion for each part of treatment *NoL-L* and *L-NoL*. The right panel illustrates how collusion evolves over the course of the experiment in each of the treatments. We again observe that collusion increases over time. Moreover, the graph suggests that the introduction of a reporting option in *NoL-L* causes a drop in collusion. Since collusion is increasing over time we cannot simply compare the means before and after an institutional change has occurred. Thus, we evaluate the effect of the introduction or removal of a leniency mechanism by comparing the change in collusion rates resulting from the introduction or removal of leniency to the corresponding change in the absence of an regime change. We calculated the change of the collusion rate between the first and second half of the experiment for each group in all treatments. We then compare the changes between *NoLEN* and *NoL-L*, and between *LEN* and *L-NoL*, respectively. This disparity in differences analysis is necessary to account for the increase in collusion over time.

In treatment *NoL-L*, the average collusion rate before and after a leniency mechanism was introduced are 43.2% and 41.7%, respectively. Hence, the introduction of a leniency mechanism in *NoL-L* results in 1.5% decrease in collusion. Recall that in *NoLEN* there was an increase in collusion by 16.3% from the first part to the second part. Comparing this change from part one to part two in *NoLEN* and *NoL-L* reveals that the introduction of leniency has significantly negative effects on collusion (MWW, $N = 32$, $z = 2.2249$, $p = 0.0261$).

Similarly, we now consider the effect of the removal of leniency. In the first part of treatment *L-NoL* the collusion rate was 38.3% when leniency was present. Following its removal the collusion rate rises to 48.8%. We observe an increase in collusion by 10.5% in *L-NoL* compared to an increase of 5.3% in *LEN* from part one to part two. There is no significant difference between the increase of collusion in *LEN* and *L-NoL* (MWW, $N = 26$, $z = -0.6978$, $p = 0.4853$). We find no evidence that the removal of a leniency mechanism increases collusion beyond the gradual increase over time observed in *LEN* where there is

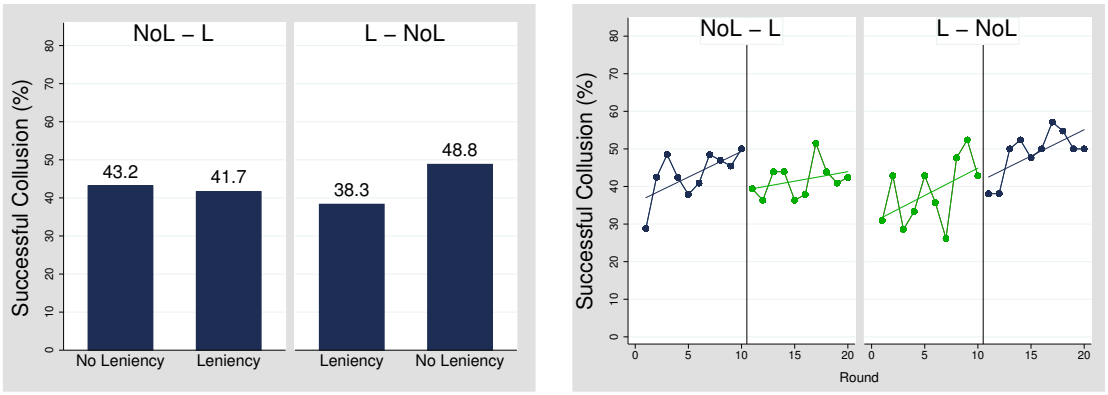

Figure 3: Average collusion in *NoL-L* and *L-NoL*.

no regime change. In particular, there is no upward "jump" in the frequency of collusive cooperation following the removal of the leniency mechanism.

In summary, our results suggest that the presence of a leniency mechanism indeed deters collusion. Interestingly, we also see some evidence for an increase in successful collusive cooperation over time in the absence of leniency, while under leniency we see no such effect. This is in line with the idea that leniency makes it more difficult to reach a collusive agreement that is honored by both parties. Regarding the effects of a regime change, we find that the introduction of a leniency mechanism in treatment *NoL-L* has a deterrent effect on collusion. This result suggests that implementing such a measure is likely to hinder collusive bribery. On the other hand, the removal of whistleblowing in *L-NoL* does not foster collusion. Collusion rates show no significant "jump" upwards after the mechanism is removed. This points towards a potential positive spillover effect from the first part where a leniency mechanism was in place that persists even after its removal. A potential explanation for this spillover effect is that leniency sows mistrust between the tax officer and the tax payer, reducing the tax officer's willingness to cooperate in later periods even when reporting is not feasible anymore.

3.2. What Are the Drivers of Collusion?

Collusion requires the cooperation of both the tax payer and the tax officer. In order to pin down the drivers of the effects on collusion found in the previous section we now analyze the behavior of tax payers and tax officers separately. We first consider the rate of collusion attempts initiated by the tax payer (the incidence of bribe offers relative to all relevant situations where offering a bribe was feasible). Since collusion requires the cooperation of

the tax officer we investigate the bribe acceptance rate (the fraction of bribes that were accepted by the tax officer relative to the number of bribe offers received in a second step). Clearly, collusion is the result of a combination of both the frequency of bribe offers and the fraction of bribe offers that are accepted. The size of the bribes is likely to affect the acceptance rate since it is natural that tax officers accept large bribes more often than small bribes. As a result, we also consider the treatment effects on the size of the bribes offered by the tax payer and how they affect the acceptance rate.

In the absence of leniency the tax payers decision to collude with the tax officer and evade taxes comes at the risk of being detected and fined. The presence of a reporting opportunity effectively reduces this risk, while shifting responsibility to the tax officer. This not only renders tax evasion more profitable, but also potentially reduces the tax payer's psychological cost associated with paying a bribe in order to evade taxes. Similarly, it is conceivable that the taxpayer associates another (and opposite) psychological cost triggered by the betrayal of the tax officer. After a collusive relationship between the two agents has been established, the tax payer might perceive blowing the whistle as breaking this "alliance." It is reasonable to think that this could cause some psychological cost for the tax payer. On the other hand, leniency offers tax payers a "safe way out" when getting caught and this can cancel or reduce this "cost of betrayal," hence they are likely to offer bribes more frequently because they anticipate this psychological mechanism. At the same time, accepting a bribe is more risky for a tax officer when a leniency mechanism is in place, since she now faces the threat of being reported and fined. Thus, we expect tax officers to reject more bribes when whistleblowing is possible.

