SABOTAGE AND DETERRENCE INCENTIVE IN TOURNAMENT: AN EXPERIMENTAL INVESTIGATION

BY

MR. SORRAVICH KINGSUWANKUL

A THESIS SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF MASTER OF ECONOMICS (INTERNATIONAL PROGRAM)

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ABSTRACT

This research analyzes the impact of deterrence incentive on sabotage behavior in rank-order tournament using experimental method. Laboratory findings confirm that Becker’s deterrence hypothesis holds in a tournament setting. Implementing punishment suppresses sabotage behavior in the game. In addition, increasing probability of inspection is more effective than increasing the magnitude of penalty despite equivalence of expected punishment. Furthermore, analysis of the experimental data reveals existence of cognitive biases influencing sabotage behavior. Findings also suggest that perceived legitimacy of the enforced rule and regulations is important. This study supports existing theoretical frameworks pertaining to tournament theory and economics of crime, and also provides policy implications for contest designers.

Keywords: Sabotage, Rank-order tournament, Deterrence incentive, Experiment
JEL Codes: C72, C91, D23, M52

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CHAPTER 1
INTRODUCTION

This chapter discusses the background of the topic and sheds light on the applicability of rank-order tournament with sabotage in different fields.

1.1 Statement of the Problem

Tournament is a kind of labor contract in which an agent receives compensation based on his relative performance instead of a pre-specified salary, hourly wage or output-based performance. In tournament, the principal sets the value and the number of prizes beforehand. An agent with higher output receives prize of higher value. Hence, in a tournament, it is not the 'magnitude' of outputs that matters but the 'relative distance' among them. The use of tournament as an incentive scheme is a common practice in firms and organizations. The most notable example is promotional tournament in which the principal seeks to promote only one agent to a higher position. In this case, high prize in tournament implies salary the agent receives at higher post while low prize implies no raise in the salary.

In a principal and agent relationship, both players try to maximize their own payoffs. The principal wants to pay the least amount of compensation to the agent while the agent wants the highest level of compensation possible for the labor they put in. For certain types of production, it is easy for the principal to measure the output level. For instance, low-tier workers in a cloth factory receives wage based on the amount of finished products they produce in a day. The principal can observe output levels and pay accordingly. In this kind of simple input-output relationship, output level serves as good information about the input level.

However, it is sometimes difficult or even impossible for the principal to observe the level of input because there is 'noise' in the production function, which affects the outcome in such a way that output no longer serves as a signal about input level. Consider the following example: A salesman's production function is the function of work hours and some exogenous shocks. It is obvious that, given no random shock, if he increases work hours, his output will rise as he can reach more customers and make more sales. However, there are also random shocks that are not within his control. For instance, the economy may experience recession, causing people to postpone consumption. In this case, the final output will be lower as people tend to buy lesser despite long hours of work. In the opposite case when the economy is booming, there is positive shock that drives up the agent's output. Therefore, observing high level of output does not always imply high level of input. If the principal offers piece-rate compensation, this salesman is exposed to risk as there are chances that his output will be low because of exogenous shock. In other words, this is a moral hazard problem; when uncertainty affects the input-output relationship, principal must find a 'second-best contract' that induces the agents to exert effort and protects them against risk. Tournament incentive is one of such contract.

Lazear and Rosen (1981), a seminal paper on tournament, describes a rank-order tournament model in which employees compete for a share of the principal's purse, called 'prizes'. The allocation of prizes is done according to the rankings of their observable output levels, not the differences between them. From the employees' perspective, they have to exert a positive level of efforts irrespective of the random shock in order to win the contest. On the other hand, this incentive scheme helps principal to measure the output levels more easily by comparing them and also by sharing risk with the employees.

Nonetheless, competition does not always result in an efficient outcome. People are heterogeneous in nature and some may resort to unfair play. When the environment is loosely monitored, it is possible for contestants to engage in unfair means in order to decrease others' probability of winning and thereby improve their own relative standing in the tournament. Such individual may choose whether to exert productive or destructive efforts as both actions eventually result in an increase in the probability of winning.

Therefore, it can be concluded that while tournament is one of the ways to achieve a high level of output, it can be made ineffective if contestants can pull unfair tricks on one another. In addition, destructive efforts or sabotage tends to decrease social welfare of the contestants. Hence, it is crucial for the principal to monitor the behavior of agents by suppressing sabotage to make tournament fair and bring about efficient outcome.

1.2 Definition of Sabotage

Sabotage is a common phenomenon in our society and it can occur in various forms. In a general sense, sabotage refers to deliberate action meted out to the enemy resulting in some forms of destruction. In most cases, sabotage is understood to cause destruction to property. Be it employees destroying machines at workplace or ill-willed citizens disfiguring public facilities, such kind of destructive act results in lower output or productivity. In the real world, sabotage can occur in many forms in the field of business, politics, sports and warfare. Examples will be portrayed in section 1.3.

In the context of Personnel Economics, Lazear (1989) defines sabotage as "*any (costly) actions that one worker takes that adversely affect the output of another*". In this case, one can imagine the saboteur secretly damaging the rival's output. Such kind of sabotage is rather blatant and outright. Another concept has been studied by literatures in Industrial Organization. Salop and Scheffman (1983) define sabotage as '*raising rival's cost*'. In this case, the victim of sabotage finds it difficult to effectively exert productive efforts. For instance, employees in the organization can withhold useful information, pass manipulated information and damage others' equipment used in the production process. All these acts are done to make it more difficult for the rivals to win. Though both concepts are different, sabotage either directly reduces rivals' output or increases their cost, which then reduces their chance of winning the tournament. However, sabotage in this study is defined as "*a set of uncooperative actions that causes a reduction in the rivals' chance of winning the contest*". With this definition, the experiment in this study will have wide applicability in many fields- from business, politics, sports and labor management.

In general, sabotage is a wasteful action which does not generate any social benefit. Instead of using resource to disrupt others, one should expend time and effort towards a truthful competition. Thus, if sabotage can be deterred, resources can be redirected towards fruitful utilization, leading to an increase in social welfare and a healthy competition.

1.3 Examples of Sabotage

Macbeth, the screenplay by William Shakespeare, portrays one of the oldest forms of sabotage in the historical context of warfare- *internal rebellion*. Governed by immorality and ambition, Macbeth and his wife slayed King Duncan and ascended the throne. Though fictional, similar kind of sabotage has been accounted in many real world historical contexts in which internal rebellion and treachery caused the kingdom's downfall. For instance, undercover agents are sent to destroy the enemies' weapons in order to decrease the chance of success in war.

In the world of business, competition is tough and playing fair may not yield desirable result. Though firms cannot sabotage their competitors in an outright manner, such act can lurk in their marketing strategies or advertising campaigns which reduce the rival's chance of success. For example, one of the most talked-about rivalries in the coffee industry in recent years has been the competition between Starbucks and Dunkin' Donuts. Despite the fact that Dunkin' Donuts primarily serves blue-collar consumers, it has engaged in indirect insinuation about Starbuck through its marketing tactic and slogans (Woolf, 2014). In its fun-provoking advertisement, widely known as '*Fritalian*', Dunkin' Donut managed to mock Starbuck's 'hard-to-read' menu with a catchy song. Although the move was not a direct destruction, indirect denouncement about the rival firm can undermine consumers and cause considerable damage to profit and reputation.

Similar issues apply for the competition among employees within the firm. In 2013, Microsoft had to eventually abolish its controversial employee evaluation system known as '*stack ranking*' (Warren, 2013). In this system, each management team is required to rank all its subordinates, from the top to the worst performers. While top performers get rewarded with bonus and promotion, employees at the bottom risk losing their jobs. Hence, employees may resort to unfair measures to increase their relative ranking. Due to this reason, stack ranking has been widely criticized. It seems the cost of this incentive scheme outweighs its benefits, which is why Microsoft has decided to scrap the system altogether. Harbring et al. (2007) notes the possibility of sabotage at Merck (which also implemented stack ranking in 1986) studied by Murphy (1992) who mentioned as to how an employee attained promotion by cracking the network messaging system which allowed him to read all memos. Then, he sabotaged the workgroup software and manipulated the appointment calendars (Murphy, 1992). This kind of action disrupts others' functioning, making it harder for others to expend efforts efficiently.

In politics, parties can engage in '*black propaganda*' to destroy their rival's reputation. Real world example about rival party, attempting to discredit the ruling party to create some kind of uproar among the citizens, is abound. For instance, Thailand is well-known for its heated politics and one of the most infamous news is the coup d'état in May 2014. Even though the military government has tried to reform the country and promised to improve the economy, its oppositions have criticized for its competency for the simple fact that its Cabinet primarily comprises of military. Declining to cooperate with the government can bring about poor performance which leads to chances of getting over thrown by the public.

Sabotage is also prevalent in sports. There are many evidences of sabotage reported to have occurred in Tour de France. In 2013, one of the group-participants, Team Sky, raised their voice over sabotage and vandalism (Chadband, 2013). Sky's riders suffered from punctures during the race and tacks had been found in their tires. Due to this, they had to change the wheels and expend harder efforts to keep up with other racers. Irrespective of who the saboteur was, such act decreases the chance of winning, reduces efficiency and heavily reduces welfare in the case of injury and death.

Thus, it is evident that sabotage is a significant issue because of its prevalence in contest. Irrespective of its form, sabotage is undesirable and it is in the interest of both the contest designer (principal) and the participants (agents) to reduce this unfair practice in order to make competition fair and healthy.

1.4 Scope of the Study and Research Gap

Despite its wide applicability in many areas, this study will focus on sabotage in tournament within a firm-like organization. As pointed out earlier, an employer can use tournament incentive by giving high prize to the agent whose output is higher. In order to win, agents choose their productive and destructive efforts. While productive efforts increase own output, destructive efforts reduce the opponent's output. One can think of the productive effort as investment the agent puts into the production. Destructive efforts can be thought of as undesirable acts that destroy the opponent's output; for instance, destroying outputs or production tools.

The objective of this study is to analyze the impact of external deterrence incentive on sabotage behavior in tournament. Becker (1968) argued in his seminal work that crime can be deterred with appropriate punishment. Deterrence incentive theory has been tested empirically and experimentally in various areas such as stealing and corruption game. The common theme of these studies is to deter any undesirable action which is likely to harm the society. Closest to this study, there are two notable theoretical papers by Curry and Mongrain (2009) and Gilpatric (2011) who combine deterrence incentive with rank-order tournament game with cheating.

With stark unavailability of field data on sabotage, this study aims to fill the research gap by examining the impact of deterrence incentive in a tournament game using laboratory experiment. It is hoped that the result of this study will allow researchers to infer about behavior in the real world setting and equip employers with guidelines to design proper incentive scheme to deter sabotage in tournament.

1.5 Research Questions

This study employs Lazear and Rosen's (1981) rank-order tournament with extension to sabotage. In our tournament game, an agent competes against one opponent by choosing productive and destructive efforts. The winner of the tournament receives high prize while the other receives low prize. As we are applying Becker's (1968) deterrence hypothesis, agents face external deterrence incentive according to the treatment they are in. The research questions are as follow:

1. Are experimental results in line with the theoretical prediction?
2. How effective is the extrinsic deterrence incentive in reducing sabotage in tournament?
3. What are the policy implications drawn from the laboratory experiments?

CHAPTER 2
REVIEW OF THE LITERATURE

This chapter reviews the literature related to sabotage in rank-order tournament and deterrence hypothesis in various contexts.

2.1 Rank-Order Tournament

Rank-order tournament is a contest in which agents exert costly productive efforts with the aim of affecting probability of winning the contest. Principal observes output level which is the outcome of efforts exerted and random shock in the production function. The random shock that affects agent's productivity is referred to as 'performance error' or 'unobservable luck'. When shock is positive, there are some other factors (or simply 'luck') that favor the agent and raise output levels. On the other hand, when shock is negative, there are some other factors that suppress agent's productivity causing output level to decrease. Prizes are awarded according to the ordinal ranking. In case there is only one prize, it is awarded to the agent with the highest level of output while other agents receive nothing.

In Lazear and Rosen's (1981) seminal paper, rank-order tournament is proposed as an optimal labor contract. It has been shown that prize incentive in rank-order tournament can achieve the efficient allocation of resources generated by piece-rate compensation under the condition that agents are risk neutral. However, tournament dominates piece rate payment when output cannot be measured directly. Thus, it may be less costly for the principal to use prize incentive based on ordinal ranking. Lazear and Rosen (1981) also examined the case when agents are risk averse. It is not conclusive as to which incentive scheme is preferred when agents are risk averse, depending on the utility function and amount of luck. However, tournament may be preferred by risk-averse agents as it eliminates income variation caused by common shock in a given firm. In short, tournament incentive offers agents a kind of insurance from common shocks in production. The first tournament experiment was conducted by Bull et al. (1987). The main objective of the paper was to test the theory and compare outcomes of a rank-order tournament and a piece-rate incentive scheme. Their results conformed to the theoretical predictions and confirmed that efforts under piece-rate compensation are similar to those under tournament, which was argued by Lazear and Rosen (1981). However, variance of efforts is much greater under tournament (Bull et al., 1987). These main findings have, since then, been replicated in laboratory experiments (For a complete survey on experimental literatures related to rank-order tournament, see Dechenaux, Kovenock & Sheremeta, 2015).

In all, common findings among these experiments on rank-order tournament are as follows: (i) there is little to no overbidding in rank-order tournament, (ii) there exists significant heterogeneity in the behavior of individual subjects and (iii) bids are usually distributed around equilibrium. The first and third common findings imply that experimental results conform to the theoretical predictions of respective research papers. It should be noted that equilibrium predicted by theory may vary across studies depending on the values of parameters set by the experimenter. However, the average value of efforts comes close to the predictions by theory. The second common finding implies that even though subjects' decisions can be predicted on average, the decision of individual subject varies and does not necessarily conform to the theoretical prediction. This implies that variance in individual performance can be larger in the case of tournament compared to piece-rate incentive scheme.

From these common findings about experiments on rank-order tournament, we can say that tournament possesses both advantages and disadvantages. As argued in Lazear and Rosen (1981), an important merit of using tournament incentive is that it protects agents from random noise that affects all players equally. This is because common shock, either positive or negative, does not affect players' relative ranking. Wu et al. (2006) confirmed this through both theory and experiment that when there are some common shocks that affect all agents equally, tournament dominates other incentive schemes (fixed payment and piece-rate contracts). Nevertheless, tournament may not be the best incentive scheme when considered in the real world business context. High variance in efforts in tournament may impose uncertainty regarding principal's revenue and therefore imposes an additional cost on employers which reduces the overall efficiency of the workplace (Lazear, 1999; 2000).

Apart from experiments that aimed to compare different incentive schemes, many studies examined the impact of variation in parameters in the tournament (number of players, heterogeneity of agents, number and size of prizes, etc.) and tournament structure (multi-stage contest, endogenous variables, etc.). There are also many other literatures that examined these parameters but employed the other two canonical contest models namely; lottery contest and all-pay auction. As the scope of this study is sabotage in tournament, only literatures related to rank-order tournament will be discussed so that it is easier to understand their impacts on subjects' behavior in the game. Nonetheless, notable research papers using the other two contest models will be discussed wherever necessary.

With regards to how the number of contestants impact players' behavior in tournament, it was argued by Gerchak and He (2003) that expected efforts may decrease, increase or remain constant when the number of players increases, depending on the distribution of noise in the production function. As for the experimental evidence, Orrison el al. (2004) found no significant difference in the average effort levels of subjects when the number of players is varied and the random term ε_i is uniformly distributed. In contrast, List et al. (2014) examined the effect of the number of players under different noise distributions, with effort increasing, decreasing and remaining constant. They found that the average effort level decreases with the number of players; a result that contradicts the theoretical predictions.

