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ВЫПУСКНАЯ КВАЛИФИКАЦИОННАЯ РАБОТА

на тему:

Исследование динамического поведения группы людей при неполной информации в контексте уклонения от работы и коррупционного поведения в фирме.

(The research of dynamics of group behaviour under incomplete information in the context of shirking and abuse of authority).

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Contents

1.INTRODUCTION

In this paper I investigate the "Broken Windows" theory (James Q. Wilson; George L. Kelling (1982)) and the "Tipping point" model (Malcolm Gladwell (2000)). First of all, I intend to test two approaches of the "Broken Windows" theory:

1. Violation of norms will cause more violation of these norms.
2. The intensity of negative behavior changes from small violations to severe violations.

In order to do so I examine the dynamics of group behavior under imperfect information in the context of shirking and abuse of authority in the firm.

According to the Global Competitiveness Report[i] of World Economic forum, Russia takes 84th place out of 144 in labor efficiency market and this happens most likely due to poor work effort and inefficiency, which can be caused by shirking as well as by abuse of authority due to high employee turnover and lack of motivation. Surely, it can be said that these problems are "pressing" in Russia since there is a lasting tendency for both shirking and abuse of authority has risen. Based on the research carried by AOL.com and Salary.com, employees waste 1.86 hours on average during workday.[ii] In this context, it becomes extremely interesting to examine this issue.

Imagine you are walking in the street and suddenly you see graffiti on the wall. Drawing on the walls is illegal, but there seems to be no one close who is being punished. Empty bottle of water or wrapper from chips is bothering your hands, why not to throw it here, if no one will punish you? So, not only you, but many others may start throwing litter here. If there was no graffiti on that particular his street, that street would be cleaner.

As people see no one is punished for small violations, there is a temptation to go further and taste the sweetness of breaking more severe norms. Step by step, an empty bottle thrown away transforms into a bicycle stolen from the parking near that wall with graffiti.[iii]

Thinking analogically, we can draw a direct parallel to the behavior of workers in the firm. It might be that shirking causes more severe shirking, which in its turn might cause the abuse of authority. Thereby, direct parallel can be drawn to behavior of agents in the firm, meaning that shirking can cause more severe shirking and that it can cause abuse of authority. According to Crime code of The Russian Federation article 201: the abuse of authority is the situation when agent uses his/her authority in order to gain some personal advantages.[iv] It is important to use different strategies such as shirking (falls under administrative penalty) and abuse of authority (falls under criminal penalty), as in the

"Broken Windows" theory different types of crime is used (for example, throwing litter is administrative offence, while steal bicycle is criminal offence).

My aim is to analyze dynamic interactions between agents at one side of "principal-agent" model, thus I do not consider any reciprocal actions between principal and agent. Following to Fischbacher and Gächter (2010) agents can be classified in groups according to their preferences in games with public good as: conditional cooperators (only cooperates if others cooperate (55%)), free-riders (never cooperate no matter what others do (23%)), "triangle-contributors" (enlarge cooperation the more others cooperate to some point and then lessen it the more people cooperate (12%)) and unclassifiable (10%)[v].Not only the propensity to cooperate and to risk, but also the attitude to laws of various levels (universal laws and values, government laws, interaction rules in collective rules) and priority to these levels determine the human behavior. Since violation of laws is not always directly connected to risk of being punished, we will not perplex the classification but will simply clarify these classes: risk-averse agents, choosing between two strategies with identical expected payoffs, always choose the one with smaller risk, (I also assume that they prefer not to violate rules); risk-neutral agents, choosing between two strategies with the same expected payoffs, are indifferent between them despite the risk (I assume that this type of agents pays greater attention to the preferences of majority regarding violation of laws); risk-loving agents, choosing between two strategies with the same expected payoffs, always prefer the riskier one, (I suppose risk-lovers are inclined to violation of laws in almost any case). Based on previous studies, I expect that the amount of risk-averse agents will dominate the amount of risk-neutral and risk-loving agents.

Secondly, it is in my field of interest to study "Tipping points" (the moments when it becomes optimal for everyone switch to negative behavior). I would like to investigate moments when "Tipping points" are passed, in what way and how agents can influence them. The idea close to "tipping" first appeared in the book "Micromotives and Macrobehavior" by Schelling (1978). He claimed that people's choices depend on the choices of others, so his book was about "interdependent decisions". Shelling used term segregation in one of the examples about all-black all-white neighborhoods. He stated that if whites, whose are least enduring to blacks, would move and they would be replaced by blacks then the most enduring whites would ultimately also move. So, this neighborhood might become almost black: in this case segregation might occur.[vi] The concept of "Tipping point" has been used in many areas of research, such as sociology (Card; Mas; Rothstein (2008)), corruption (Clark; Wihardja (2006)), epidemiology

(Wertler (2007)), climate (Lenton; Held; Kriegler; Hall; Lucht; Rahmstorf; Schellnhuber (2008))and economics (Jackson, Yariv (2006)).To my knowledge it has not been applied in the context of agents behavior before. Formally, I define the "Tipping point" as the proportion of total number of agents, choosing negative behavior, which is needed to make others change their strategy to negative, and, thus, leading to the acceleration of the spread of bad behavior (shirking & abuse of authority). In more simple words, "Tipping point" will occur when negative conduct becomes optimal to everyone.