As in the previous section, we first seek to understand the drivers of collusion in treatments *NoLEN* and *LEN* where there was no regime change. In a second step, we analyze the role of the institutional history by evaluating the effect of the introduction of a leniency mechanism in *NoL-L* and the effect of the removal of such a mechanism in *NoL-L*.

3.2.1. Incidence of bribe offers and acceptance rate in NoLEN and LEN

We first consider the behavior of the tax payer. We analyze the incidence of bribe offers. The left panel of Figure 4 shows the dynamics of the average frequency of bribe offers per round over the course of the experiment. Surprisingly, we see that bribe offers are not more frequent, but rather less frequent in *LEN* compared to *NoLEN*. In fact, the average incidence of bribe offers per group over all rounds was 67.7% in *NoLEN* and 55.1% in *LEN*. It was even lower in the presence of leniency. However, this difference fails

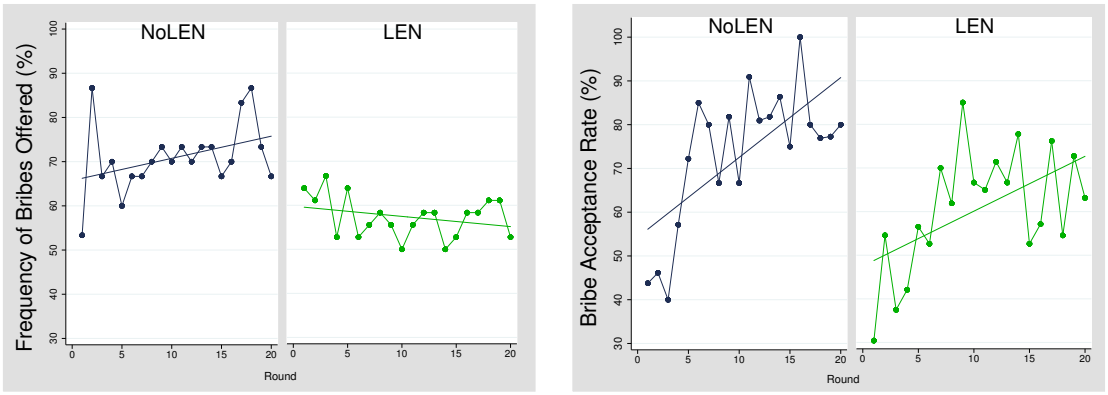

Figure 4: Average frequency of bribes offered and bribe acceptance rate in *NoLEN* and *LEN*.

to reach significance according to a Mann-Whitney-Wilcoxon test ($N = 22$, $z = 1.4870$, $p = 0.137$). Further, the graphs suggest that the frequency of bribe offers is increasing over time in *NoLEN*, whereas it appears to be slightly decreasing in treatment *LEN*. According to Spearman rank order correlations, there is a positive trend in *NoLEN* ($\rho = 0.3803$, $p < 0.001$), whereas the bribe offers exhibit a negative trend in *LEN* ($\rho = -0.2496$, $p < 0.001$). For both treatments we again calculated the average frequency of bribe offers for the first and second half of rounds, separately. In *NoLEN* the average incidence of bribe offers is 68.3% in rounds 1-10 and 73.7% in rounds 11-20. The difference is not statistically significant. In *LEN* the frequency of bribe offers is 56.6% in the second half of the experiment. This is slightly lower than in the first ten rounds where it is 58.1%. Again, this difference is not statistically significant.

In treatment *LEN* the tax payer not only faces less risk than in treatment *NoLEN*, but this risk is also effectively shifted to the tax officer as leniency exposes her to the possibility of being reported and fined. In Appendix A we show that this raises the optimal bribe acceptance threshold in equilibrium. A failure of the tax payers to acknowledge this increased risk for the tax officers is likely to result in more rejections of bribes. Next, we consider the behavior of the tax officer. More precisely we look at the average fraction of bribes accepted by tax officers. The right panel of Figure 4 shows the evolution of the bribe acceptance rate over the 20 rounds for the two treatments without a regime change. The graphs indicate a higher acceptance rate in *NoLEN* compared to *LEN* and clearly show that the acceptance rate is increasing in both treatments over time. The average acceptance rate in *LEN* is 58.8% and is lower compared to the average acceptance rate of 73.2% in *NoLEN*.

This difference fails to reach significance (MWW, $N = 22$, $z = 1.51657$, $p = 0.1294$). Spearman rank order correlations confirm our observation of a significant positive trend in both treatments of about the same magnitude in *NoLEN* ($\rho = 0.5245$, $p < 0.001$) and *LEN* ($\rho = 0.5073$, $p < 0.001$). Comparing the average acceptance rate for the first ten rounds with the average acceptance rate in the second part, we find a significant increase in *NoLEN* from 64.4% to 81.6% (MWW, $N = 10$, $z = -2.7557$, $p = 0.0059$), as well as a significant increase in *LEN* from 52.9% to 65.0% (MWW, $N = 12$, $z = -2.353393$). Our results suggest that the acceptance rate is increasing over time in both treatments without a regime change. This phenomenon can be seen as the insurgence of a sort of social agreement in favor of collusion and that over time the interaction between the tax payers and the tax officers establishes some form of social convention against the state.