Heterogeneity among players in the tournament can be modelled through different ways. For instance, players can differ in cost functions which imply that players with high cost function find it harder to exert productive efforts compared to players with low cost function. Other type of heterogeneity can be modelled through player's prize valuation. In the real world, wage rate may be different for male and female workers. This can be modelled in the laboratory setting by fixing different prizes for a group of players in the tournament. Theoretical studies on contest claimed that greater heterogeneity among players leads to lower aggregate effort (Baik, 1994; Stein, 2002). This reduction in aggregate effort stems from what experimental economists referred to as "discouragement effect". This effect implies that "weaker" players tend to drop out of tournament because they know that it is unlikely for them to win when they encounter strong players. Similarly, when a player knows the prize to be received is low, he may perceive competition as unworthy and chooses to slack. The effect, however, does not end here. Knowing that weak players tend to exert low effort levels, strong players cut back their costly efforts, leading to a relatively passive bidding behavior compared to the case when they compete with players with similar abilities. Thus, heterogeneity in tournament may be costly for the principal on account of discouragement effect. Other heterogeneities investigated in the context of rank-order tournament are asymmetries in the contest. Schotter and Weigelt (1992) investigated the case of unfair (when rules of the game favor one group of players) and uneven (when players have different cost functions) tournaments and found that such asymmetry leads to reduction in individual efforts.

Many studies also investigated the case of multiple prizes. The central aim of these studies is to estimate the optimal prize structure in contest (i.e. which prize structure is better?) Orrison et al. (2004) were the first to conduct an experiment that examines the impact of prize structure on efforts in tournament. It was found that aggregate effort is lower with many small prizes than with few large prizes. This result is in line with the impact of “discouragement effect”; petty reward is not worth the costly effort. Kalra and Shi (2001) argued theoretically that a multiple-prize rank-order tournament can generate higher efforts than a single-prize tournament when players are risk-averse. This argument was confirmed by Lim et al. (2009) who conducted an experiment to test the theoretical predictions regarding prize structure. Their study consisted of both laboratory and field experiments to test the effect of prize structure on sales contest. It was found that effort levels in treatments with multiple prizes were higher than the baseline case where there was only one winner prize. By having multiple winners, sale performance was enhanced (Lim et al., 2009).

2.2 Sabotage in Tournament

With some real world examples and rationale behind sabotage discussed in Chapter 1, the issue of sabotage is significant owing to the negative externalities. Instead of exerting productive efforts, one can invest in destructive efforts to disrupt others and thereby causes the opponents’ output to fall. In short, sabotage reduces productivity, social welfare of players and renders competition unfair. This section will provide an overview on the existing literature pertaining to sabotage in contest and tournament.

The problem of sabotage in tournament was first pointed out by Lazear (1989). Despite widespread occurrence in the real world, the issue of sabotage in tournament has not been given much attention by researchers owing to data unavailability (See survey by Chowdhury & Gürtler, 2015). Most of the studies in this extension aimed to investigate policies to restrict unfair measure under different contest designs (varying number of prize, prize spread, number of players, etc). Among these works, Harbring and Irlenbusch (2005, 2008, 2011) and Harbring et al. (2007) are among the most prominent works in this extension.

According to the mainstream economic theory, a rational individual makes decision based on cost-and-benefit analysis. Thus, contest designer can deter sabotage either by decreasing the marginal benefit or increasing the cost of doing so (Chowdhury & Gürtler, 2015). Thus, an experimenter can design tournament and consider factors that affect these two parameters to see the effect of policies to restrict sabotage in the contest.

Harbring and Irlenbusch (2005) tested the effect of endogenous prize selection in the tournament game with sabotage by using a principal and agent setting. Winner prizes are either exogenously determined or endogenously chosen by the principal according to the treatment. It was found that in a baseline treatment with no interaction, efforts and sabotage increase with the prize spread which qualitatively follow the theoretical prediction. However, when prize spread is larger, increment in sabotage is more than that of effort which in turn adversely affects principal’s payoff (Harbring & Irlenbusch, 2005). However, their study did not find concrete evidence to support interaction between principal and agent as a way to mitigate sabotage. It was found that sabotage level was much higher in interaction treatment than that of baseline treatment if the lowest winner prize is implemented. Thus, it was concluded that in a principal and agent setting, sabotage decision in tournament is directed by prize spread and retaliation towards unkind principal (Harbring & Irlenbusch, 2005). Similar results had been achieved by Falk et al. (2008).

Apart from prize spread, number of contestants is another parameter studied in tournament experiment. Harbring and Irlenbusch (2008) conducted an experiment to test the effect of number of agents as well as the number of winners on effort and sabotage. Variation in the number of agents is 2,4 and 8 while fraction of winner is ½, ¼, and ¾. As for the number of contestants, it was found that tournament size does not affect effort and sabotage level. However, result of the effect of number of winners is more evident. It was found that the level of productive efforts is highest in the treatments with balanced winner and loser ratio (Harbring & Irlenbusch, 2008). This result is similar to that of Orrison et al. (2004) who found that players exert lower efforts in treatments with more winners compared to more losers. Harbring and Irlenbusch (2008) explained this result with Atkinson's (1958) *Achievement Motivation Theory*. From the psychological aspect, it is argued that people take pride in the success they have accomplished. Thus, when the fraction of winner prize is low, expectancy of winning is low but the challenge is large. On the other hand, when the fraction of winner prize is high, expectancy of winning is high but the challenge is low. Therefore, the overbidding in effort observed when the fraction of winner might have been motivated intrinsically.

Harbring and Irlenbusch (2011) aims to test the effect of communication between principal and agents on efforts and sabotage. This study replicated the main findings found in the earlier studies; sabotage increases with prize spread. As the gap between what the winner and the losers get increases, it becomes more worthwhile to sabotage. Harbring and Irlenbusch (2011) proposed minimization of prize spread as the solution which is in line with that of Lazear (1989) who suggested "pay compression" as a solution to sabotage. Pay compression implies smaller prize spread, which can be interpreted as lower wage differential. Regardless of the solution it may offer, pay compression imposes one additional problem for contest designer because when differential wage is minimized, expected efforts by players in the tournament will fall too. As for the effect of communication, it was found that sabotage is suppressed when negotiation can take place. In communication treatment, effort increases and sabotage decreases significantly which results in higher level of output produced. The fact that principal and agents can agree upon the wage rate makes agents feel that the wage they receive is somewhat justified and hence exert high level of efforts and low level of sabotage (Harbring & Irlenbusch, 2011).

In addition to the above result, Harbring and Irlenbusch (2011) found that the number of contestants has no effect on the sabotage level, contradicting Konrad's (2000) theoretical prediction. Konrad's theory predicts decreasing marginal benefit from sabotage as the number of contestant increases because the saboteur cannot fully internalize the benefit of his own action. This dynamic occurs because Konrad (2000) assumes that a player can direct sabotage towards a particular player while Harbring and Irlenbusch (2011) assumes sabotage to be "reducing outputs of all other players", which explains why number of contestants does not affect sabotage level. However, Konrad's (2000) idea regarding externality of sabotage was proved in an experimental paper by Ch'ng (2013) who assumed that sabotage is directly towards one opponent only. With this assumption, it was found that probability that an agent will sabotage is lower for high wage spread in a 3-player treatment compared to a 2-player treatment. As Konrad (2000) had suggested, an agent can increase his probability of winning relative to the victim by sabotaging. However, if he exerts productive efforts, he can increase the probability of winning over two other agents. In other words, an agent who does not sabotage can 'free ride' others who do. Thus, the implication from Ch'ng (2013) is that sabotage can be mitigated when tournament size is large enough and there is uncertainty regarding the chance of winning through sabotage.

Within the experimental paradigm, results in laboratory can be affected by the way in which an experiment is conducted. Harbring and Irlenbusch (2011) address experimenters by putting framing effects to test. It was found that when language used in the instruction is framed in an employment context, sabotage is significantly lower. This allows us to explain the phenomenon outside the realm of Neo-classical economics. Players are not absolutely led by pure self-interest and their decisions are affected by the situation they are put in. This result implies that outcome in laboratory experiments may vary with the type of frames used in the experiment.

In the other research paper, Harbring et al. (2007) conducted an experiment on corporate contest with heterogeneous agents. Heterogeneity has been modelled through different cost functions. Less able agents have steeper cost function compared to that of more abled ones. In a two-stage game with three players, players decide whether to sabotage or not. If an agent is sabotaged, his cost function is raised which implies that it is more difficult to exert productive efforts when one is sabotaged. After sabotage decision is made, players receive respective cost functions and choose effort levels, which determine the prize distribution. Three treatments were carried out namely; (i) Hom: 3 homogenous agents, (ii) HetF: 2 Favorites (low-cost agents) and 1 Underdog (high cost agent), and (iii) HetU: 1 Favorite and 2 Underdogs. Harbring et al. (2007) anticipated that different group compositions would lead to different behavioral patterns. First, their experimental results confirmed that effort increases in the sum of marginal costs of an agent's opponents and decreases in one's own marginal cost of effort. Regarding behavioral hypotheses, it was found that Underdogs sabotage Favorites less the higher the proportion of strong agents. This implies that when facing with more than one strong opponent, weak agent is more likely to give up but when he is faced with fewer strong opponents (one in their case), weak players exert higher sabotage level. The paper also observed that sabotage in the treatment with few Favorites was significantly higher than that in the baseline case. Harbring et al. (2007) referred to this as a "Battle of Giants" in which Favorites compete against each other more fiercely when they face with few strong agents. Apart from the main findings, Harbring et al. (2007) found that when saboteur is identified to the victim, sabotage level is significantly higher.

A theoretical examination by Gürtler et al. (2013) showed that sabotage is '*counterproductive*' as well as '*weakening incentives*' to expend efforts. Gürtler et al. (2013) examined this in a two-stage game with a simultaneous binary choice of effort in the first stage, followed by a simultaneous binary choice of sabotage, contingent on the efforts in the first stage. They found that subjects have less incentive to exert efforts in the first stage, knowing that the opponents can sabotage them in the second stage. Thus, they proposed that by concealing information about intermediate output, sabotage level can be decreased. This has been supported by a small experiment in the paper (Gürtler et al., 2013).

Chen (2005) offered a different theoretical solution for sabotage. His work considers a situation of contest where workers compete in a promotional contest. What employers would normally do is to select the most suitable candidate internally. As discussed, such incentive scheme is prone to sabotage. The solution to this problem is to fill in the position with external contestant (Chen, 2005). The rationale behind this is that the marginal benefit of sabotaging external competitor is zero. Put it simply, internal contestants cannot sabotage the external competitor. Thus, the best option for internal contestants is to exert productive efforts so to compete with both internal and external contestants.

As mentioned above, raising the cost of sabotage is the alternative to decreasing the marginal benefit. The saboteur can be punished if his action is detected. In a laboratory experiment, what the experimenter can do is to exclude the saboteur from the prize pool, confiscate the prize previously given or even punish him. Curry and Mongrain (2009) examined in their theoretical paper about the effect of redistribution of the confiscated prize in case a winner is caught cheating (note that cheating increases own's output by unfair means while sabotage decreases opponent's output). Curry and Mongrain (2009) considers a contest in which players decides on a dichotomous choice whether to cheat or not. When prize is redistributed, subjects find it more worthwhile to exert productive efforts and improve his ranking given that others who sabotage is caught. With this imposed, the subjects find winning through unfair means costlier and the issue is mitigated (Curry & Mongrain, 2009).

One other theoretical paper, which is closest to this study, was by Gilpatric (2011) who considers a continuous cheating decision in a rank-order tournament. In this paper, players decide on their choice of effort and cheating levels simultaneously. The paper employed "perfectly correlated audits". With certain probability, all players will be audited, else no one is. When players are audited, they face certain probability of getting caught, which depends on the level of cheating chosen by them. In the event that they are caught, players receive loser prizes and suffer outside penalty as punishment. Under this framework, Gilpatric (2011) found that cheating in a symmetric equilibrium decreases with the probability of audit, the ratio of outside penalty to prize spread and the greater random noise. This study has adapted Gilpatric's (2011) model to accommodate for the case of sabotage in rank-order tournament. This will be revisited in Chapter 3.

Other policy to raise the cost of sabotage, proposed by Lazear (1989), is to separate the contestants by distance. When contestants are not located in the same neighborhood, they find it costlier to sabotage. Apart from these, Harbring et al. (2007) explained that when the identity of saboteur is known, subjects engage in retaliation. Some subjects may engage in sabotage simply to take revenge or to be nasty towards other contestants even at their own cost. Thus, the possibility of retaliation adds up to the cost of sabotage which may help suppress sabotage at the initial stage.

Another method to mitigate sabotage in tournament is punishment. In real world, those who commit crime are punished if caught. Depending on the magnitude of punishment and the probability of getting caught, punishment will decrease the marginal benefit (or increase the marginal cost) of exerting destructive efforts. Intuitively, appropriate level of punishment can deter sabotage in tournament. So far, there is still no experimental literature which test deterrence hypothesis. Aimed to fill this gap, this study will test deterrence hypothesis by implementing punishment in tournament setting to deter sabotage. To bridge this gap, we discuss literatures related to punishment as a tool to mitigate undesirable actions in other contexts.

2.3 Deterrence Hypothesis

Crime can be defined as any illegal activity prescribed by law where the consequence of conviction imposes punishment upon the undertaker. The issue of crime is significant in Economics as its occurrence is likely to generate negative externality on the general public. Corruption, bribery, stealing are some examples of crime. Crimes generate benefits for certain group of people at the cost of others. Irrespective of its form, the rationale behind deterrence hypothesis is to impose cost of the action to deter crime.

Deterrence hypothesis states that imposing penalty will reduce crime, *ceteris paribus.* Economic theory of crime was first pioneered in the classic paper by Becker (1968). In Becker's (1968) model, severity of punishment and probability of detection are perfect substitutes under the assumption of risk neutrality. However, the effectiveness of deterrence incentive depends on the severity of punishment as well as probability of detection. Since this seminal work, there have been many empirical and experimental studies that have applied and tested the effectiveness of deterrence incentive in various contexts. It should be noted that traditional empirical analysis suffers from drawbacks regarding data unavailability or incomplete data (i.e. underreporting of crime, estimation of aggregate statistics, etc.) which can potentially cause bias estimation. Thus, most researchers have resorted to laboratory experiment to generate appropriate data. For a survey on experimental law and criminology, see Engel (2016). The remaining part of this section will discuss some interesting experimental papers related to deterrence hypothesis.

Public good is a resource which is both non-excludable and non-rivalrous. Owing to its nature, public good suffers from a free-rider problem. According to the *homo economicus*, economic theory predicts that it is in the individual's interest to free-ride others because he cannot be excluded irrespective of his contribution. Assuming common knowledge, there will be no public good. However, empirical evidence does not reach that extreme. A common finding among public good literature is that free-rider problem exists in the form of suboptimal contribution. To mitigate the free-rider issue, economists have examined ways to increase contribution to public goods and one of the ways to mitigate this behavior is to impose penalty. Anderson and Stafford (2003) investigated punishment as a regulatory tool to curb freeriding behavior in a public good experiment. In this study, penalty is incorporated in the voluntary contribution mechanism to mitigate freeriding in order to achieve the highest possible contribution from all players. Anderson and Stafford (2003) mimicked two real-world instances; (i) one-time treatment, which corresponds to the case when people encounter contribution decision once, and (ii) repeated treatment, which corresponds to the case when people face contribution decisions repeatedly. Theoretically, both scenarios suffer from free-riding problem. With repeated interaction, contributors gather more information and 'decay' in public good contribution is usually observed. In both treatments, it was found that punishment encourages compliance to contribute; group contribution increases in the expected punishment.

Another study by Gürerk, Irlenbusch and Rockenbach (2006) focuses on the endogenous choice between two institutional settings; a sanction-free society and a sanctioning one for a public good game. It is found that in a long run participants prefer to be in a sanctioning institution rather a sanction-free one even though punishing free rider incurs a private cost. At first, participants choose a sanction-free institution but then witness the decay in contribution. As time passes, subjects start to migrate to a sanctioning institution where punishment can be meted out. Free riders in a sanctioning institution learn that they can be punished for not contributing. Due to this, sanctioning institution is likely to generate more payoff for subjects, nudging them to adopt practices of high-payoff institutions (Henrich, 2006). Thus, ability to punish free riders can establish a norm in the society, achieve cooperation and further deter non-cooperative behavior. It should however be pointed out that in our study, deterrence incentive aims to reduce crime (i.e. sabotage), while the aforementioned studies aim to induce (reduce) cooperation (non-cooperation).