I approach the questions of spreading the disorder, its intensity and "Tipping Points" by dint of laboratory experiments. I chose laboratory experiments because it allows for exhaustive observation of all interactions between the individuals; hence I can receive the full picture of the process of reciprocal action of people within the group.

In this paper I also focus on how shirking can be cured. Therefore, I am interested in how incentives affect the "Tipping Point". Consequently, I consider both the effects of increase in the bonus, and the amount of it as well as exogenous introduction of HR manager.

This paper differs from the literature I mentioned above and used in the research. Firstly, almost all studies focused on sociological problems, while my aim is to concentrate on economics. Secondly, no much laboratory experiments can be observed for this specific topic in the papers, so I propose relevant and reliable experiments in the context of shirking and abuse of authority.

2. DESCRIPTION OF THE MODELAND BENCHMARK SOLUTIONS

I investigate a repeated finite game with incomplete information for N-agents. There are two Nash equilibriums in this game videlicet we do not observe mixed strategies, what can be proved analytically. Specifically, I use this game to simulate real firm situation, in which I immerse actual people in order to study their behavior with regard to the "Broken windows" theory and "Tipping point" model.

First, I describe how the model is arranged and then deduce the benchmark solutions for the "Tipping points". Benchmarks describe behavior of risk-neutral agents. In reality, there are different types of agents: risk-averse, risk-neutral and risk-lovers. Therefore, I expect the results obtained from the experiment sessions to be different from initial benchmarks since I calculated them only for risk-neutral agents, so I examine the difference observed between "Tipping points" from experiment sessions and benchmarks and explain it.

2.1 The model

The game contains two stages. In stage one, agent can choose one of the two strategies: "work hard" or "shirk". If agent chooses the former strategy then he/she receives wage w and bonus b for assiduity, but also experiences costs c. Those costs might be additional efforts he/she spends on concentration and endeavor. So, the expected payoff is $w + b - c$. If agent chooses the latter strategy then he/she will receive wage but there is a probability to be caught for shirking and not to receive a bonus$p_1(s)$, where s is quantity of shirking agents. So, the expected payoff is

$$p_1(s)w + (1 - p_1(s))(w + b) \qquad (1)$$

Parameters w, b and c are constant positive numbers; $p_1(s)$ is endogenous since it depends on the quantity of shirking agents s and decreases with increase in the number of shirkers. Quantity of shirking agents s and quantity of agents who received the bonus r are random values. So, quantity of agents who received the bonus can be represented as difference between total number of agents N and amount of shirking agents caught s_c, which is a random value, therefore $r = N - s_c$, where s_c can take values from 0 to s.After the decision is made, the following information set will be available for agents:

- quantity of shirking agents in previous round (s);

- quantity of agents who received the bonus agents in previous round (*r*);
- quantity of agents were caught agents in previous round(s_c)*;*
- his /her payoffs for current round and for all previous rounds (*pf* and *spf,* respectively).

The agent can make the decision for the next round based on information from the previous rounds. Stage number one will be played for *k* rounds in order to observe dynamic behavior of agents through time-series analyze. Agents receive more precise information about how $p_1(s)$ depends on quantity of shirking agents *s* with each new round as they can observe the dynamics of quantity of shirking agents *s*, quantity of shirkers were caught s_c and quantity of agents who received the bonus *r* for all previous rounds.

As was mentioned above, it is incomplete information game since agents are not informed about *s,* s_c, *r* and $p_1(s)$ in current round, they only know *s,* s_c and *r* for previous round and they do not know $p_1(s)$ at all, where $p_1(s) = 1 - \frac{s}{N}$,[vii] the only available information about the probability $p_1(s)$ is that it depends on the behavior of all agents within the group. It is quite reasonable to use such probability in my model as I assume the monitoring capacity of principal is constant, which means that the more violations the smaller the probability for a specific violator to get caught.