In combination these results suggest that the decrease collusion in *LEN* compared to *NoLEN* is likely the result of both the absence of an increase in the number of bribes offered by the tax payer (which are even slightly less frequent, but not statistically significant) and a reduced acceptance rate by the tax officer in *LEN*, which, however, fails to reach significance. The increase in collusion over time seems to be mainly driven by an increase in the acceptance rate of the tax officer, especially for *LEN* where the number of bribes offered is decreasing. In *NoLEN* there is a positive trend for the frequency of bribe offers which might explain why in *NoLEN* collusion seems to be increasing more rapidly than in *LEN*.

3.2.2. Incidence of bribe offers and acceptance rate in NoL-L and L-NoL

We now study the effects of the introduction and the removal of a leniency mechanism that allows for whistleblowing on the frequency of bribe offers by the tax payer and on the bribe acceptance rate by the tax officer. The left panel of Figure 5 shows the frequency of bribe offers in treatments *NoL-L* and *L-NoL*. We observe that there is an increase in the frequency of bribe offers after the introduction of leniency in *NoL-L*. From that point on we see a steep decrease until the end of the experiment. Overall, bribe offers seem to be more frequent in the presence of leniency for both treatments, but more so for *L-NoL*. In *L-NoL* there is a positive trend before and after the removal of the reporting option, but the frequency of bribe offers drops sharply.

In treatment *NoL-L* the average frequency of bribe offers is 65.0% in the first part and 70.5% in the second part when a leniency mechanism is introduced. This increase is identical to the increase observed in *NoLEN* where no regime change occurred. A Mann-

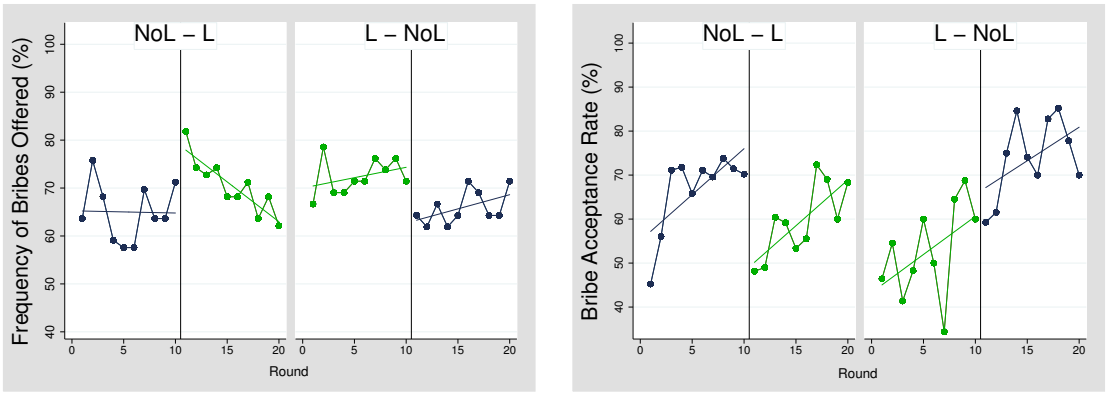

Figure 5: Average frequency of bribes offered and bribe acceptance rate in *NoL-L* and *L-NoL*.

Whitney-Wilcoxon test comparing the increase in *NoL-L* to the increase in *NoLEN* from part one to part two confirms this observation ($N = 32$, $z = 0.0001$, $p = 1.000$). We conclude that the introduction of a leniency mechanism has no significant effect on the average incidence of bribe offers. However, Figure 5 suggests that the introduction of whistleblowing affects the dynamics of bribe offers over rounds. Spearman rank order correlations reveal that during the first part of *NoL-L* bribe offers show no clear trend ($\rho = 0.0369$, $p = 0.5859$). There is a significant negative trend following the introduction of a reporting mechanism, however ($\rho = -0.8924$, $p < 0.001$).

We now turn to the effect of the removal of leniency on bribe offers. In treatment *L-NoL* tax payers offered bribes in about 72.5% of all cases on average when whistleblowing was possible. This rate is 6.5% higher than in the second part, where this number falls to 66.0% following the removal of the mechanism. This change is very close to the decrease of 1.5% observed in *LEN* and, indeed, the difference in the effects from the first part to the second part between *LEN* and *L-NoL* is not statistically significant (MWW, $N = 26$, $z = 0.7232$, $p = 0.4696$). We also observe from Figure 5 that there is a similar positive trend both before ($\rho = 0.4075$, $p < 0.001$) and after the removal of the leniency mechanism ($\rho = 0.4909$, $p < 0.001$).

Next, we consider how the behavior of tax officers (as revealed by the average acceptance rate of bribe offers) is affected by the introduction and the removal of a leniency mechanism. The right panel of Figure 5 shows the evolution of the acceptance rate of tax officers over the course of the experiment for *NoL-L* and *L-NoL*. The graphs suggest that tax officers accept less bribes after the introduction of leniency, which is likely due to the potential risk

of being reported and fined. Our findings in treatment *NoL-L* indicate that the average acceptance rate of bribes decreases from 64.4% to 59.7% following the transition to an institutional environment with leniency. Recall that in *NoLEN*, where no such measure was introduced, we have seen that the acceptance rate increases by 17.2% from the first part to the second part. The difference in the change between parts across *NoLEN* and *NoL-L* is highly significant (MWW, $N = 32$, $z = 3.0910$, $p = 0.0020$). This result suggests that the introduction of a reporting option is an efficient deterrent for the tax officer as reflected by a stark negative effect in bribe acceptance rates. Moreover, the dynamic pattern in *NoL-L* confirms our earlier observation that acceptance rates are increasing over time independent of the presence of a leniency mechanism.

The removal of the reporting mechanism in *L-NoL* appears to have a different effect as revealed by the dynamics in the right panel of Figure 5. Acceptance rates are increasing over time in a similar fashion as we observed in *LEN* where the mechanism was not removed. Most importantly, in *L-NoL* the dynamic does not indicate any behavioral change in acceptance rates from the first to the second part, but only a steady increase over time. The average acceptance rate increases from 52.2% in part one, where whistleblowing was possible, to 74.2% in the second part where leniency is no longer available. This increase is not statistically different from the increase observed in *LEN* (MWW, $N = 26$, $z = -0.4115$, $p = 0.6807$). Thus, we find no evidence that the removal of leniency significantly increases acceptance rates. Further, in treatment *L-NoL*, the dynamic pattern over the course of the experiment confirms that acceptance rates are increasing as subjects gain more experience.