Many experimental papers have applied deterrence hypothesis in a stealing game. In stealing game, players are given unequal endowments. While the advantaged player is passive, the disadvantaged player decides how much endowment he wishes to take away. Schildberg-Hörisch and Strassmair (2012) found a result which contradicts deterrence hypothesis. From between-subject analysis, it was found that the average amount taken does not monotonically decrease in deterrence incentive. For small and intermediate incentives, subjects take significantly more compared to that in which there is no deterrence incentive. However, strong incentive could deter stealing (Schildberg-Hörisch & Strassmair, 2012). As for the within-subject analysis, it was also found that small and intermediate incentives backfire. For instance, their result reported that fair-minded players (who take intermediate amount in no incentive round) take larger amount from the other person when incentive is imposed. This result is in line with motivation crowding theory. A "crowding-out effect" refers to an anomaly in economics that suggests a phenomenon that contradicts the fundamental economic law (Frey & Jegen, 2001). Tversky and Kahneman (1986) argued that when extrinsic incentive is in place, it interferes the decision making process by shifting motivation away from an intrinsic one. In this case, extrinsic incentive shifts attention from ethical and other-regarding to instrumental and self-regarding one (Schildberg-Hörisch & Strassmair, 2012). Subjects may initially think- *"I do not want to take a lot from the other person because we should receive somewhat fair payoffs"*. But when deterrence incentive is in place, this intrinsic motivation may be crowded out and subjects may think- *"Now that there is a chance that my payoff will be reduced, how much more should I take away from him so that payoffs are fair"*. Apart from the main findings, they found that probability and severity of punishment are interchangeable (Schildberg-Hörisch & Strassmair, 2012). This implies that policymakers can design punishment scheme be considering just an expected penalty.

Another paper which found evidence that deterrence incentive backfires is a field experiment about a group of day-care centers in Israel by Gneezy and Rustichini (2000). Their study examined the effect of fine on the frequency of late arrivals for child pickup from day-care centers. The data included observations from 10 day-care centers over a period of 20 weeks. No fine was imposed on any late arrivals for the first 4 weeks for all day-care centers. However, at the beginning of the fifth week, fine was imposed on 6 day-care centers which charges parents who arrived more than 10 minutes late. The other 4 day-care centers did not impose fine which were treated as a baseline case. The effect of fine was rather surprising; frequency of late arrivals increased and was significantly higher than that of the baseline case. In addition to this, fine was abolished at the beginning of the seventeenth week. However, parents' misbehavior remained the same; they continued to arrive late and the number was higher than that in the initial 4-week period (Gneezy & Rustichini, 2000).

The result is rather ambiguous; introduction of fine actually increased the activity that was fined and the new higher level could not be reduced when fine was removed (Gneezy & Rustichini, 2000). Their argument was based on differential information and incomplete contracts. It was argued that change in behavior on the part of parents could have occurred because they have acquired information about the day-care centers which reshaped their perception. When fine was introduced, parents might have realized that fine was the heaviest punishment possible. Knowing that fine was the only (legally) feasible punishment, the behavior of parents to arrive late could be thought of as a best response in a game of incomplete information (Gneezy & Rustichini, 2004).

However, there is still no experimental paper which incorporates external deterrence incentive together with rank-order tournament and this study aims to fulfill this gap. The theoretical framework of the model is based on Gilpatric (2011).

CHAPTER 3
RESEARCH METHODOLOGY

This chapter is divided into four sections; (3.1) outlines the basic theoretical framework, (3.2) discusses the details of experimental design and treatment specification, (3.3) provides an overview of the experimental procedure and (3.4) lays down the hypotheses.

3.1 Theoretical Framework

Rank-order tournament with sabotage follows the original version of Lazear and Rosen (1981). In this extension, players choose productive and destructive efforts. Productive effort or investment increases own output. On the other hand, destructive effort or sabotage decreases opponent's output and thereby his likelihood of winning the tournament. The production function of agent i follows this equation:

$$y_i = e_i - s_{-i} + \varepsilon_i \tag{3.1}$$

where y_i is observable output

e_i is unobservable effort level; $e_i \in [0, \bar{e}]$

s_{-i} is destructive effort by agent i's rival; $s_{-i} \in [0, \bar{s}]$

ε_i is performance luck; $\varepsilon_i \in [-\varepsilon, +\varepsilon]$.

Note that the production of player $-i$ is symmetrical to Equation (3.1). Work environment is in such a way that principal cannot observe efforts (e_i) owing to the random shock or performance luck (ε_i). This random term is i.i.d. for all players and is drawn from a uniform distribution with interval $[-\varepsilon, +\varepsilon]$. Thus, since principal can only observe output (y_i), he awards workers based on their relative performance to protect them from shocks. Player with higher output will receive winner prize (W_1) and the one with lower output receives loser prize (W_2) where $W_1 > W_2 > 0$.

Unfortunately, workers in this setting have an option to sabotage their co-worker. In this study, we only consider a 2-player tournament game and thus, effort and sabotage are substitutes.

Hereafter, the discussion has been adapted from Gilpatric (2011) who examined cheating in rank-order tournament. However, this research considers a set of uncooperative actions, collectively termed as “sabotage”. While cheating raises own output, sabotage decreases rival’s output but ultimately, they result in “increasing own chancing of winning” in the case of a 2-player tournament.

Let us now focus on the sabotage decision by player i. If he decides to sabotage ($s_i > 0$), the output level of the opponent reduces by that amount and the consequent effect is the increase in the probability of ranking first. From the parameter defined above, $s \in [0, \bar{s}]$ which represents a decrease in the output level caused by sabotage. It is assumed here that all contestants are inspected by the principal with probability α and this is a common knowledge in the game. The auditing system used here is known as “correlated audit”. In the event that inspection occurs, both contestants are caught sabotaging with probability $\beta(s)$, which is a twice continuously differentiable function which satisfies these conditions- $\beta(0) = 0$, $\beta'(0) = 0$, $\beta' \geq 0$ and $\beta'' > 0$.

In the real world tournament, penalty imposed on unfair play can be roughly categorized into 2 types: (i) the contestant is disqualified from the winner prize and receives loser prize and (ii) the contestant incurs “outside” penalty in addition to the cost incurred in the contest. The first is a common norm for unfair players to be deprived of prizes in the competition. Consider a promotional tournament in which workers compete for a high-rank position, the person who ranks first but caught unfair is deprived of the right to promotion. Instead, he continues to receive the loser prize, which is the wage at his current position. The second type of penalty can be thought of as an additional cost, after the unfair action is caught. For instance, in a workplace competition, if a person is found to have sabotaged, he spoils his employment record. Gilpatric (2011) referred to this as “reputation cost” that reduces future earnings. In this study, we assume that the probability of getting caught depends on the magnitude of sabotage but the punishment when caught is fixed. Outside penalty is fixed at F.

We now consider a 2-player tournament game between player i and j. Both players compete for the winner prize by making a simultaneous choice of effort and sabotage. Unlike other studies discussed in Chapter 2, we make two important assumptions. First, while others assume that sabotage requires agents to expend resource, the cost of sabotage in this study is the punishment after the act has been detected. Therefore, sabotage in this study is “costless” to the undertaker as long as it is not detected. By setting resource expenditure zero, relationship between sabotage and deterrence incentive can still be made. In addition, this assumption is made to simplify the decision making process for subjects in the experiment. Second, it is assumed that cost function for effort is a standard convex function $C_e(e_i)$ with $C' > 0$ and $C'' > 0$. As this experiment uses both real effort task for measuring the effort levels, quantitative prediction cannot be made regarding effort at equilibrium as true cost function is unknown. In other words, cost of effort is represented with disutility from work while the cost of sabotage comes with probability of detection. Let $P_i(e_i, s_i, e_j, s_j)$ be the probability that player i ranks first.

The expected payoff of player i can be written as:

$$E\pi_i(e_i, e_{-i}, s_i, s_{-i}) = \alpha\Delta(1-\beta(s_i))\left(1-\beta(s_j)\right)P_i(e_i, s_i, e_j, s_j) + \alpha\Delta\beta(s_j)(1-\beta(s_i)) + (1-\alpha)\Delta P_i(e_i, s_i, e_j, s_j) + W_2 - C_e(e_i) - F\alpha\beta(s_i) \quad (3.2)$$

The first term signifies the payoff when player i wins when inspection occurs but no one is caught. The second term is the payoff when player i wins when inspection occurs but player j is caught and disqualified. The third term is the payoff when player i wins when there is no inspection. The expected payoff function for player j is symmetric to Equation (3.2).

Assuming that player i is a rational, self-interested decision maker, he maximizes his expected payoff choosing e_i and s_i. We have the following FOCs (or player i’s best response functions):

$$e_i: \Delta\frac{\partial P_i(e_i, s_i, e_j, s_j)}{\partial e_i}\left[\alpha(1-\beta(s_i))(1-\beta(s_j)) + (1-\alpha)\right] - C'_e(e_i) \quad (3.3)$$

And

$$\mathrm{s_i}: -\alpha\Delta\, \beta'(\mathrm{s_i}) \left[\left(1-\beta(\mathrm{s_j})\right) \mathrm{P_i}(\mathrm{e_i}, \mathrm{s_i}, \mathrm{e_j}, \mathrm{s_j}) + \beta(\mathrm{s_j})\right] + \Delta \frac{\partial \mathrm{P_i}(\mathrm{e_i},\mathrm{s_i},\mathrm{e_j},\mathrm{s_j})}{\partial \mathrm{s_i}} \left[(1-\alpha) + \alpha\left(1-\beta(\mathrm{s_j})\right)\left(1-\beta(\mathrm{s_i})\right)\right] - \mathrm{F}\alpha\beta'(\mathrm{s_i}) = 0 \quad (3.4)$$

Furthermore, we make a Nash Cournot assumption. In other words, players arrive at a symmetric equilibrium where they choose $e_i = e_{-i} = e^*$ and $s_i = s_{-i} = s^*$. We can write the unique symmetric equilibrium as:

$$C'_e(e) = \Delta \frac{\partial P_i(e_i,s_i,e_j,s_j)}{\partial e_i} \left\{1 - 2\alpha\beta(s) + \alpha\left(\beta(s)\right)^2\right\} \quad (3.5)$$

And

$$\beta'(s) = \frac{\Delta \frac{\partial P_i(e_i,s_i,e_j,s_j)}{\partial s_i}\left[1-2\alpha\beta(s)+\alpha\left(\beta(s)\right)^2\right]}{\frac{\Delta\alpha(1+\beta(s))}{2} + \alpha F} \quad (3.6)$$

It should be noted that with the Nash Cournot assumption, the marginal probability that the player wins depends on the distribution of random noise. It was shown in Harbring and Irlenbusch (2008) that in a symmetric equilibrium e^* and s^*, the marginal probability of winning equals $\frac{1}{2\bar{\varepsilon}}$ where $\bar{\varepsilon}$ is the spread of random component.

Equation (3.6) defines the degree of sabotage in symmetric equilibrium if an interior solution exists. Probability of inspection α should be sufficiently large such that an interior solution exists.

The level of sabotage in equilibrium depends on probability of inspection α, the shape of $\beta(s)$ which determines how quickly probability of detecting sabotage increases with sabotage level, distribution of ε and the ratio of outside penalty to the spread $\frac{F}{\Delta}$. However, when there is no inspection ($\alpha = 0$), both agents will exert maximum level of sabotage because it is costless. But when there is inspection ($\alpha >$

0), sabotage should decrease monotonically. It can be concluded that sabotage in symmetric equilibrium decreases with probability of inspection, ratio of outside penalty to spread and higher random noise.

The level of effort in equilibrium (See Equation 3.5) depends on probability of inspection, sabotage level and random noise. This is because with positive auditing probability and some level of sabotage, effort loses its power in determining "who is the winner" as there are chances that either player is caught sabotaging. The higher the probability of inspection, the lesser will effort influence output level, which causes players to exert low efforts. However, there exists a countervailing effect of probability of inspection on effort; sabotage decreases and eventually causes a reduction in the probability of detecting sabotage. The fact with regards to which effect will dominate requires an empirical investigation.

We can differentiate Equation (3.5) with respect to α to see how probability of inspection affects effort. We have

$$\frac{\partial e}{\partial \alpha} = \frac{\Delta g(0)}{C"(e)}\{2\alpha\beta'(s)\frac{\partial s}{\partial \alpha}[\beta(s) - 1] + \left(\beta(s)\right)^2 - 2\beta(s)\} \tag{3.7}$$

Effort will increase in equilibrium as a consequence of higher probability of inspection if and only if

$$-2\alpha\beta'(s)\frac{\partial s}{\partial \alpha}[\beta(s) - 1] > \beta(s)(2 - \beta(s)) \tag{3.8}$$

For Equation (3.8) to hold, $\left|\frac{\partial s}{\partial \alpha}\right|$ and $\beta'(s)$ must be large enough as the effect of an increase in probability of inspection must significantly decrease the extent of sabotage if inspection occurs. This condition will not hold for small value of α for which an increase in probability of inspection will decrease effort.

In short, when there is the inspection and detection system is not enforced, we have a corner solution and sabotage will be maximum. When the system is perfectly enforced, inspection always occurs and a small amount of sabotage is detected with near certainty, so s approaches zero. Based on the model in the earlier section, parameters are chosen as in Table 3.1.

Table 3.1

Parameter specification

Parameters	Specification
Productive efforts	$e \in [0,48]$
Destructive efforts	$s \in [0,10]$
Prize spread ($W_1 = 150, W_2 = 50$)	$\Delta = 100$
Interval size of random component	$\bar{\varepsilon} = 20$
Cost functions for productive efforts	$C(e) = \frac{e^2}{c_e}$ $with\ c_e > 0$
Probability of detection	$\beta(s) = \frac{s^2}{100}$
Outside penalty if caught	$F = 20{,}40$

Source: Author's specifications

With the above specification, the FOCs in equations (3.5) and (3.6) can be rewritten as:

$$e^* = \frac{5c_e}{4}\{1 - \alpha\frac{s^2}{50} + \frac{\alpha s^4}{100^2}\} \tag{3.9}$$

$$\alpha s^4 - 40\alpha s^3 - 200\alpha s^2 - 5600\alpha s + 10000 = 0\ for\ F = 20 \tag{3.10}$$

$$\alpha s^4 - 40\alpha s^3 - 200\alpha s^2 - 7200\alpha s + 10000 = 0\ for\ F = 40 \tag{3.11}$$

Equation (3.9) implies that effort level at equilibrium is dependent on the level of sabotage at equilibrium. The value of $e^*$is unknown and depends on the value of c_e. On the other hand, the level of sabotage at equilibrium is independent of effort level. From Equation (3.10) and (3.11), s^* can be calculated for any positive level of α. When $\alpha = 0$, it is rationale for subjects to choose $s^* = \bar{s} = 10$. Thus, we can conclude that when there is no inspection, we have corner solution where subjects choose maximum level of sabotage, which implies $s^* = 10$.

When inspection is enforced, sabotage reduces with an increase in the probability of inspection α. Our experiment will also vary two levels of penalty where $F = 20{,}40$. Hence, the levels of sabotage in symmetric equilibrium are given in Table 3.2. It can be concluded that as probability of inspection increases, sabotage level decreases. This relationship reflects situation in real world. In a contest in which players can choose unfair measures against their rivals, they tend to do so when their actions are not inspected. However, when there are chances that these unfair actions are inspected and detected, players tend to cut back on such behavior. For higher outside penalty, sabotage level is relatively lower at every level of probability of inspection.