We find no evidence that the introduction of leniency for the tax payer has a strong effect on bribe offers. In particular, the idea that leniency encourages tax payers to offer bribes more frequently is not supported by our data. At best, there is weak evidence for a temporary increase in bribe offers following the introduction of leniency, but this is coupled with a sharp and steady decrease over later periods. On the other hand, our data suggests that the introduction of a whistleblowing mechanism that renders the tax officer formally responsible is able to discourage tax officers from accepting bribes. We find no evidence that the removal of such a mechanism triggers an effect in the opposite direction; acceptance rates show no significant jump upwards when the threat of whistleblowing is removed, indicating that whistleblowing has a positive spillover effect. We find consistent evidence for a general increase of acceptance rates over time that is independent of the presence of a leniency mechanism. Our results identify the deterent effect of leniency on tax officers as motivating the effects on collusion rates reported in Subsection 3.1. Tax

officers reject more bribe offers after leniency is introduced and do not accept more bribes when it is removed. This effect outweighs any potential encouragement for tax payers to offer more bribes under leniency, a conjecture for which our data offers only limited support.

3.2.3. Effects of Bribe size, Reporting and Beliefs on the Bribe Acceptance Rate

Let us now consider the size of bribes paid. Recall that in the bribery game with leniency the optimal bribe acceptance threshold is higher. In order to sustain collusion the tax payer has to compensate the tax officer for the additional risk with higher bribe payments. As shown in Appendix A equilibrium bribe payments are about 3.7 ECU higher in the bribery game with leniency compared to the bribery game without leniency. In line with these theoretical predictions we observe that average bribe payments are 14.4 ECU in *NoLEN* compared to 16.6 ECU in *LEN*. Although this difference is smaller than predicted, we find that the difference is marginally significant (MWW, $N = 22$, $z = -1.7808$, $p = 0.0749$). Similarly, there is a significant upwards shift in the size of bribes paid following the introduction of a whistleblowing mechanism in treatment *NoL-L* from 13.2 ECU to 15.4 ECU (WSR, $N = 22$, $z = -2.3538$, $p = 0.0186$). Analogously, bribe payments are 16.6 ECU during the first part of treatment *L-NoL* and they decrease to 15.2 ECU following the removal of whistleblowing. This difference, however, is not statistically significant. Evidently, taxpayers acknowledge the higher risk that public officials have to bear in the presence of a leniency mechanism and compensate them, at least partially, with higher bribes. It is important to note that for a tax officer, all bribe payments above 6 ECU, respectively 8.16 ECU, are profitable in the presence of leniency. Bribe offers below the respective threshold only occurred in about 10% of the cases for both *NoLEN* and *LEN*; such offers were relatively rare. Non-profitable bribe offers were slightly more common, but equally likely, in treatments *NoL-L* and *L-NoL*. They occurred in 15.5% and 16.3% of all cases, respectively. All of this is to say that differences in the frequency of non-profitable bribe offers cannot explain the effects of leniency on collusion and bribe acceptance rates.

Figure 6 illustrates the evolution of bribe payments across treatments over the course of the experiment. In both *NoLEN* and *LEN* the size of bribe payments remains fairly constant over time apart from an initial adjustment period during the first five rounds of *LEN*. In *NoL-L*, bribe payments show some positive trend following the introduction of the reporting option. There is a similar trend in treatment *L-NoL*, but also only in the presence of leniency.

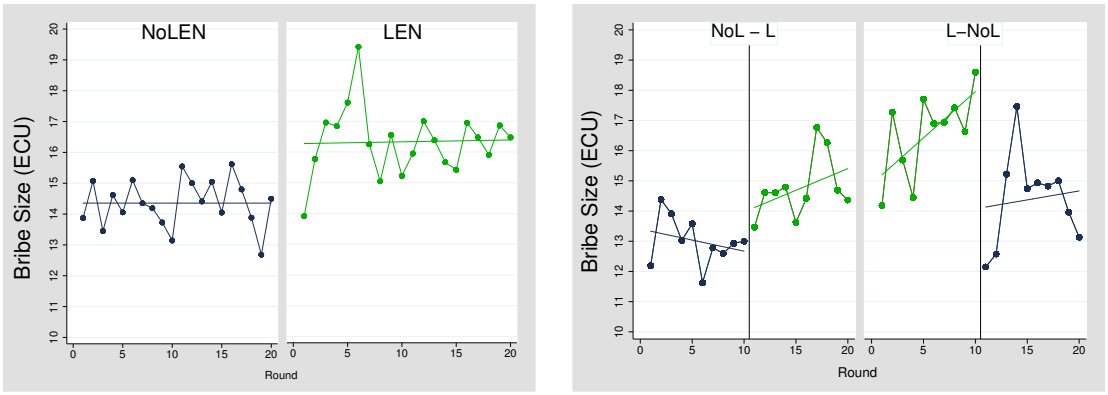

Figure 6: Average bribe size over rounds across treatments.

In our setting, a tax payer's decision on whether to evade taxes goes hand in hand with the decision to pay a bribe and make the tax officer look the other way. Ceteris paribus, higher bribe payments should naturally lead to higher collusion rates. To test whether this is indeed the case we ran a logistic panel regression with random effects and standard errors clustered at the group level separately for each treatment. The dependent variable is whether a bribe was accepted or not. Any instance of a bribe offer is one observation. We include the size of the bribe offer as an independent variable. For *NoL-L* and *L-NoL* we also include a dummy for the presence of a leniency mechanism and the interaction with bribe size. Table C.2 in Appendix C reports the results of these four regressions. The regression results show that larger bribes are more likely to be accepted by the tax officer across all treatments independent of potential whistleblowing, confirming our intuition. The effect of bribe size appears to be smaller in the presence of a leniency mechanism, but is still positive and significant. This suggests that when reporting is possible tax officers react less to the size of the bribe offer. One explanation for this is that some tax officers are sufficiently deterred by the threat of being reported, making the size of the bribe less relevant.