Table 3.2

Sabotage levels given probability of inspection and outside penalty

Probability of inspection (α)	$F = 20$	$F = 40$
	Sabotage level (s^*)	Sabotage level (s^*)
0	10	10
0.1	9.65	8.79
0.2	6.16	5.39
0.3	4.59	3.91
0.4	3.67	3.06
0.5	3.05	2.52
0.6	2.61	2.14
0.7	2.28	1.85
0.8	2.03	1.64
0.9	1.82	1.47
1	1.66	1.33

Source: Author’s calculation

3.2 Experimental Design

This research employs both real and induced value effort task. As for the measurement of effort levels, real effort task[1] used is a Slider Game, which was first developed and used by Gill and Prowse (2011). The Slider Game represents a production procedure. Subjects are presented with 48 sliders. Each slider possesses integer with value from 0 to 100. All sliders are initially positioned at 0. Within 120 seconds, subjects need to position the bar at 50 with the help of a mouse. For every bar positioned at 50, subjects successfully produce 1 unit of a product. Thus, number of products produced can be used as proxy of effort.

The Slider Game have many advantages: (i) it is simple and does not require any prior knowledge, (ii) it is identical cross repetitions, which enhances learning (iii) it involves little to no randomness which implies that the number of correctly positioned bars can be used as a proxy of effort and (iv) there is no scope for subjects to "guess" which is a major issue associated with complex understanding of the game. Having sabotage and punishment as a central issue, Slider Task requires relatively less mental labor compared to induced value effort. Thus, this design would help in saving mental labor for the understanding of sabotaging decision. Nonetheless, real effort task suffers one major drawback- "Since the experimenter does not know the workers' effort cost, it is not possible to derive precise quantitative predictions" (Falk & Fehr, 2003).

On the other hand, induced value effort task is used for sabotage decision[2]. Based on the discussion in section (3.1), cost of sabotage is categorized into (i) disqualification, which depends on probability of inspection and detection, and (ii) magnitude of outside penalty. It should be emphasized that we assume sabotage to be costless to the undertaker as long as it is not detected. Traditional theories discussed in Chapter 2 assume sabotage to consume resources like productive effort in Lazear and

[1] Other real effort tasks used by experimental economists are solving math problems (Sutter & Weck-Hannemann, 2003) or Sudoku (Calsamiglia et. al., 2013), solving maze (Gneezy et al., 2003), decoding (Chow, 1983), stuffing envelopes (Konow, 2000).

[2] Other papers concerning sabotage in tournament uses induced value effort task. Note an exception for Carpenter et al. (2010) who uses real effort task to measure sabotage.

Rosen's model. If inspection is introduced over this traditional model, cost of sabotage will arise from resource expenditure and punishment if detected. Thus, subjects would have to consider both aspects of cost. With the assumption that sabotage is costly only if detected, subjects will choose sabotage based on expected punishment. This is done to avoid any confounding effect possible while conducting an experiment.

Regarding treatments with deterrence incentive, subjects are informed about probability of inspection and detection. Based on this information, subjects choose sabotage level. While the action increases the chance of winning, it becomes costly if detected. This design is sensible if sabotage is perceived to be an additional, indirect way of winning. For instance, workers oftentimes create an impression, pass on rumors or fabricate information. If undetected, such act increases chance of winning and it goes unpunished. In this sense, induced value effort design is appropriate as subjects exert mental effort and psychological cost of thinking about the outcome that may ensue in case of detection.

3.2.1 Treatments

As the main objective of this research is to test deterrence hypothesis on sabotage behavior in tournament, we are interested in "how subjects' decision to sabotage responds to deterrence incentive". While expected punishment consist of 3 factors; probability of inspection, probability of detection and outside penalty, only probability of inspection and magnitude of penalty are varied. Probability of detection, whose functional form is kept the same for all treatments, depends on the sabotage level chosen.

To fulfill the objective of this research, we specify the treatments as in Table 3.3 and design experimental protocol as in Table 3.4.

Table 3.3

Treatment specification

	No inspection ($\alpha = 0$)	Low inspection ($\alpha = 0.4$)	High Inspection ($\alpha = 0.8$)
No penalty = 0	NoDeter (Game 1)	-	-
Low penalty=20	-	Deter (Game 2)	DeterInspect (Game 3.2)
High penalty =40	-	DeterPenalty (Game 3.1)	-

Source: Author's specification

Table 3.4

Experimental Protocol

Session type	Game 1	Game 2	Game 3	Questionnaire
Type 1	NoDeter	Deter	DeterPenalty	Holt and Laury & questionnaire
Type 2	NoDeter	Deter	DeterInspect	

Source: Author's experimental design

The detail of treatment is explained below:

Controlled group

1. **NoDeter treatment:** This is a baseline case in which there is no inspection. Thus, sabotage is costless and outside penalty is zero.

Treatment groups

1. **Deter treatment:** Deterrence incentive is in place with low probability of inspection and low outside penalty.

2. **DeterPenalty treatment:** Deterrence incentive is in place with high probability of inspection and low outside penalty.

3. **DeterInspect treatment:** Deterrence incentive is in place with low probability of inspection and high outside penalty.

This design uses both "within-subject" as well as "between-subject" design. In one session, subjects play tournament game under 3 institutional settings; no punishment, low punishment and high punishment (See Table 3.3). A group of participants in 1 session play 3 games consecutively (See Table 3.4). The difference between sessions is in Game 3 where Game 3.1 has high outside penalty and Game 3.2 has high probability of inspection. This allows us to examine their relative power of kinds of deterrence incentives. Our theoretical model suggests inspection to be a better stick.[3] The limitation of this experimental design pertains to the "carry-over effect" within a session. Nonetheless, as the asymmetric change of punishment is not of our concern, this design is appropriate in addressing the research questions.

In summary, we should observe sabotage to be the highest in Game 1 while it declines in Game 2. As expected punishment is increased in Game 3, sabotage should further decline. However, comparing Game 3.1 and 3.2, sabotage level in Game 3.2 should be lower.

3.3 Experimental Procedure

There were 4 experimental sessions (see Table 3.5); 2 sessions were conducted at Faculty of Economics, Chulalongkorn University on 28th and 29th April 2016 and the other 2 sessions were conducted at Faculty of Economics, Thammasat University on 11th May 2016. The experiments were conducted with Z-Tree (Fischbacher, 2007). All participants are Economics students (86% undergraduate and 14% graduate). 46% are male. Age range of subjects is 19-26 years (mean age is 22.4).

Table 3.5

Sessions conducted

Session no.	No. of participants	Venue	Session type
1	22	Chulalongkorn University	Type 1
2	10	Chulalongkorn University	Type 2
3	16	Thammasat University	Type 1
4	8	Thammasat University	Type 2

Source: Author's compilation

[3] For theoretical proof, see Appendix A.

Three things need to be noted; (i) participants at Chulalongkorn University were students enrolled in Experimental Economics course while participants at Thammasat University were Economics students in general, (ii) participants received Starbucks Gift cards as reward for their performance in the game and (iii) prizes for Chulalongkorn students were set at 500, 300, 100 Thai Baht and nothing, while for Thammasat students, prizes were set at 600, 400, 200 and 100 Thai Baht. The proportion of prizes was 1:1:1:2.

Before starting the session, participants are informed that they will be playing 3 Games; 10 rounds of each. There is 1 practice round for Game 1 so that participants can get familiarized the Slider Game. Regarding the rewarding scheme, the experimenter informs participants that only 3 out of 30 rounds will be selected at random. The sum of payoffs will then be ranked which is used to determine the rewards each subject will receive. They are also informed that they will be matched with a new opponent at random after each round (i.e. Stranger Matching Protocol).

Instructions used are framed[4] as an employment-context one (For detail of instruction, see in Appendix B). Procedures of all experimental sessions were carried out as follow- The experimenter reads the instruction of Game 1– (NoDeter treatment). Before commencing and during the practice round, subjects are allowed to ask the experimenter about the game.

In each round, participants play the Slider Game to measure their effort levels. After 120 seconds, the screen reports the number of products produced, which is the number of sliders correctly positioned. Then, subjects make decision about their sabotage. After all subjects make decision, the screen reports the outcome of the tournament (values of products produced by subject and the opponent, and the prize received in that round). After Game 1, the experimenter continues with instruction of Game 2 (Deter treatment). To ensure that subjects acknowledge the deterrence incentive, a new screen with information about inspection is added prior to the sabotaging stage. In addition, information about probability of detection with each level

[4] Although Harbring and Irlenbusch (2011) found framing effect to suppress sabotage, framed instruction is used in this study to merely enhance subjects' understandability of the game. When deterrence incentive is implemented, neutral instruction may be too vague.

of sabotage is provided on the screen of sabotaging stage. The experiment is resumed after all subjects understand the game. After Game 2, the experimenter informs the change in Game 3. The change to the game is either heavier penalty (DeterPenalty treatment) or higher probability of inspection (DeterInspect treatment). Then, the game is resumed. Subjects are asked to fill out post-game questionnaire form, which includes a lottery form[5] adapted from Holt and Laury (2002) to measure risk aversion. All participants are informed about the selected rounds. They are rewarded based on their rankings of the tournament. All sessions lasted approximately 1 hour 45 minutes to 2 hours.

3.4 Research Hypotheses

In this research, we test the following hypotheses:

Hypothesis 1: Deterrence incentive causes lower average sabotage

Hypothesis 1 corresponds to the classical argument made by Becker (1968). As discussed earlier, theory predicts that sabotage decreases with expected punishment.

Hypothesis 2: The average level of sabotage is lower in treatments with relatively heavier punishment compared to those with relatively lighter punishment.

The experimental design discussed in the previous section allows us to derive both main effect and interaction effects of the factors that are varied. According to the theory, sabotage should follow this relationship; $s_{G3.2} < s_{G3.1} < s_{G2} < s_{G1}$. This follows directly from the fact that penalty is the heaviest in Game 3.2.

Hypothesis 3: The average level of sabotage in DeterInspect (Game 3.2) is lower than that of DeterPenalty (Game 3.1).

Despite the equivalence of expected punishment in DeterPenalty and DeterInspect, theory predicts that sabotage level is lower in DeterInspect, where probability of inspection is high. This suggests that inspection is a more effective deterrence incentive.

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[5] It should be pointed out that this task is uncompensated.

CHAPTER 4
FINDINGS AND ANALYSIS

This chapter analyzes the experimental findings in 4 sections; (4.1) conducts hypotheses testing, (4.2) discusses about noise and other biases in the experimental data, (4.3) provides a panel regression analysis and (4.4) interprets the findings.

4.1 Hypotheses Testing

Before proceeding to the testing of the hypotheses in Chapter 3, it is vital to ensure that all sessions are comparable. For this purpose, Kruskal Wallis test is used to ensure equality of populations with regards to the average effort level in the Slider Game.

Table 4.1

Kruskal-Wallis equality-of-populations rank test (for efforts)

Game	Rank Sum (by Session)				Chi-squared with ties (d.f.=3)	p-value
	1	2	3	4		
1	534	214	568.50	279.50	7.596	0.0551
2	640.50	275.50	411.50	268.50	1.322	0.7239
3	599	228	510	259	2.596	0.4581

Source: Author's calculation

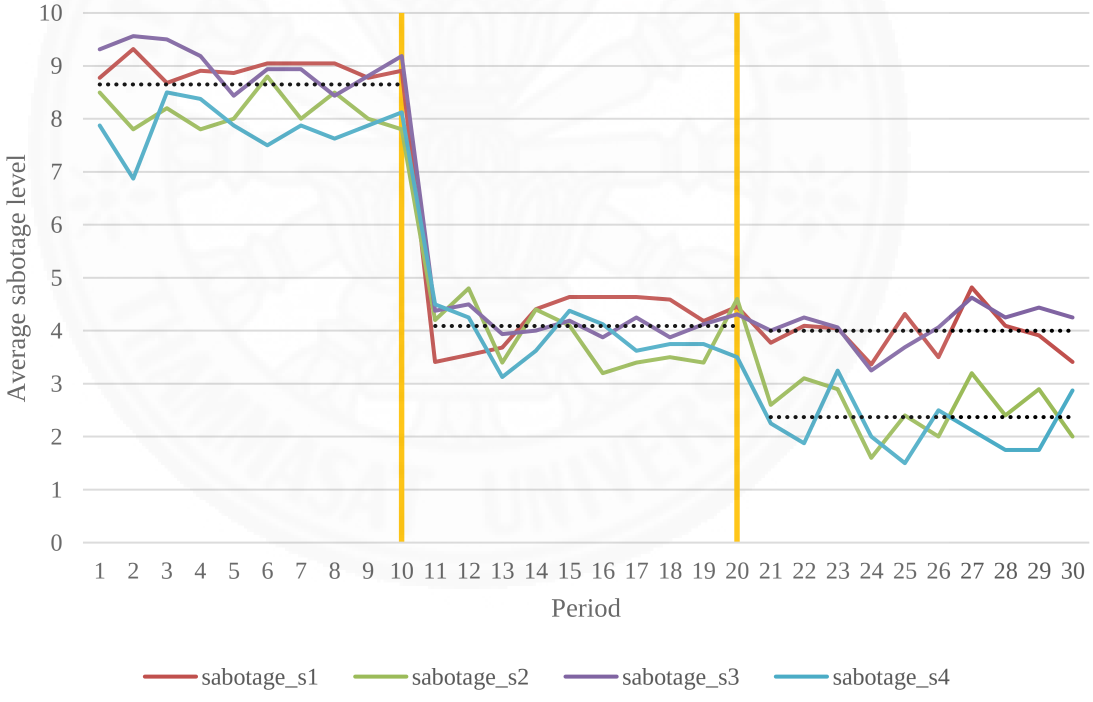
Kruskal Wallis test does not reject the null hypothesis of equality of population ($p > 0.05$ for all games). This implies that despite unequal number of participants across sessions, subjects of all sessions exert similar level of efforts on average. Given similar effort levels, we compare sabotage behaviors in various games to test the hypotheses.

Hypothesis 1: Deterrence incentive causes lower average sabotage

Figure 4.1 exhibits the average sabotage level in all sessions. Based on the graphical presentation, several observations are worth pointed out; (i) sabotage level in Game 1 is at a high level (average of 4 sessions at 8.65), (ii) sabotage level reduces when deterrence incentive is implemented (iii) in sessions where subjects played DeterPenalty in Game 3 (sessions 1 and 3), sabotage level is somewhat the same as in Game 2, (iv) in sessions where subjects played DeterInspect in Game 3 (sessions 2 and 4), sabotage level is lower relative to that of Game 2. At this simple level, deterrence hypothesis seems to hold well, except for DeterPenalty.

Figure 4.1

Average sabotage level in respective period and session



Source: Author's illustration

Note: sabotage_s1 refers to average sabotage level in session 1, so on. Black dotted lines refer to the weighted average sabotage level for all sessions in respective games.

To confirm the hypothesis, sabotage levels of Game 1, 2 and 3 are compared. It should be noted that subjects play the 3 games consecutively and hence within-subject analysis is employed. Using average sabotage levels for Wilcoxon signed-rank test (yielding one observation per individual), it is found that sabotage is higher in NoDeter in comparison to Deter, DeterPenalty and DeterInspect.

Table 4.2

Wilcoxon signed-rank test (Game 1 and 2; Game 2 and 3; Game 1 and 3)

Session no	Observations	$H_0: sabotage.G_1 = sabotage.G_2$		$H_0: sabotage.G_2 = sabotage.G_3$		$H_0: sabotage.G_1 = sabotage.G_3$	
		Critical value	Prob > |z|	Critical value	Prob > |z|	Critical value	Prob > |z|
1	22	z = 3.815	0.0001***	z = 0.488	0.6256	z = 3.686	0.0002***
2	10	z = 2.553	0.0107**	z = 2.293	0.0218**	z = 2.499	0.0125**
3	16	z = 3.413	0.0006***	z = 0.440	0.6599	z = 3.466	0.0005***
4	8	z = 2.457	0.0140**	z = 2.457	0.0140**	z = 2.460	0.0139**

Source: Author’s calculation

Note: *** indicates 1% level of significance, ** indicates 5% level of significance

The null hypotheses that average sabotage level in Game 1 equals that of Game 2 and 3 are rejected (at 1% and 5% level of significance). This implies that sabotage levels in Game 1 differ significantly from those in Game 2 and 3 where deterrence incentive is implemented. However, when average sabotage levels in Game 2 and 3 are compared, Wilcoxon sign-rank test rejected the null hypotheses (at 5% level) for sessions in which subjects played DeterInspect as Game 3. On the other hand, the test finds no significant difference in average sabotage between Game 2 and 3 for sessions in which subjects played DeterPenalty as Game 3.