It is also important to briefly note the impact of the whistleblowing mechanism among tax payers. Tax payers almost always chose to report instance of collusion with tax officers. Their overall average propensity to report the tax officer was about 91.4%. Reporting was most frequently used in treatment *L-NoL* (98.6%), but not significantly different from the frequency observed in *NoL-L* (87.4%) and *LEN* (90.0%). We do not find any evidence for reciprocity among tax payers and tax officers, which may partially be attributed to the

fact that in our setting tax payers who chose to report were granted partial anonymity. Tax officers were only informed that they were reported and by how many tax payers, but not by whom. Depending on the particular situation tax officers were not able to determine whether a particular tax payer blew the whistle or not. This limited the scope for retaliation (for example, via withholding future cooperation) and may explain the high rate of reporting decisions. It has been argued that betrayal, such as reporting, is associated with a moral or psychological cost (see also Coricelli et al., 2010). This is not supported by our data.

The tax officer's optimal bribe acceptance threshold depends on his belief about the amount of taxes declared by the tax payer (see Appendix A). Although it is not the main objective of our study, we believe it might be of some interest to see whether tax officer's beliefs affect their acceptance behavior. To that end, whenever a tax officer was offered a bribe we elicited her beliefs regarding the amount of taxes evaded by the tax payer offering the bribe after she chose to accept or reject that bribe. As shown in Appendix A the optimal acceptance threshold for a tax officer is increasing in the amount of taxes evaded, hence one would expect a negative correlation between the acceptance of bribes and the tax officer's belief about the amount of taxes evaded by the tax payer. Considering all instances of a bribe being offered, a Spearman rank order correlation shows a weak negative relation between a bribe being accepted and the tax officer's beliefs ($\rho = -0.0841, p < 0.001$). We find this correlation to be strongest in *L-NoL* ($\rho = -0.1022$, $p = 0.014$), whereas there is only a very weak correlation for *NoL-L* and *LEN*. There is no significant correlation for *NoLEN*. Thus, in line with our theoretical predictions there is a negative, yet rather weak, correlation between acceptance decisions and beliefs.

3.3. Effects on Tax Evasion

Experimental evidence suggests that subjects' tax compliance is usually well above the theoretically optimal level, for example, due to moral costs of engaging in illicit behavior.[12] In our experiment tax payers had to make two decisions: first, whether and how much to bribe the tax officer, and second, how much to declare in taxes. Since in our setup tax evasion is nested within a framework of collusive bribery, the amount of taxes actual paid is the result of a tax payer's decision about the amount of taxes declared as well as the

[12]It was shown in Banerjee (2016b) that a loaded frame that creates the right sense of entitlement significantly decreases corruption, suggesting that moral costs are indeed at work.

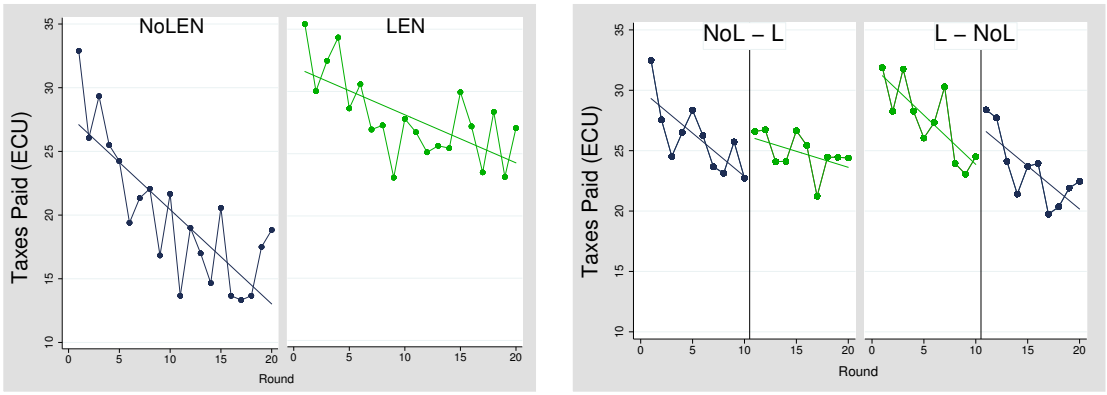

Figure 7: Average amount of taxes finally paid over rounds and across treatments.

tax officer's decision to accept or reject the report (thus, the bribe offered). We have to distinguish between attempted tax evasion, as revealed by the amount of taxes declared, and actual tax evasion, as revealed by the amount of taxes finally reported. Recall that following a rejection by the tax officer the tax payer is forced to truthfully report taxes. While attempted tax evasion is also of some interest and can surely cause moral damage to society as a whole, it is the actual amount of taxes evaded which directly causes a negative externality on society. In this subsection we focus on actual tax evasion, that is, the amount of taxes finally reported. The results for attempted tax evasion are very similar to those of actual tax evasion and are omitted for brevity.

The average amount of taxes paid in *NoLEN* is 20.1 ECU. This is smaller than the average of 27.9 ECU observed in *LEN*. This difference is statistically significant (MWW, $N = 22$, $z = -2.4397$, $p = 0.0147$) showing that the lower rate of collusion in *LEN* observed previously translates into a higher tax yield collected. As illustrated by Figure 7, the amount of taxes paid also shows a negative trend across all treatments independent of the presence of a leniency mechanism. In fact, in *NoLEN* the amount of taxes paid decreases from 23.9 ECU to 16.2 ECU from part one to part two. In *LEN* this decrease is smaller with average tax payments of 29.7 ECU in part one and 26.2 ECU in part two. In treatment *NoL-L*, taxes paid show almost no decrease following the introduction of whistleblowing with average payments of 26.1 ECU before and 24.8 ECU after the mechanism was introduced, respectively. Comparing the changes in taxes paid between *NoLEN* and *NoL-L* we find a significantly smaller decrease in treatment *NoL-L* (MWW, $N = 32$, $z = -1.8093$, $p = 0.0704$). Thus, the introduction of a whistleblowing mechanism

has a significant positive effect on the tax yield collected. In contrast, in *L-NoL* paid taxes decrease on average from 27.5 ECU in the first part of the experiment to 23.4 ECU in the second part of the experiment. This decrease is similar in size to the one observed in treatment *LEN*. A Mann-Whitney-Wilcoxon test confirms that the removal of the reporting option has no significant negative effect on the amount of taxes paid ($N = 26$, $z = 0.4115$, $p = 0.6807$).

3.4. Gender differences

In this subsection, we would like to highlight some of the more unexpected results that we have come across upon closer inspection of our data. These findings relate to behavioral heterogeneity with respect to gender.[13] We deem such an analysis important as it adds to the growing body of evidence on gender differences within the frame of choice under risk and strategic uncertainty, and it provides further support for the idea that females are generally more sensitive to the contextual frame (Croson and Gneezy, 2009; Dreber et al., 2013). We find surprising differences in behavioral reactions to the introduction, but not the removal, of leniency across gender. Gender differences have been repeatedly demonstrated in various domains such as risk preferences, social preferences, lying behavior (Childs, 2012), and honesty (Muehlheusser et al., 2015). For example, Hasseldine and Hite (2003) study framing effects in tax compliance and find a significant frame by gender interaction indicating a stronger reaction to changes in framing for females. Although, aside from the standard observation that females are found to be less inclined to be corrupt or evade taxes (see for example Kastlunger et al., 2010; Torgler and Valev, 2010), we did not expect strong gender differences. We present the results first and offer a discussion of the potential mechanisms at the end of this subsection. In a first step, we will reconcile the gender outcomes with our previously discussed general results.[14]

We start with our first observation pertaining to our previous finding that the tax yield collected is higher in *LEN* than in *NoLEN*. A look at the actual amount of taxes paid reveals a significant increase for males from 17.7 ECU in *NoLEN* to 25.1 ECU in

[13] For the purpose of this exercise, we present the following analysis at the individual level since our study was not explicitly designed to study gender effects at the group level.

[14] Here, we are more interested in within-gender differences across different institutional environments, rather than between-gender differences within the same institutional settings. In terms of level differences, our findings are in line with existing research suggesting that males are generally more prone to risky behavior and, often as a consequence thereof, engage in illicit behavior more often and to a larger extent than females (cf. Torgler and Valev, 2010; Banuri and Eckel, 2012).

LEN (MWW, $N = 38$, $z = -2.188$, $p = 0.0287$), whereas we do not observe a significant increase on the side of the females. We also find that the general increase in taxes declared is solely driven by female participants, indicating a marginally significant increase from 17.4 ECU when lenience is absent to 26.5 ECU where lenience is present (MWW, $N = 28$, $z = -1.751$, $p = 0.0799$), whereas male behavior remains statistically invariant to the existence of leniency in the *LEN* treatment. What is more, for female participants we do not observe that the existence of a lenience mechanism causes any significant change in either the frequency at which bribes were offered or the size of the bribe. However, while the former result also holds for male participants, we observe a statistically significant increase in bribe sizes from 14.0 ECU in *NoLEN* to 17.0 ECU in *LEN* (MWW, $N = 37$, $z = -2.192$, $p = 0.0284$). It is worth highlighting that this significant increase in bribe sizes does not yield a sufficient compensation for the increased risk on the side of the tax officers, leading to a significant drop in successful collusion of male tax payers, resulting in a decrease from 58.3% in *NoLEN* to 41.8% in *LEN* (MWW, $N = 38$, $z = 2.075$, $p = 0.0380$). We do not observe a significant change in collusion rates of females. Next, we turn to an analysis of gender heterogeneity in our two treatments with institutional history, *NoL-L* and *L-NoL*. Surprisingly, although we find no significant differences with regards to taxes actually paid, we find ample gender heterogeneity concerning the introduction or removal of leniency. The results indicate that females strongly react to the introduction of leniency by decreasing their declared tax amounts from 21.2 ECU to 13.2 ECU in the *NoL-L* condition (MWW, $N = 64$, $z = 2.674$, $p < 0.01$). There is no adjustment in behavior after the removal of leniency in the *L-NoL* condition. Males, on the other hand, remain completely invariant to institutional changes with respect to the amount of declared taxes. We present the results in Figure 8.[15]

The experimental design adopted in our study included two main factors that potentially play a role in explaining female participants reactions to the implemented institutional change. The first ingredient is risk (to be fined) and the second one is the particular institutional setting adopted. For one, a general difference in risk attitudes across gender could potentially explain the significant drop in female tax compliance after the introduc-

[15]Other results indicate that both male and female participants neither adjust the bribe frequency nor bribe size significantly in any direction regardless of whether leniency was introduced to a no-leniency environment or vice versa. We also do not observe any significant gender heterogeneity with regards to successful collusion.