It can then be concluded that this result supports Becker’s deterrence hypothesis (at least qualitatively) as sabotage level decreases with punishment.

However, sabotage behavior in DeterPenalty treatment deviates from expected pattern. Thus, result 1 can be summarized as follow:

Result 1: Sabotage can be suppressed by implementing deterrence incentive. In general, our finding supports Becker's (1968) deterrence hypothesis (except for DeterPenalty in which sabotage only weakly decreases).

Hypothesis 2: The average level of sabotage is lower in treatments with relatively heavier punishment compared to those with relatively lighter punishment.

Table 4.3 compares predictions by theory and average sabotage levels in all games. Due to unequal number of observations in each session, weighted average for each game is reported.

Table 4.3

Comparisons of theoretical predictions and average sabotage levels in all games

	Game 1 (NoDeter)		Game 2 (Deter)		Game 3.1 (DeterPenalty)		Game 3.2 (DeterInspect)	
Session no.	Theory	Experim-ent	Theory	Experim-ent	Theory	Experim-ent	Theory	Experim-ent
1	10	8.90	3.67	4.22	3.06	3.93	-	-
2	10	8.14	3.67	3.90	-	-	2.03	2.51
3	10	9.03	3.67	4.14	3.06	4.09	-	-
4	10	7.85	3.67	3.86	-	-	2.03	2.19
Weighted Average	10	8.65	3.67	4.09	3.06	4.00	2.03	2.37

Source: Author's calculation

It can be summarized from Table 4.3 that sabotage level in games with relatively lighter expected punishment is lower. However, the difference in sabotage levels in Game 2 and 3.1 is very small. Two sample t-test confirms insignificant difference in the average sabotage levels in Game 2 and 3.1 ($p = 0.6364$). Thus, it can be concluded that sabotage level in games with relatively heavier punishment is lower (except for Game 3.1 to Game 2 where sabotage levels are similar). Therefore, result 2 can be formulated as follow:

Result 2: Sabotage levels in treatment with heavier punishment are lower than those with relatively lighter punishment (See Table 4.3). This only holds true for the case of DeterInspect, where probability of inspection is high. However, sabotage levels in DeterPenalty are similar to those in Deter, despite the increment in the level of penalty.

Hypothesis 3: The average level of sabotage in DeterInspect (Game 3.2) is lower than that of DeterPenalty (Game 3.1).

To test Hypothesis 3, we find if there is a treatment effect in Game 3. In Game 3, participants either played DeterPenalty (Game 3.1) or DeterInspect (Game 3.2). Since samples are independent, we employ Mann-Whitney U test for Game 3[1]. Table 4.4 reports a result of Mann-Whitney U test which rejects the null hypothesis at 5% level of significance, implying that subjects in DeterPenalty and DeterInspect reacted towards types of disincentives differently. Despite the same level of expected punishment, probability of inspection is a better tool to curb sabotage in tournament.

Table 4.4

Mann-Whitney U test (for Game 3, treatment-wise)

Game 3	Observations	$H_0: sabotage.G_{penalty} = sabotage.G_{inspect}$	
		Critical value	Prob > |z|
DeterPenalty vs. DeterInspect	38 vs. 18	z = 2.232	0.0256**

Source: Author's calculation

Note: ** indicates 5% level of significance

[1] As Game 1 and 2 are same for all sessions, there should be no treatment effect. Kruskal Wallis confirms no significant difference in sabotage behavior across sessions in Game 1 and 2 ($p = 0.5404$ and $p = 0.9701$ respectively).

With this finding, we can formulate Result 3 as follow:

Results 3: In line with the theoretical prediction, sabotage level in DeterInspect is lower, compared to that of DeterPenalty despite equivalence of expected level of punishment. This finding suggests that probability of inspection is a better 'stick' in suppressing sabotage behavior in tournament.

4.2 Noise in the Experimental Data

In spite of having proven our hypotheses in the earlier section, it is evident that there exists noise and other plausible biases in the experimental data. These biases are like 'gaps' which need to be filled. By understanding them, theorists can enhance frameworks to better explain the real world.

4.2.1 Negative and Positive Biases

To reinforce Table 4.3 that biases exist, Table 4.5 reports one-sample t-test which indicates significant differences between experimental data and theoretical predictions. For NoDeter treatment, the test rejects null hypothesis at 1% level of significance, confirming a negative bias. For Deter and DeterPenalty treatments, the test also rejects the null hypothesis at 1% level of significance. This implies that sabotage behavior in the 2 settings exceed the predictions. For DeterInspect treatment, the test only rejects the null hypothesis at 5% level of significance, indicating a more subdued positive bias in this case.

Table 4.5

One-sample t-test, comparing experimental data and theoretical predictions

Game	Hypothesis	Critical value	$\Pr(T < t)$	$\Pr(\|T\| > \|t\|)$	$\Pr(T > t)$
Game 1 (NoDeter)	$H_O: mean = 10$ $H_a: mean < 10$	$t = -11.0726$	0.0000***	0.0000***	1.0000
Game 2 (Deter)	$H_O: mean = 3.67$ $H_a: mean > 3.67$	$t = 3.4926$	0.9997	0.0005***	0.0003***
Game 3.1 (DeterPenalty)	$H_O: mean = 3.06$ $H_a: mean > 3.06$	$t = 6.0035$	1.0000	0.0000***	0.0000***
Game 3.2 (DeterInspect)	$H_O: mean = 2.03$ $H_a: mean > 2.03$	$t = 1.8289$	0.9655	0.0691*	0.0345**

Source: Author's calculation

*indicates 10% level of significance, ** indicates 5% level of significance, *** indicates 1% level of significance.

Despite the theoretical prediction that a rational utility maximizer would choose maximum sabotage in NoDeter treatment ($\bar{s} = 10$), the average sabotage level is not equivalent to the prediction. There exists heterogeneity in the sabotage behavior; a group did choose maximum sabotage while others either choose a suboptimal level of sabotage. Two subjects chose zero level of sabotage for all periods even when there is no deterrence incentive. Choosing sabotage below $\bar{s} = 10$ in NoDeter treatment is to play a 'dominated strategy'. This might have occurred because humans may not be 'purely selfish' as claimed by an economic theory. Other studies (i.e. see stealing game by Schildberg-Hörisch & Strassmair, 2012) have also found a similar 'prosocial' behavior which contradicts theoretical predictions. Presumably, even though this competition is a non-cooperative game, not all subjects want to win by unfair means. In other words, there are those who prefer 'not to exert maximum sabotage', resulting in a negative bias in the behavior in NoDeter treatment.

While there exists a negative bias in NoDeter treatment, sabotage behavior in treatments with deterrence incentive exhibits positive bias. It can be concluded that there is negative bias in sabotage behavior in Game 1 but when deterrence incentive is implemented, positive bias seems to play a role. From the data, it is also found that when there is risk of detection and penalty, subjects either reduce their sabotage or sabotage more highly. While reducing level of sabotage is intuitive, those who sabotage more highly do so on account of the need to compensate for the risk of detection itself. In other words, when disincentive is in place, there is a tendency that less people will sabotage, but those who decide to sabotage intensify their activity to compensate the risk born.

Table 4.6

Percentage of participants whose sabotage is above an average level in each session

	Percentage of participants whose sabotage is above an average level		
Session no.	Deter	DeterPenalty	DeterInspect
1	50%	59.09%	-
2	60%	-	30%
3	62.5%	56.25%	-
4	62.5%	-	37.5%

Source: Author's calculation

From Table 4.6 it can be pointed out that although the percentage of participants whose sabotage is above average (except for Session no. 1), decreases when expected punishment increases, these participants become more aggressive by intensifying their sabotage level, causing the positive bias in the data. Similarly, for Session no .1 the percentage increases which creates positive bias. As the percentage for DeterInspect is relatively lower than that of DeterPenalty, there is lesser positive bias in DeterInspect.

Another plausible explanation for the prevalence of positive bias in sabotage behavior is that people may suffer from some kinds of cognitive biases known as “self-serving bias” and “optimism bias”. Self-serving bias refers to a tendency for people to attribute an occurrence of positive events to be intrinsic, while attributing negative events to extrinsic factors. This cognitive dissonance is quite common (i.e. we often account our success on how hard we work but blame bad luck when we fail).

Optimism bias refers to a tendency for people to have unrealistic optimism. Studies in psychology and neuroscience have found that people are more likely to be overoptimistic and anticipate outcomes in their own favor. For instance, we are more likely to overestimate the chances of good events (i.e. success, marriage, promotion, winning lottery) but underestimate the chances of bad events (i.e. failure, divorce, getting fired, losing a bet).

In the light of these biases, participants may suffer from the illusion that they may not be caught. Put differently, they may underestimate probability of bad outcome (getting inspected and detected), and thus think that they will not be caught. This finding is in line with that of Nagin and Pogarsky (2003) who found that subjects who suffer from self-serving biases are more likely to cheat in their experiment. This is why in Deter and DeterPenalty treatments, where probability of inspection is low, positive bias is more pronounced; compared to DeterInspect treatment where probability of inspection is higher.

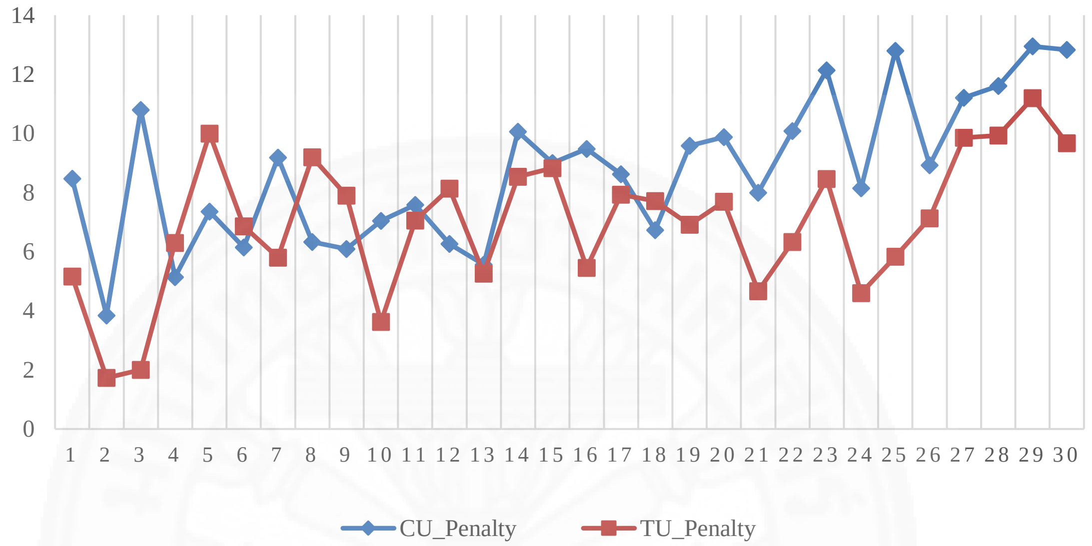
In addition to the self-serving and optimism biases, motivational crowding may play a role in the biased decision-making. As pointed out earlier, subjects may be led by intrinsic motivation when there is no deterrence incentive. However, implementing deterrence incentive interferes with subjects' intrinsic motivation, shifting their attention to extrinsic ones. In effect, subjects become less inclined to play fair when they are being monitored. This finding is in line with literatures pertaining to motivation crowding theory (see Chapter 2). Since the net effect of deterrence incentive is ambiguous, this may have caused biases in the experimental data.

4.2.2 Variances and Adjustment Towards Social Norm

As pointed out, sabotage decision is heterogeneous. Figure 4.2, 4.3 and 4.4 exhibit variances in the sabotage levels chosen in each period. Upon observation, variances of sabotage in NoDeter and Deter are somewhat similar; variances fluctuate but stabilize at a high level. However, the patterns of variance start to diverge at around period 23. In sessions with DeterPenalty as game 3 (see Figure 4.2.), the pattern of variance is upward. On the other hand, in sessions with DeterInspect as game 3, the pattern is downward. F-test confirms that variances of DeterPenalty are significantly higher than those of DeterInspect at 1% level of significance ($F(379,179) = 1.5188, p = 0.0008$).

Figure 4.2

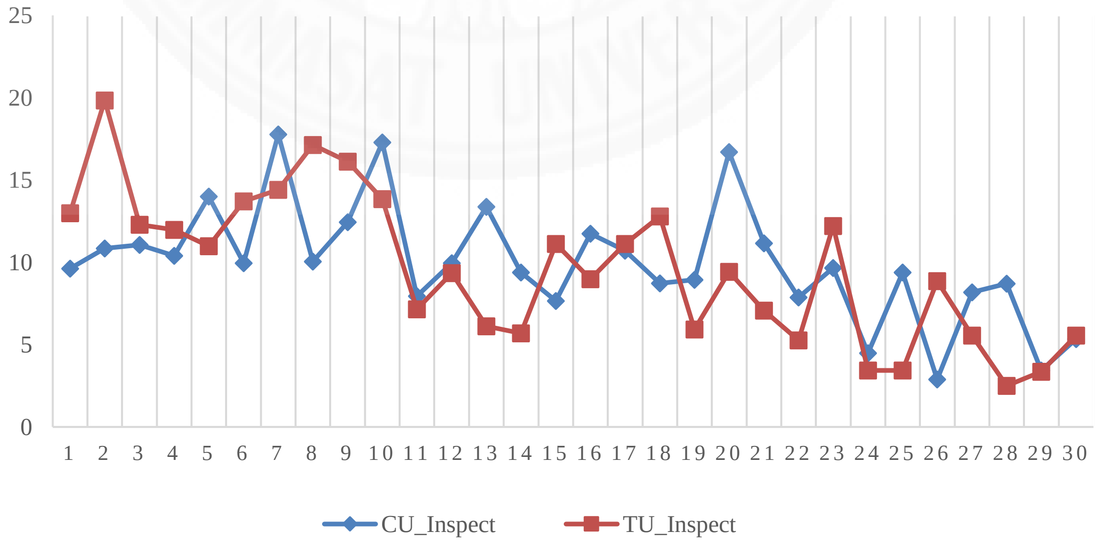
Variances of sabotage in sessions 1 and 3 (with DeterPenalty as Game 3)



Source: Author’s illustration

Figure 4.3

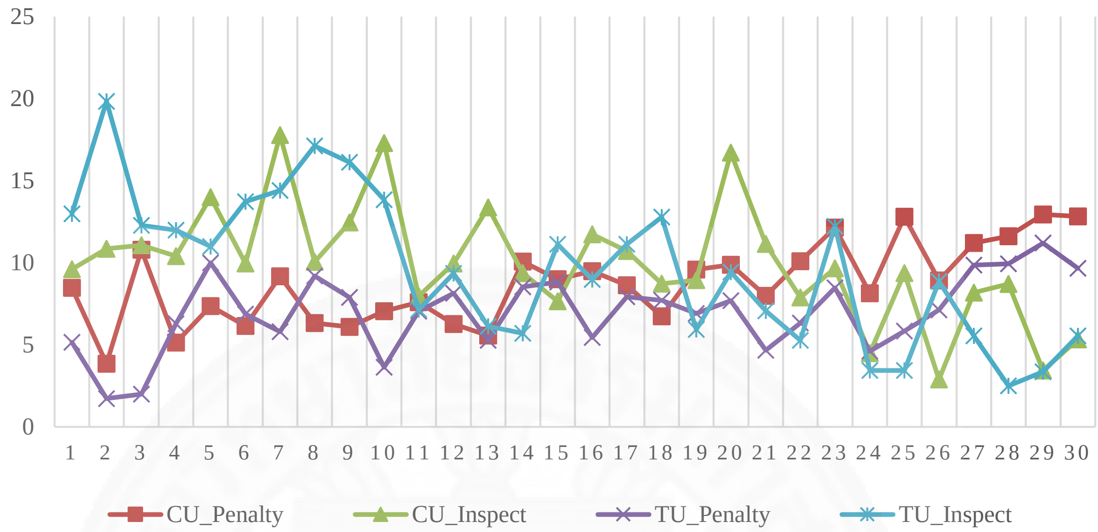
Variances of sabotage in sessions 2 and 4 (with DeterInspect as Game 3)



Source: Author’s illustration

Figure 4.4

Variances of sabotage in all sessions



Source: Author's illustration

Fluctuation and divergence suggest that people adapt their strategies given the institutional setting. Different games represent different monitoring and sanctioning institutions. In NoDeter treatment, subjects tend to converge to a sabotaging strategy. As time passes and the majority of participants choose to sabotage, the action establishes a "culture" for the society. If the subject does not choose sabotage, he loses the competitive advantage and falls behind his peers. Hence, subjects conform to the society. Even in Deter treatments, the pattern of sabotage is similar to that of NoDeter. Participants react to deterrence incentive by reducing sabotage level, but as expected punishment is quite low, sabotaging is still a norm in the society. Sabotage behavior differs in DeterPenalty and DeterInspect treatments. It can be seen from Figure 4.2 that variance of sabotage in DeterPenalty escalates towards the end of the game. High variance can be interpreted in such a way that subjects are segregated into two groups; those who continue to sabotage intensively and those who adapt by cutting back on their sabotage. In contrary, variance of sabotage in DeterInspect gradually descend to a low level towards the end of the game. As probability of inspection is high in this game, majority of the subjects adapt their strategy more quickly and therefore approach a new social norm- "exerting low sabotage". This may be because deterrence incentive in

Deter and DeterPenalty is not powerful enough, rendering the law enforced illegitimate in the eyes of the saboteurs. On the other hand, high inspection imparts legitimacy to the law enforcement and thereby brings about low level of sabotage in the society.