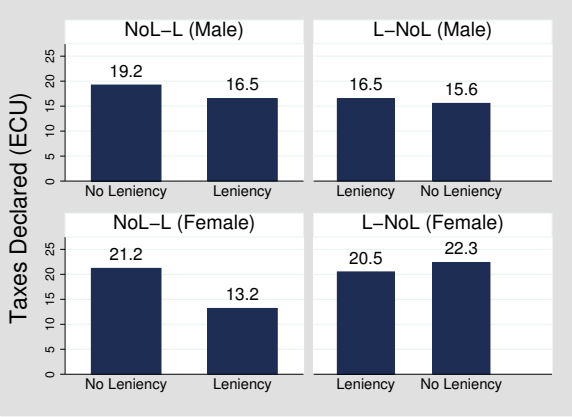

Figure 8: Average amount of taxes declared by gender and treatment.

tion of a leniency mechanism in our *NoL-L* condition, as leniency sharply reduces the risk of deviant behavior by design.[16] Additionally, Lighthall et al. (2009) studed how stress affects decision-making under risk and found that males take more risk than females overall. Interestingly, stress increases risk-taking for males, while making females become more risk-averse. Assuming that a regime with leniency is perceived as less stressful for tax payers as it offers a "safe way out," the observed different reactions across gender in our *NoL-L* condition might be explained by such an "inverted stress effect." Unfortunately, we did not collect any physical measure of stress (such as cortisol levels or heartrate) that would allow us to test this explanation, but we view this as an interesting avenue for future research. An alternative explanation would be that the sudden institutional change affects females more strongly than males. This is in line with the work of Croson and Gneezy (2009) and Dreber et al. (2013) who argued that females are more sensitive to contextual framing. There is a growing body of evidence on gender differences within the frame of choice under risk and strategic uncertainty that argues that females are generally more sensitive to the contextual frame. Hasseldine and Hite (2003) study framing effects in tax compliance and find a significant frame by gender interaction indicating a stronger reaction to changes in framing for females. In our context, the introduction of a leniency mechanism renders the tax officer formally responsible, creating a situation where the responsibility (and risk) is

[16] It is worth noting that our results remain robust to the control of risk as measured by our risk elicitation task. We do not explicitly show these results for the sake of brevity. However, the results are available upon request from the authors.

shared between the tax payer and tax officer. Our evidence indicates that females strongly react to this new situation by a drastic drop in compliance. Males appear to be unaffected. It is important to note that the same does not hold for the removal of leniency in the *L-NoL* condition. We interpret this as evidence supporting the idea that gender effects might oftentimes stem from a higher sensitivity of females to the institutional environment as proposed by Croson and Gneezy (2009).

4. Discussion and Conclusion

Our results shed light on the effects of a leniency mechanism on collusive bribery in a tax evasion framework utilizing a controlled laboratory setting. We nest collusive corruption in a tax evasion framework in which tax payers require the cooperation of a tax officer to evade taxes, thus, opening the door for collusive bribery. The leniency mechanism we consider offers leniency to tax payers for reporting corrupt tax officers. In our setup, leniency not only shifts the risk and negative consequences (fines) of collusive bribery from the tax payer to the tax officer who otherwise faces little to no consequences, but also renders her formally responsible. Compared to most studies in the tax evasion literature we add a dimension of strategic interaction that allows us to capture a richer strategic environment that is applicable in other domains, including custom duties, that are understudied to date. Further, we investigate the dynamics of institutional changes and their effects on both corruption and tax evasion by considering not only environments with and without leniency, but also the introduction and the removal of such a policy. By doing so we have identified a positive spillover effect of the presence of a whistleblowing mechanism present from the first half of the experiment to the second half of the experiment where it is no longer in place.

Comparing settings with and without leniency in the absence of an institutional change, we found leniency to be effective in combating collusive bribery. When leniency for a tax payer is in place successful collusion between tax payer and tax officer is less frequent. Further, it effectively deters the tax officer from accepting bribes; at the same time, we find no evidence that leniency encourages the tax payer to offer bribes. We identify a lower willingness of the tax officer to accept bribes as the main driver behind the observed effects on collusion. We also find a positive effect of leniency on tax compliance with more taxes being collected when such a mechanism is in place. In addition, our results highlight the role of institutional changes and its importance on the evaluation of policy measures. We show

that the introduction of the opportunity to blow the whistle effectively breaks up already established collusive patterns by sowing distrust between the colluding parties, preventing further collusive bribery and tax evasion. In contrast, the removal of the institutional mechanism does not cause similar effects in the opposite direction. This points towards a positive spillover effect of the particular institutional mechanism we consider, i.e., the positive effects of offering leniency to whistleblowers persists even after the mechanism has been removed. This in in line with some recent evidence emphasizing the importance of spillover effects (e.g., see d'Adda et al., 2017; Engl et al., 2017).

We provide empirical evidence emphasizing that a political measure should not be judged in isolation by disregarding the reference point provided by the pre-reform system. This might lead to an incomplete or even flawed assessment of its effectiveness. It is therefore crucial to consider the history of political or legal systems when deciding upon means to combat corruption and tax evasion. The classical economic model of tax evasion does not consider the fact that individuals are "born into" a certain legal system, but exactly this status quo might determine whether a potential reform is effective or not. Taking this evidence into account will be crucial for understanding why sometimes reforms are highly effective in a certain country or cultural environment, but ineffective in others. This might be related to the echo effect found in Mittone (2006) that suggests that a change in the audit sequence affects behavior, because subjects "learn" to be risk-averse or risk-seeking through experiencing early or late first audits. This indicates that past experience can create some sort of reference behavior that cannot easily be "unlearned," and hence, might enhance or hinder the effectiveness of a subsequent reform. Following that line of reasoning, reforms can turn out to be a one-way street. Once implemented their effects cannot simply be undone by reestablishing the pre-reform regime. Rolling out reforms is a process that ought to be taken with great caution by policy makers.

Appendix A. Theoretical Analysis of the Bribery Game (with Leniency)

Consider the bribery game with and without leniency described in Subsection 2.1 above as a one-shot interaction between a TP and a TO, both assumed to be rational in the sense of being risk-neutral expected payoff-maximizers. Assuming the rational model of crime (Allingham and Sandmo, 1972), we now derive theoretical predictions regarding tax compliance and bribe exchange. Our analysis shows that the predicted tax compliance of the TP is the same for both institutional frames. On the other hand, the optimal

bribe payment is higher in the BGL where reporting is possible. Moreover, bribe exchange (collusion) is optimal under both regimes. Denote the amount of taxes declared by D and the bribe offered by b.

In the BG a rational TO will accept any bribe b that is (weakly) above the expected foregone commission of 15% from the taxes declared. That is, 7.5% of the declared income D. Since the TO does not observe the income declared by the TP we assume that she holds a belief $\mu : \{0, \ldots, 80\} \longrightarrow [0, 1]$ about D. The expected amount of declared income given this belief μ is then $D(\mu) = \sum \mu(D)D$. Hence, the TO will accept a bribe if she believes that the bribe is larger than her foregone commission. This will be the case if and only if

$$b \geq 4.8 - 0.06D(\mu).$$

The bribe acceptance threshold, which we denote by $b_{BG}(\mu)$, depends only on the expected amount of declared income $D(\mu)$. For example, if the TO expects the TP to declare zero taxes, that is $D(\mu) = 0$, then only bribes of at least 6 are accepted. If she expects the TP to declare half, that is $D(\mu) = 40$, all bribes above 3 are accepted. Note that the threshold is strictly increasing in $D(\mu)$. Should the TP offer a bribe b and the TO accepts (which is the case for $b \geq b_{BG}(\mu)$), the TP's expected payoff for reporting an amount of D is

$$\Pi_{\text{TP}}(D, b \mid \textit{accept}) = 70 - b - 0.375D.$$

Note that Π_{TP} is decreasing in D and b, hence, a rational TP will optimally declare an income of $D = 0$ and pay the smallest bribe that is accepted by the TO, which is $b = 6 - 0.075D(\mu)$.

In BGL, leniency introduces the possibility for a TP to report a corrupted TO following an audit. In the one-shot scenario it is optimal for the TP to report the TO when being audited, in which case the TP now has an expected payoff of

$$\Pi_{\text{TP}}(D, b \mid \textit{accept}, \textit{report}) = 72 - b - 0.4D.$$

This payoff is still decreasing in D and b, and, as a result, the TP prefers to declare zero taxes and pay the smallest bribe that is accepted by the TO. However, the bribe threshold in the BGL is not the same as in the BG. To see this, suppose the TO anticipates that the

TP will always report her when audited. A rational TO will accept a bribe if and only if

$$8.5 - 0.075D(\mu) =: b_{BGL}(\mu).$$

Intuitively, the TP has to compensate the TO not only for his forfeited (expected) salary, but also for the risk of being reported and its consequences.

The game described above is a game of imperfect information (the TO does not observe D) and as such it has many equilibria. We use Perfect Bayesian Equilibrium (PBE) as our solution concept of choice. Given a point belief μ with $\mu(0) = 1$ and $\mu(D) = 0$ for $D \neq 0$ there is a PBE of BG where the TP declares exactly $D = 0$ and offers a bribe $b = b_{BG}(\mu)$; the TO accepts this bribe. Similarly, given the same belief there is a PBE for BGL where the TP declares $D = 0$, offers a bribe $b = b_{BGL}(\mu)$ and always reports the TO when audited; again, the TO accepts the bribe b. In both, BG and BGL, collusion is an equilibrium of the one-shot game. However, since $b_{BGL}(\mu) > b_{BG}(\mu)$ for any μ, the bribe acceptance threshold in BGL is higher compared to BG. It is important to note that for both games the bribe acceptance threshold is decreasing in the mean of the TO's belief μ.

Appendix B. Summary statistics

Table B.1 provides an overview of the behavior in all four treatments. We report the frequency of successful bribe exchanges (collusion), the frequency of bribe offers, the amount of bribes paid, the proportion of bribes accepted by the tax officer, tax compliance (both attempted and effective), and the propensity of tax payers to report tax officers when given the chance.

Table B.1: Summary statistics across treatments.

Treatment	*NoLEN*	*LEN*	*NoL-L*		*L-NoL*	
Rounds	1-20	1-20	1-10	11-20	1-10	11-20
Collusion (in %)	52.3	34.6	43.2	41.7	38.3	48.8
BribeOffered (in %)	71.0	57.3	65.0	70.5	72.4	66.0
BribeSize (in ECU)	14.4	16.6	13.1	15.4	16.6	15.2
AccRate (in %)	73.1	58.8	64.5	59.7	52.2	74.2
TaxDeclared (in ECU)	13.9	20.6	20.2	14.9	18.1	18.3
TaxPaid (in ECU)	20.1	27.9	26.8	24.8	27.5	23.4
Reporting (in %)	-	85.5	-	91.5	98.7	-

Note: Collusion denotes the incidence of successful bribe exchanges (bribes offered and accepted); BribeOffered denotes the incidence of a bribe being offered relative to all situation where this was possible; BribeSize is the average size of the offered bribes (0-30 ECU); AccRate denotes the fraction of bribe offers that were accepted by tax officers; TaxesDeclared denotes the amount of taxes initially reported (0-40 ECU); TaxesPaid denotes that taxes actually paid according to the final accepted report (0-40 ECU); Reporting denotes the fraction of reporting decisions by tax payers when audited.

Appendix C. Additional analysis

Table C.2: Logistic panel regression with random effects of acceptance on bribe size.

Accepted	*NoLEN*	*LEN*	*NoL-L*	*L-NoL*
BribeSize	0.3987***	0.1613***	0.2434***	0.2403***
	(0.1219)	(0.0445)	(0.0501)	(0.0578)
Leniency			−0.1954	−2.5350*
			(0.5717)	(1.3143)
Leniency × BribeSize			−0.0607**	0.0229
			(0.0296)	(0.0750)
Constant	−4.1264**	−2.1187***	−2.1590***	−1.9292*
	(1.8780)	(0.7271)	(0.7008)	(1.0607)
Linear combination test			0.1828***	0.2632**
BribeSize + Leniency × BribeSize			(0.03703)	(0.1142)
Observations	426	413	894	581

Note: Standard errors clustered at the group level in parentheses. * $p < 0.1$,** $p < 0.05$,*** $p < 0.01$.

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