4.3 Panel Regression Analysis

To further support the findings, Table 4.7 and 4.8 reports random effect regressions for all periods (without and with risk aversion). Independent variables include time-lag magnitude of sabotage, dummy variables which indicate if a subject is caught in period $t-1$, $t-2$, $t-3$, $t-4$ and $t-5$. Time-lag of sabotage is included to examine whether subjects' decision making display any focalism (i.e. anchoring). Time-lag dummies of getting caught also shed light on the effect of getting caught and the period of adjustment in sabotage behavior. Others independent variables include demographic variables including gender, age and degree of risk aversions measured by Holt and Laury form, and dummy variables to control for treatment effects (Deter, DeterPenalty and DeterInspect respectively). Each specification differs in the inclusion time-lag of getting caught. It should be pointed out that 16 participants made irrational decisions and thus render their degrees of risk aversion unmeasured. Irrational decisions can be detected in Holt and Laury form for those who switch back and forth between safe to risky options (See Holt and Laury form in the Appendix C).

Table 4.7

Linear Random-Effects Regressions: Testing treatment effects on sabotage behavior (Without risk aversion)

	Dependent variable: $s_{i,t}$ (sabotage level)					
Independent variables	I	II	III	IV	V	VI
$s_{i,t-1}$ (continuous, time lag)	0.633*** (0.019)	0.615*** (0.018)	0.617*** (0.018)	0.616*** (0.019)	0.608*** (0.019)	0.610*** (0.020)
$caught_{i,t-1}$ (dummy, time lag)	-0.622*** (0.216)	-	-	-	-	-0.696*** (0.215)
$caught_{i,t-2}$ (dummy, time lag)	-	0.739*** (0.217)	-	-	-	0.683*** (0.216)
$caught_{i,t-3}$ (dummy, time lag)	-	-	0.776*** (0.226)	-	-	0.696*** (0.226)
$caught_{i,t-4}$ (dummy, time lag)	-	-	-	0.849*** (0.234)	-	0.809*** (0.234)
$caught_{i,t-5}$ (dummy, time lag)	-	-	-	-	0.491** (0.246)	0.349 (0.245)
$gender$ (dummy)	0.117 (0.111)	0.108 (0.113)	0.118 (0.114)	0.139 (0.116)	0.180 (0.120)	0.155 (0.119)
age (continuous)	0.061* (0.033)	0.058* (0.034)	0.074** (0.034)	0.074** (0.035)	0.082** (0.036)	0.082** (0.036)
$Game$ 2 (dummy)	-1.885*** (0.158)	-2.068*** (0.159)	-2.040*** (0.163)	-2.043*** (0.169)	-2.090*** (0.179)	-2.169*** (0.185)
$Game$ 3 (dummy)	-1.644*** (0.178)	-1.897*** (0.177)	-1.862*** (0.180)	-1.872*** (0.186)	-1.910*** (0.195)	-2.029*** (0.206)
$Inspect$ (dummy)	-0.704*** (0.200)	-0.705*** (0.200)	-0.731*** (0.199)	-0.736*** (0.200)	-0.733*** (0.201)	-0.773*** (0.200)
Constant	1.715** (0.766)	1.922* (0.778)	1.544* (0.788)	1.545* (0.804)	1.439* (0.826)	1.436* (0.816)
R^2	0.5963	0.5830	0.5725	0.5531	0.5280	0.5345
Individuals	56	56	56	56	56	56
No. of observation	1624	1568	1512	1456	1400	1400

Source: Author's calculation

Note: The observation is a subject's sabotage level in a period. Treatment NoDeter (Game 1) is the baseline case. Standard errors are given in the parentheses, *indicates 10% level of significance, ** indicates 5% level of significance, *** indicates 1% level of significance.

Table 4.8

Linear Random-Effects Regressions: Testing treatment effects on sabotage behavior (With risk aversion)

	Dependent variable: $s_{i,t}$ (sabotage level)					
Independent variables	I	II	III	IV	V	VI
$s_{i,t-1}$ (continuous, time lag)	0.615*** (0.022)	0.589*** (0.022)	0.594*** (0.227)	0.587*** (0.023)	0.580*** (0.023)	0.577*** (0.024)
$caught_{i,t-1}$ (dummy, time lag)	-0.554** (0.248)	-	-	-	-	-0.652*** (0.249)
$caught_{i,t-2}$ (dummy, time lag)	-	1.019*** (0.247)	-	-	-	0.961*** (0.250)
$caught_{i,t-3}$ (dummy, time lag)	-	-	0.722*** (0.260)	-	-	0.609** (0.259)
$caught_{i,t-4}$ (dummy, time lag)	-	-	-	0.916*** (0.270)	-	0.853*** (0.316)
$caught_{i,t-5}$ (dummy, time lag)	-	-	-	-	0.679** (0.284)	0.479* (0.282)
$gender$ (dummy)	-0.073 (0.134)	-0.094 (0.136)	-0.068 (0.140)	-0.066 (0.143)	-0.047 (0.146)	-0.052 (0.144)
age (continuous)	0.070* (0.038)	0.078** (0.038)	0.793** (0.039)	0.090** (0.040)	0.094** (0.041)	0.099** (0.041)
RA (continuous)	-0.085** (0.035)	-0.091** (0.036)	-0.0812** (0.037)	-0.087** (0.038)	-0.082** (0.039)	-0.079** (0.038)
$Game$ 2 (dummy)	-2.044*** (0.189)	-2.3125*** (0.188)	-2.191*** (0.196)	-2.231*** (0.202)	-2.283*** (0.212)	-2.41*** (0.220)
$Game$ 3 (dummy)	-1.656*** (0.216)	-2.006*** (0.213)	-1.865*** (0.220)	-1.900*** (0.225)	-1.957*** (0.235)	-2.121*** (0.247)
$Inspect$ (dummy)	-0.817*** (0.221)	-0.821*** (0.220)	-0.836*** (0.222)	-0.871*** (0.223)	-0.858*** (0.224)	-0.905*** (0.221)
Constant	2.000** (0.878)	2.084** (0.888)	1.914** (0.913)	1.747* (0.931)	1.735* (0.955)	1.637* (0.939)
R^2	0.6153	0.6072	0.5843	0.5652	0.5404	0.5485
Individuals	40	40	40	40	40	40
No. of observation	1160	1120	1080	1040	1000	1000

Source: Author's calculation

Note: The observation is a subject's sabotage level in a period. Treatment NoDeter (Game 1) is the baseline case. Standard errors are given in the parentheses, *indicates 10% level of significance, ** indicates 5% level of significance, *** indicates 1% level of significance.

Our finding suggests that subjects are persistent with their choice of sabotage. The time-lag of sabotage is highly significant. Time-lag dummies for getting caught suggest that the effect of punishment is only immediate. When subjects are caught, they reduce sabotage level in the following period due to fear. However, 2-period, 3-period and 4-period time-lag dummies for getting caught are positively significant at 1%. Moreover, coefficients of the time-lag dummies are quite similar, which implies that when subjects are caught they reduce their sabotage, but after 2 periods they revert back to their original level of sabotage. Such behavioral pattern displays '*anchoring*', a cognitive bias with which humans make decision based on information given. In this case, subjects may exert mental effort in the 1st round of each Game when information is presented, and use that as a reference point for decision making. In other words, the effect of getting caught is nullified in the long term[2]. Though subjects reduce sabotage immediately after they are caught, they revert back to the strategy they had initially evaluated.

As for the demographic variables, age is significant (at 5% and 10% level depending on specification), which suggests that older samples tend to sabotage more highly. Dummies for Game 2 and Game 3 are highly significant, confirming existence of treatment effects; sabotage level in Deter, DeterPenalty and DeterInspect treatments are lower relative to NoDeter treatment. The dummy *Inspect* additionally breaks down the treatment effect for DeterInspect. The result reports significant treatment effect which suggests that an increment in probability of inspection can further curb sabotage behavior. In models with risk aversion (see Table 4.8), it is found that degree of risk is significant at 5% level. This implies that the more risk aversive subjects choose relatively lower sabotage level. This finding is intuitive as sabotaging incurs cost upon detection. A risk aversive individual would acknowledge this cost and tends to play a safe and subtle strategy.

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[2] Field evidence displays similar criminal behavior. A punished criminal is likely to avoid committing the same offense right after getting penalized. However, in the long run, he may commit the same offense again as he no longer takes into account the fear of getting caught.

4.4 Interpretation of Findings

The findings of this study are in line with others in the field of behavioral economics and laws, in particular to those focusing on deterrence incentive and crimes. Overall, the findings support Becker's deterrence hypothesis. Extrinsic deterrence incentive reduces sabotage behavior in a competitive setting. However, analysis of the experimental data confirms the relative strength of inspection but finds no significant effect of increasing magnitude of penalty.

There are, however, noises in the experimental data. In NoDeter treatment, sabotage level is significantly lower than the prediction. This negative bias may stem from subjects' intrinsic motivation. Nonetheless, when deterrence incentive is implemented, subjects abandon intrinsic motivation and focus on the extrinsic motivation (i.e. 'how to win under such circumstances'). This has, therefore, caused a positive bias in treatments with deterrence incentive, especially in Deter and DeterPenalty treatments, where probability of inspection is low. Subjects effectively 'self-select' their own strategy. While some subjects reduce sabotage in fear of getting caught, those who decide to sabotage do so more aggressively to compensate for the risk of getting caught. In addition, positive bias may also stem from self-serving bias and optimism bias. Participants may underestimate the likelihood of getting caught and think that situation is in their favor. Also, penalty is conditional on inspection and detection. When probability of inspection is low, detection and magnitude of penalty may become irrelevant for some subjects. They may perceive punishment to 'not occur after all' because getting punished requires 'inspection' as well as 'detection' to occur. On the other hand, there is relatively lesser positive bias in sabotage behavior in DeterInspect treatment, where probability of inspection is high. As punishment also includes revoking the right to win high prize, it is better for subjects to play safe by reducing sabotage level. Thus, by cutting back on sabotage level, subjects maintain the right to win.

Furthermore, panel regression sheds light on the behavioral responses of participants in the game. Based on the findings, sabotage decision is anchored. In their mind, subjects evaluate their own strategy using the information given. Getting caught has no effect on sabotage in the long run. Saboteurs immediately cut down their sabotage level in the period following the detection. However, after 2 periods, saboteurs' fear of detection disappears, urging them to revert back to their evaluated strategy. In other words, decision reverts back to the anchor set initially.

Finally, our findings are in line with studies pertaining to institutional economics and law enforcement in the society. Cooperative environment cannot be sustained in a sanction-free society because there is no law enforcement. Subjects are compelled to sabotage as it is a social norm and not doing so deprives them of the competitive advantage in the contest. However, low inspection does not reduce sabotage either as the enforced rule is not perceived as legitimate. Social dilemma, which is to have contestants sabotaging heavily, is resolved by implementing appropriate scheme of deterrence incentive. In our case, high inspection is a key towards a fairer tournament. Though deterrence incentive cannot fully discourage sabotage behavior in tournament, it redirects individuals' flow of decisions and strategies towards a new social norm (Henrich, 2006).

CHAPTER 5
CONCLUSIONS AND RECOMMENDATIONS

This chapter summarizes research findings and provides policy implications drawn from the laboratory experiment. Recommendations for future studies are made.

5.1 Conclusions

This research aims to test the impact of extrinsic deterrence incentive on sabotage in Lazear and Rosen's (1981) rank-order tournament by conducting a laboratory experiment. In the tournament with sabotage, players can increase their chance of success either by exerting productive or destructive efforts. By allowing players to sabotage their opponents, tournament theory mimics one 'additional' dimension of human nature- *some people play unfair in order to win the contest*. Being a rent-seeking, wasteful action, sabotage should be discouraged among contestants. One of the ways to increase the cost of sabotage is via punishment.

Theoretically, this study tests a 2-player tournament with sabotage extension and follows a deterrence incentive in Gilpatric (2011). Players are inspected by a perfectly correlated auditing system. In case of inspection, the chance that contestants are detected depends on the sabotage level chosen. If detected, a caught saboteur loses by default (i.e. receive low prize and suffer outside penalty). This, by effect, implies that the opponent wins high prize irrespective of relative output levels. In the case that both players are detected, they both are penalized.

The theory suggests that sabotage is a dominant strategy when there is no deterrence incentive. With the assumption that sabotage is costless unless detected, sabotaging increases the chance of success in tournament. Implementing deterrence incentive should result in a monotonic decrease in sabotage level, as prescribed by Becker's (1968) deterrence hypothesis.

The experimental results support Becker's (1968) deterrence hypothesis that punishment reduces crime. However, it should be noted that sabotage in DeterPenalty treatment is similar to that of Deter treatment, whose punishment is relatively lighter. On the other hand, sabotage behavior is lower in DeterInspect, compared to DeterPenalty treatment despite equivalence of expected punishment. Therefore, this study finds that inspection is relatively better in curbing sabotage behavior. This is because by increasing the probability of inspection and keeping magnitude of penalty low, there is higher chance of triggering detection system, which eventually leads to higher chance of getting detected if subjects do not alter strategy. On contrary, increasing magnitude of outside penalty while keeping probability of inspection low implies higher cost (but equal to the earlier case). However, this higher cost is realized only when subjects are inspected (i.e. detection occurs after inspection). Seeing probability of inspection is low, subjects may not alter their strategy altogether.

Nonetheless, there exists heterogeneity in choice of sabotage. Even in NoDeter treatment when there is no punishment, some subjects play a dominated strategy by choosing low levels of sabotage. This accounts for the negative bias in NoDeter treatment. Similar to other studies, participants display others-regarding preferences and may choose not to hurt others. Additionally, since NoDeter is a control treatment, the intrinsic motivation contributes to subjects' decision making in a meaningful way.

On the other hand, sabotage behavior in treatments with deterrence incentive possesses a considerable degree of positive bias. This can be accounted from the fact that announcing about punishment interferes with subjects' intrinsic motivation and causes them to pay more attention to an extrinsic one. Furthermore, when deterrence incentive is introduced, subjects are segregated into 2 groups; those who exert low sabotage, and those who sabotage more intensively to compensate for the risk of detection. Positive bias exists in a greater deal in Deter and DeterPenalty treatments. Since rate of inspection is low, subjects may experience an illusion caused by self-serving bias and optimism bias. These biases are known to cause people to overestimate chances of good outcomes and underestimate risks. Thus, positive bias in DeterInspect treatment exists in a smaller degree as inspection is high.

As a final note, the findings reveal an insight about law enforcement and social order. Without punishment, sabotage is a social norm. Though some subjects choose low sabotage, they are overwhelmed by those who sabotage highly. However, a new social norm (i.e. low sabotage) can be achieved with an efficient punishment system. As pointed out earlier, high inspection brings about low level of sabotage. It can then be concluded that sabotage level will be low if and only if subjects perceive the enforced rule as legitimate. If subjects do not perceive the legitimacy of punishment, implementing punishment fails to alter maladaptive behavior.

5.2 Policy Implications

Certain policy implications can be drawn from this study. As tournament is a non-cooperative game, participants may resort to all kinds of actions to increase their chance of success. Contest designers and practitioners in personnel management should take into account the possibility of sabotage behavior in tournament. This loophole in tournament should be filled to make it 'fair' for players who do not display rent-seeking and destructive behaviors.

Sabotage can be reduced significantly by implementing an efficient punishment system to achieve a desirable outcome. Contest designers should consider legitimacy of the punishment scheme too. Weakly enforcing a rule for '*the sake of having it'* cannot curb sabotage behavior among contestants Our findings suggest that high inspection drives down sabotage as it imparts credibility and legitimacy of the enforced rule. When imposed rule and regulations are perceived as legitimate, people are more likely to conform to them. Thus, contestants should acknowledge that they would be inspected regularly so that they keep sabotage to its minimum.

In addition, the rule that '*anyone who is found to have used unfair measures to augment the chance of winning will lose by default*' is extremely effective in the sense that contest designer automatically makes the cost of sabotage high. After all, the aim of participating in a tournament is to win high prize. Hence, putting high prize at stake creates a dynamic that reverses contestants' strategy, nudging them to lessen the degree of unfair play.

Nonetheless, inspection in the real environment requires the principal to expend resources. Thus, principal should find an optimum to balance between cost and benefit of inspection. Despite the effectiveness of inspection, announcement of the level of punishment is relatively less costly compared to implementation of an inspection system.

5.3 Recommendations for Future Studies

This study possesses several limitations, which can be improved in the future. Unlike most experimental studies, incentive used in this study is non-monetary incentive. Starbucks Gift card is not universally acceptable like cash. Starbucks Gift card is also indivisible and less liquid compared to cash. Nonetheless, 50% of the participants mention their desire to win the prize while 34% mention their desire to win the game (not prize).

However, the issue does not entirely associate with using Starbucks Gift card as an incentive, but with the distribution of incentive. The values of Starbucks Gift cards are unequal. For Chulalongkorn University, prizes are set at 500, 300, 100 Baht and nothing. On the other hand, prizes used at Thammasat University are set at 600, 400, 200 and 100 Baht. To distribute prizes, payoffs from 3 randomly selected rounds are added and then ranked. Such prize distribution creates unbalanced incentive for the participants. While some subjects strategically behave to win the prize, others may not put in effort to play the games because incentive is unevenly distributed. Cash payment would solve this limitation as it is divisible. Monetary incentive can be structured in such a way that all subjects are incentivized.

Other limitations arise from experimental protocol. For instance, the number of participants across sessions is unequal. While Kruskal Wallis test confirms that all sessions are comparable since samples exert similar level of efforts in the Slider task, it is more ideal to have equal number of subjects across sessions. This result can also be enhanced by recruiting larger samples.

There are potential areas regarding different designs and rules to discourage sabotage in tournament. For instance, in promotional tournament, caught saboteurs may be removed from the contestant pool for certain time periods as a result of bad reputation. Contest organizers usually share information regarding unfair players, which imposes high cost on the saboteur. Further analysis about the relationship of cognitive biases and sabotage behavior would clarify the causes of noise in the experimental data. Another issue of interest concerns principal's decision in choosing kinds of punishment since inspection is costly in the real world. Design of the game can be innovated to replicate real world situations, which can potentially further the area of experimental paradigm to represent the real world.

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APPENDICES

APPENDIX A
INSPECTION IS MORE EFFECTIVE THAN PENALTY

Rewriting equation (3.6), we have

$$G(s,F,\alpha) = \alpha\beta'(s)\left[1+\beta(s)+\frac{2F}{\Delta}\right]+\frac{2\alpha\beta(s)}{\bar{\varepsilon}}-\frac{\alpha}{\bar{\varepsilon}}\left(\beta(s)\right)^2-\frac{1}{\varepsilon}=0 \tag{3.6.1}$$

Using Implicit Function Theorem,

$$\frac{\partial s}{\partial \alpha} = -\frac{G_\alpha}{G_s}$$

$$= -\frac{\beta'(s)\left(1+\beta(s)+\frac{2F}{\Delta}\right)+\frac{2\beta(s)}{\bar{\varepsilon}}-\frac{\left(\beta(s)\right)^2}{\bar{\varepsilon}}}{\alpha\beta''(s)\left[1+\beta(s)+\frac{2F}{\Delta}\right]+\alpha\left(\beta'(s)\right)^2+\frac{2\alpha}{\bar{\varepsilon}}\beta'(s)-\frac{\alpha}{\bar{\varepsilon}}2\beta'(s)\beta(s)} \tag{3.6.2}$$

And

$$\frac{\partial s}{\partial F} = -\frac{G_F}{G_s}$$

$$= -\frac{\frac{2}{\Delta}\alpha\beta'(s)}{\alpha\beta''(s)\left[1+\beta(s)+\frac{2F}{\Delta}\right]+\alpha(\beta'(s))^2+\frac{2\alpha}{\bar{\varepsilon}}\beta'(s)-\frac{\alpha}{\bar{\varepsilon}}2\beta'(s)\beta(s)} \tag{3.6.3}$$

As inspection and penalty have different units of measurement, we compare their elasticities because they are unit-free. Using equations (3.6.2) and (3.63), we can calculate the inspection and penalty elasticities as below

$$\eta_\alpha = \frac{\partial s}{\partial \alpha}\cdot\frac{\alpha}{s}$$

$$= -\frac{\beta'(s)\left(1+\beta(s)+\frac{2F}{\Delta}\right)+\frac{2\beta(s)}{\bar{\varepsilon}}-\frac{\left(\beta(s)\right)^2}{\bar{\varepsilon}}}{\alpha\beta''(s)\left[1+\beta(s)+\frac{2F}{\Delta}\right]+\alpha\left(\beta'(s)\right)^2+\frac{2\alpha}{\bar{\varepsilon}}\beta'(s)-\frac{\alpha}{\bar{\varepsilon}}2\beta'(s)\beta(s)}\cdot\frac{\alpha}{s} \tag{3.6.4}$$

And

$$\eta_F = \frac{\partial s}{\partial F} \cdot \frac{F}{s}$$

$$= -\frac{\frac{2}{\Delta}\alpha\beta'(s)}{\alpha\beta''(s)\left[1+\beta(s)+\frac{2F}{\Delta}\right]+\alpha\left(\beta'(s)\right)^2+\frac{2\alpha}{\bar{\varepsilon}}\beta'(s)-\frac{\alpha}{\bar{\varepsilon}}2\beta'(s)\beta(s)} \cdot \frac{F}{s} \tag{3.6.5}$$

Case 1: Inspection is as effective as penalty ($\eta_\alpha = \eta_F$)

Assuming that inspection is as effective as penalty, equations (3.6.4) and (3.6.5) can be written as

$$-\frac{\beta'(s)\left(1+\beta(s)+\frac{2F}{\Delta}\right)+\frac{2\beta(s)}{\bar{\varepsilon}}-\frac{\left(\beta(s)\right)^2}{\bar{\varepsilon}}}{\alpha\beta''(s)\left[1+\beta(s)+\frac{2F}{\Delta}\right]+\alpha\left(\beta'(s)\right)^2+\frac{2\alpha}{\bar{\varepsilon}}\beta'(s)-\frac{\alpha}{\bar{\varepsilon}}2\beta'(s)\beta(s)} \cdot \frac{\alpha}{s}$$

$$= -\frac{\frac{2}{\Delta}\alpha\beta'(s)}{\alpha\beta''(s)\left[1+\beta(s)+\frac{2F}{\Delta}\right]+\alpha\left(\beta'(s)\right)^2+\frac{2\alpha}{\bar{\varepsilon}}\beta'(s)-\frac{\alpha}{\bar{\varepsilon}}2\beta'(s)\beta(s)} \cdot \frac{F}{s}$$

which can be simplified as

$$\beta'(s)\left(1+\beta(s)\right)+\frac{2\beta(s)}{\bar{\varepsilon}}-\frac{\left(\beta(s)\right)^2}{\bar{\varepsilon}} = 0 \tag{3.6.6}$$

It is easily seen that equation (3.6.6) is violated because when there is deterrence incentive, $\beta(s) > 0$. Therefore, the term on the L.H.S. is not equal to zero.

Case 2: Inspection is less effective than penalty ($\eta_\alpha < \eta_F$)

Assuming inspection is less effective than penalty, then equation (3.6.6) can be written as

$$\beta'(s)\left(1+\beta(s)\right)+\frac{2\beta(s)}{\bar{\varepsilon}}-\frac{\left(\beta(s)\right)^2}{\bar{\varepsilon}} < 0 \tag{3.6.7}$$

Equation (3.6.7) is violated under all circumstances as $\beta(s) \geq 0$. Therefore, the term on the L.H.S. is not lower than zero.

Case 3: Inspection is more effective than penalty ($\eta_{\alpha} > \eta_{F}$)

Assuming inspection is more effective than penalty, then equation (3.6.6) can be written as

$$\beta'(s)\big(1+\beta(s)\big)+\frac{2\beta(s)}{\bar{\varepsilon}}-\frac{\big(\beta(s)\big)^2}{\bar{\varepsilon}}>0 \qquad (3.6.8)$$

It is easily seen that equation (3.6.8) holds when there is deterrence incentive. As $\beta(s) > 0$, the term on the L.H.S. is positive.

Hence, it is proved that inspection is more effective than penalty ■

APPENDIX B
INSTRUCTIONS[1]

Welcome to an economic experiment. You are not allowed to communicate during the experiment. If any questions, raise your hand and the experimenter will come to you. Do not see others' answers or tell them your answer. You will be asked to leave the lab if the rules are broken. You are not allowed to use any mobile devices during an experiment. You are requested to switch off your mobile phone. There will be 3 Games. Each game is for 10 rounds. When the game finishes, the computer selects 3 rounds at random. Your reward depends on these 3 rounds.

Scenario of the game

You are an employee in a production company. You have to compete in producing with another worker. We call this person "Mr. X". While working, you and Mr. X can sabotage each other (destroy each other's output). Also, there is an equal chance that your products can be of good or bad grade. Your payment depends on the values of products you and Mr. X produced in 1 day.

Value of your product = no. of your products – sabotage by Mr. X + grade of your product.

Procedures for Game 1

(1) In Game 1, you will be matched with another person. After every round, you will be matched with a new person. We call this person "Mr. X.

(2) In the first stage of the game, you and Mr. X compete in producing by playing "The Slider Game" at the same time.

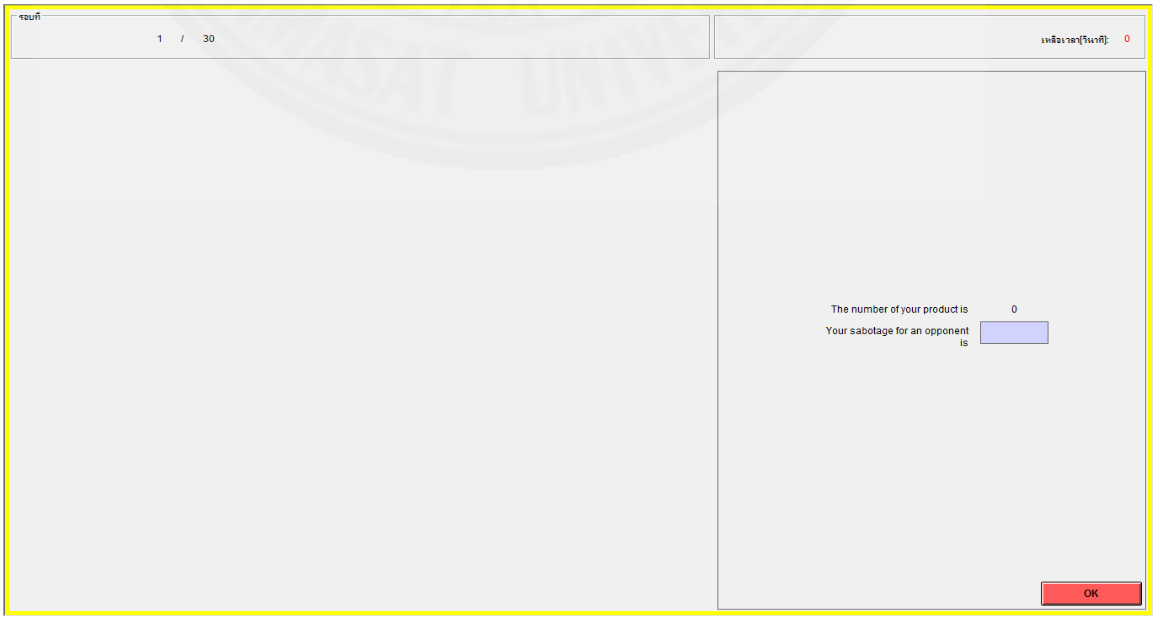
(3) You will see 48 sliders on the screen. Each slider has the value from 0 to 100, with initial value equal to 0 as seen in the figure below.

[1] Instructions used were in Thai.

(4) To generate 1 unit of a product, you need to position the slider at exactly 50. You can adjust as many times as you want within 120 seconds. For example, if you can position 20 sliders at 50, it means that you have produced 20 units of products.

(5) When time is up, the computer records the no. of products you produced. Mr. X **does not know** this number. Then, we proceed to Stage 2.

(6) Then, the screen will show the no. of products you produced as in the figure below.



(7) You can sabotage Mr. X to reduce the no. of products he produced by choosing any whole number from 0 to 10. You can make decision in the given box within 15 seconds, click “OK” to proceed to the next stage.

(8) Sabotage is costless. For example, if your sabotage is 1, you reduce the no. of Mr. X’s products by 1 unit.

(9) Next, the computer randomly selects a whole number between -20 to +20 for each of you separately to determine the product grade. The chance that your product is of good or bad grade is equal.

(10) After selecting your product grade at random, the computer calculates the value of products for you and Mr. X as in the equations below.

(11) Value of your product = no. of products you produced – sabotage by Mr. X + grade of your product

(12) Value of Mr. X’s product = no. of products Mr. X produced – sabotage by you + grade of Mr. X’s product

Payment calculation

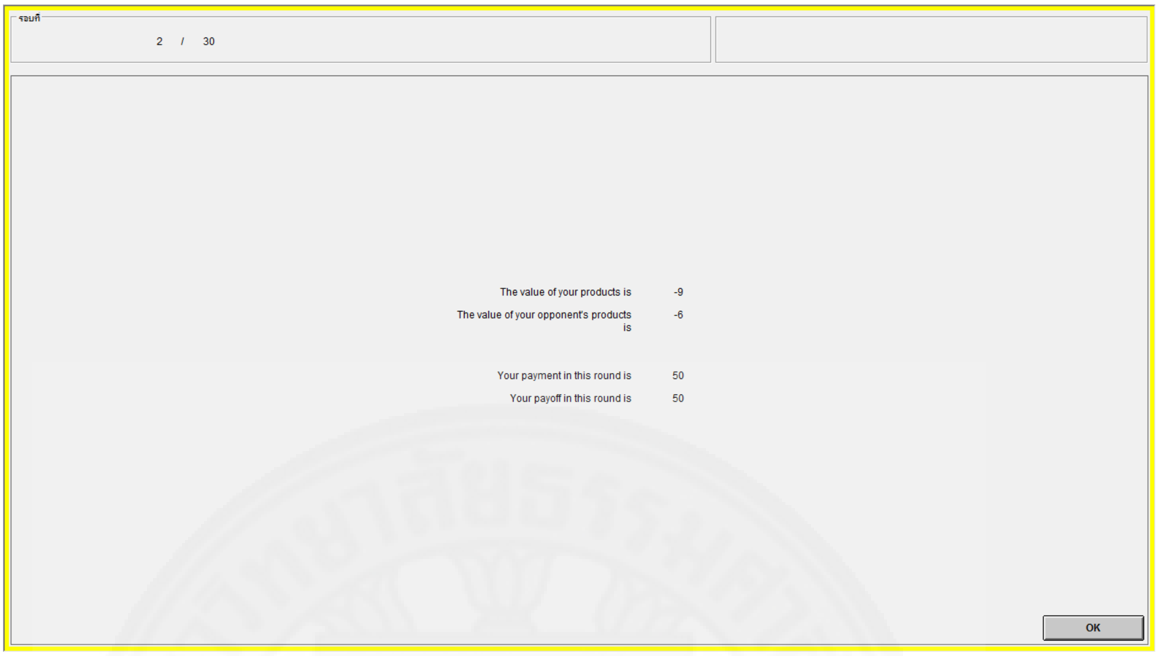
At the end of each round, the computer calculates payment by comparing the values of your product and Mr. X’s product.

(1) If the value of your product is **higher** than that of Mr. X, your payment is 150 Baht.

(2) If the value of your product is **lower** than that of Mr. X, your payment is 50 Baht.

(3) If the value of your product is **equal** to that of Mr. X, the computer randomly selects one of you to receive 150 Baht with equal chance.

(4) After comparing the values of your products and Mr. X’s products, the screen shows the value of your product, of Mr. X’s products and the payment you receive as in the figure below.



(5) We will play Game 1 for 11 rounds. The first round is practice round and will not be used for payment.

(6) If any questions, please raise your hand.

[Instruction for Game 2]

Procedures of Game 2

(1) Procedures of playing "The Slider game" and random selection of product grade are the same as in Game 1.

(2) **However,** there is a chance that your boss inspects workplace. You and Mr. X do not know exactly when your boss will inspect the workplace.

(3) There are chances of 60% that your boss does not inspect workplace, and chances of 40% that your boss inspects workplace.

(4) If your boss does not inspect workplace, there is no inspection.

(5) If your boss inspects workplace, there is a chance that he detects sabotage by you and Mr. X. The probability of detection depends on the sabotage chosen.

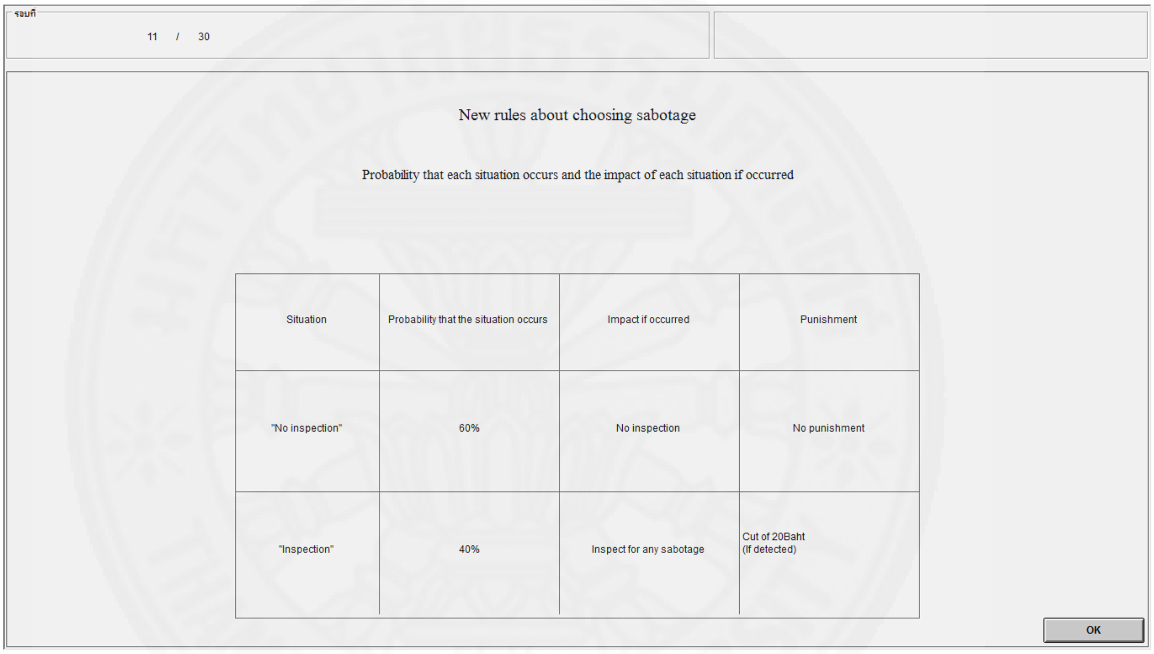
(6) The higher sabotage is, the higher the probability of detection.

(7) If detected, the person is punished by a cut of 20 Baht from your payment.

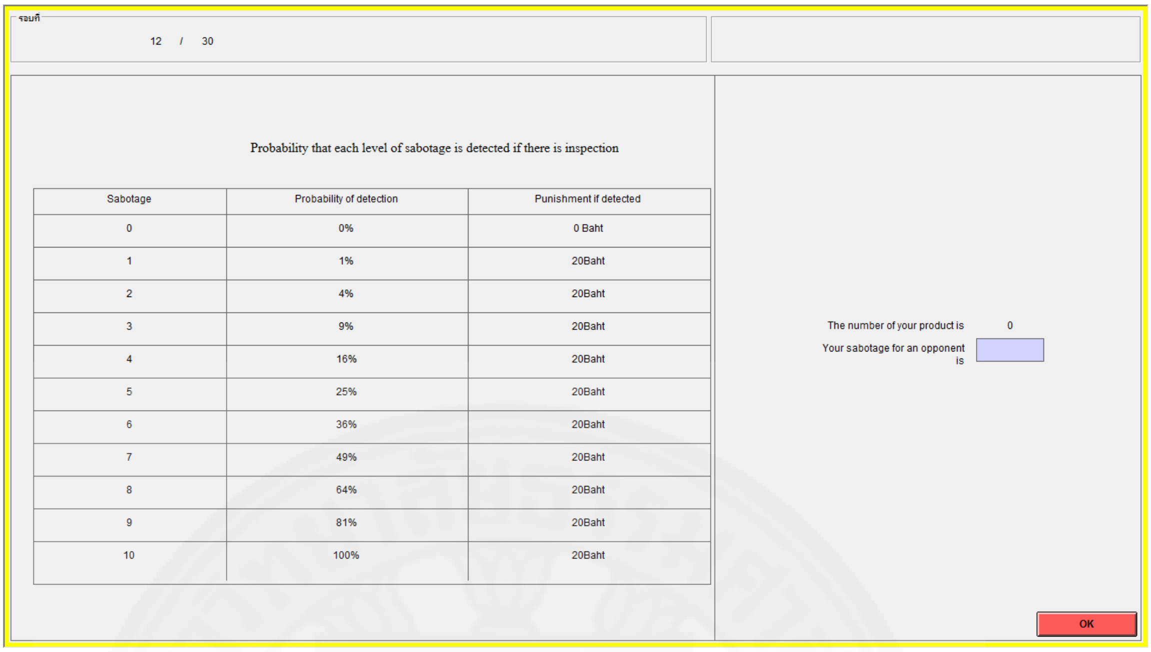
(8) The probability that your boss inspects the workplace and the impact of the situation in the table below.

Situation	Probability that it occurs	Impact if occurs	Punishment
No inspection	60%	No inspection	No punishment
Inspection	40%	Inspect for any sabotage	Cut of 20 Baht (if detected)

(9) After the Slider game, the screen shows the probability of each situation occurring and the impact of each situation as in the figure below.



(10) Then, the right side of the screen shows the number of products you produced and the left side of the screen shows the probability that your boss detects your sabotage if there is inspection.



(11) You can sabotage Mr. X to reduce the no. of products he produced by choosing any whole number from 0 to 10, and enter in the given box.

(12) Your sabotage will determine the chance that your boss detects it or not, in case there is inspection.

(13) The probability that each level of sabotage is detected if there is inspection is in the table below.

If there is inspection		
Sabotage	Probability of detection	Punishment (if detected)
0	0%	0 Baht
1	1%	20 Baht
2	4%	20 Baht
3	9%	20 Baht
4	16%	20 Baht
5	25%	20 Baht
6	36%	20 Baht
7	49%	20 Baht
8	64%	20 Baht
9	81%	20 Baht
10	100%	20 Baht

(14) For example, if your sabotage is equal to 1, you reduce the no. of Mr. X's product by 1 unit. If the situation is "No inspection", your sabotage is not detected. If the situation is "Inspection", there is a chance of 1% that your sabotage is detected. If detected, your payment is cut by 20 Baht. If not, there is no punishment.

(15) You can make decision in the given box within 15 seconds, click "OK" and proceeds to the next stage.

Payment calculation

At the end of each round, the computer calculates payment depending on the situation that occurs.

(1) If the computer randomly selects **"No inspection"**, payment is calculated by comparing the values of the products you and Mr. X produced.

(1.1) If the value of your product is **higher** than that of Mr. X, your payment is 150 Baht.

(1.2) If the value of your product is **lower** than that of Mr. X, your payment is 50 Baht.

(1.3) If the value of your product is **equal** to that of Mr. X, the computer randomly selects one of you to receive 150 Baht with equal chance.

(2) If the computer randomly selects **"Inspection"**, payment depends on the outcome of detection.

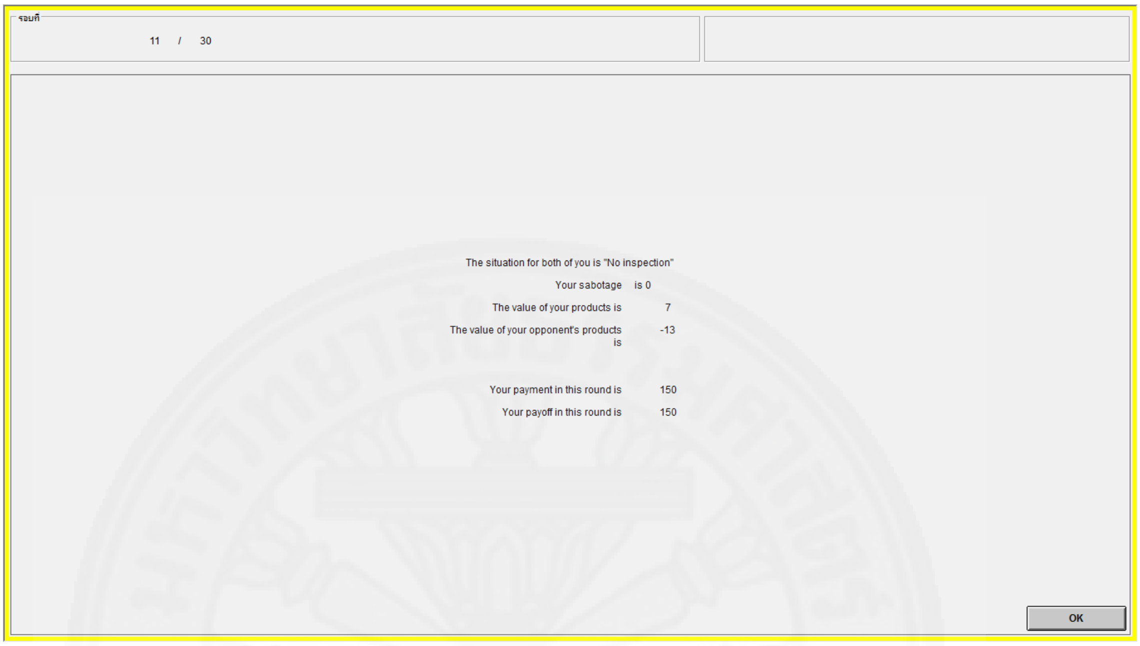
(2.1) If your boss detects your sabotage, your payment is 50 Baht and the punishment is 20 Baht. Therefore, your payoff is 30 Baht (50-20=30). In this case, payment for Mr. X is 150 Baht.

(2.2) If your boss detects Mr. X' sabotage, Mr. X's payment is 50 Baht and the punishment is 20 Baht. Therefore, your payoff is 30 Baht (50-20=30). In this case, payment for you is 150 Baht.

(2.3) If your boss detects sabotage by you and Mr. X, payment for both of you is 50 Baht and the punishment is 20 Baht. Therefore, payoff for both of you is 30 Baht (50-20=30). In this case, no one gets 150 Baht.

(2.4) If your boss does not find any sabotage, payment for you and Mr. X is made by comparing the values of the products.

(3) After payoff calculation, the screen shows the situation that occurred, detection outcome, the value of your product, of Mr. X's products, your payment and payoff as in the figure below.



(4) We will play Game 2 for 10 rounds.

(5) If any questions, please raise your hand.

APPENDIX C
QUESTIONNAIRE[1]

This questionnaire consists of 3 parts. Your response will be confidential. In case of any question, please ask the experimenter.

Part1: You need to make 10 decisions (1 decision per row). You have a choice between Option A or B. If you choose Option A, you get 25 Baht for sure. If you choose Option B, you get 75 Baht depending on the probability in the table. Indicate your choice in the last column.

Decision no.	Option A	Prob. of getting		Option B	Prob. of getting	A or B
Decision 1	25 Baht	100%	OR	75 Baht	10%	
Decision 2	25 Baht	100%		75 Baht	20%	
Decision 3	25 Baht	100%		75 Baht	30%	
Decision 4	25 Baht	100%		75 Baht	40%	
Decision 5	25 Baht	100%		75 Baht	50%	
Decision 6	25 Baht	100%		75 Baht	60%	
Decision 7	25 Baht	100%		75 Baht	70%	
Decision 8	25 Baht	100%		75 Baht	80%	
Decision 9	25 Baht	100%		75 Baht	90%	
Decision 10	25 Baht	100%		75 Baht	100%	

[1] Questionnaire was in Thai and collected via Google Form.

Part 2: Basic information

1.	Computer lab no:	
2.	Gender	□Male □Female
3.	Year of birth	
4.	Student of	□Bachelor □Master
5.	Monthly pocket money from parents	
6.	Do you drink coffee?	□Yes □No
7.	Which is your working style?	□ I like to continue using the same method if it works □ I like to keep trying new methods until I find the best method
8.	Do you like/are interested in Game Theory or Experimental Economics?	

Dislike/ Uninterested	◦ 0	◦ 1	◦ 2	◦ 3	◦ 4	◦ 5	◦ 6	◦ 7	◦ 8	◦ 9	◦ 10	Like/ Interested

Part 3: About the game

1. Is the Slider game difficult?	□Difficult □Medium □Easy
2. What do you think about the Slider game?	□Not boring □Boring
3. Did you sabotage your opponent?	□Yes □No
4. What is the main reason for sabotaging?	□I want to win the prize □I want to win the game (not prize) □I am too lazy to play the Slider game □I did not sabotage □Other (specify) . . . .
5. When there is inspection, did you get detected?	□Detected □Not detected
6. When detected, did you change your strategy?	□I changed my strategy □I did not change my strategy □I was not detected
7. When there is inspection, what is the mostly chosen level of sabotage?	
8. Tell your strategy in choosing level of sabotage	
9. Rule of the game is	□Easy to understand □Difficult to understand
10. Duration of the game is	□Appropriate □Too long

Please collect your reward from the experimenter

-THANK YOU-

BIOGRAPHY

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