In order to derive the "Tipping point" for the pair of strategies "work hard" vs "shirk", the latter strategy should be more attractive to agents comparing to the former one, according to the definition of the "Tipping point". That is expected payoff from strategy "to shirk" should be higher then from strategy "to work hard":

$$w + b - c \le p_1(s)w + (1 - p_1(s))(w + b); \tag{1.1}$$

$$p_1(s) \le \frac{c}{b}; \tag{1.2}$$

Substitute $p_1(s)$ with $1 - \frac{s}{N}$:

$$1 - \frac{s}{N} \le \frac{c}{b}; \tag{1.3}$$

$$s \ge (1 - \frac{c}{b})N; \tag{1.4}$$

where *c* is costs, *b* is bonus and *N* is total number of agents.

The smallest value s (shirking agents), which satisfies this inequality, will be the "Tipping Point", after which the optimal strategy for everyone is shirking.

In the stage two, agent can choose between three strategies: "work hard", "shirk" or "abuse of authority". For the first two strategies mechanics and expected payoffs are the same as in the stage one. But, if agent chooses third strategy then he/she can receive some costs J with probability to be caught for abusing of authority$p_2(a)$, where a is the number of agents who abuse authority. J can be costs of going to jail or costs for covering from offence. Agent can also receive wage w, bonus b, extra gain g and costs c with some probability not to be caught$1-p_2(a)$. In this case I assume that agent has to work hard so he/she is imposed with cost c for diligence. Thus, expected payoff is

$$(1 - p_2(a))(w + b - c + g) - p_2(a)J \qquad (1.5)$$

$p_2(a)$ is endogenous since it depends on number of people who abuse authority a and decreases with increase in them, while J and g are a constant numbers. Values a (quantity of agents who abuse authority) and a_c(quantity of agents who were caught for abuse of authority) are a random values, the latter can be from 0 to a. After agent made a decision, the following information set will be available:

- quantity of shirking agents in previous round (s);
- quantity of agents who received the bonus agents in previous round (r);
- quantity of agents were caught agents in previous round(s_c);
- quantity of agents who abuse authority in previous round(a);
- quantity of agents who are caught for abusing the authority in previous round(a_c);
- his /her payoffs for current round and for all previous rounds (pf and spf, respectively).

Again, agent can make the decision for the next round based on information from the preceding rounds. Stage number two will be played for t rounds in order to observe dynamic behavior of agents through time-series analyze. Agents receive more precise information about how $p_2(a)$ depends on quantity of those who abuse authority a with each new round as they can observe the dynamics of quantity of shirking agents s, quantity of agents who received the bonus r, quantity of agents who were caught for shirking s_c, quantity of those who abuse authority a and quantity of people who were caught for abusing the authority a_c for all previous rounds.

In the second stage, agents are not informed about values of *s, r,* s_c and a_c in current round, they are acquainted this information only for the previous rounds, besides, they do not know real value of $p_1(s)$ and $p_2(a)$, where $p_2(a) = \frac{1}{m+a}$, $m - const$, monitoring capacity of the principal is assumed constant that is the more violations the smaller the probability for a specific violator to get caught and $p_2(a)$ is less then $p_1(s)$.

The "Tipping point" will be achieved for the pair of strategies "work hard" and "abuse of authority" when the second strategy is more beneficial to agents in its expected payoffs then the first one. Analytically this can be represented this way:

$$w + b - c \le (1 - p_2(a))(w + b - c + g) - p_2(a)J; \tag{1.6}$$

$$p_2(a) \le \frac{g}{w + b - c + g - J}; \tag{1.7}$$

Substitute $p_2(a)$ with $\frac{1}{m+a}$, $m = const$:

$$\frac{1}{m+a} \le \frac{g}{w + b - c + g - J}; \tag{1.8}$$

$$a \ge \frac{w + b - c + g - J}{g} - m; \tag{1.9}$$

where w is wage, b is bonus, c is cost, g is gain, J is jail cost, m is constant.

The smallest value a (people who abuse authority), which satisfies this inequality, will be the "Tipping point", where the optimal strategy for everyone is "abuse of authority".

Finally, the third pair of strategies is considered, in order to approach the "Tipping point" in this case, strategy "abuse of authority" should be more appealing for agents then the strategy "shirk", meaning expected payoffs from former strategy is greater than from the latter:

$$p_1(s)w + (1 - p_1(s))(w + b) \le (1 - p_2(a))(w + b - c + g) - p_2(a)J; \tag{2}$$

$$p_2(a) \le \frac{b \times p_1(s) + g - c}{w + b - c + g - J}; \tag{2.1}$$

Substitute $p_2(a)$ and $p_1(s)$ with $\frac{1}{m+a}$, $m = const$ and $1-\frac{s}{N}$, respectively:

$$\frac{1}{m+a} \le \frac{b(1-\frac{s}{N})+g-c}{w+b-c+g-J}; \tag{2.2}$$

$$a \ge \frac{w+b-c+g-J}{b(1-\frac{s}{N})+g-c} - m; \tag{2.3}$$

The boundary of the area, described by inequality above, is a graph of the following function:

$$a = \frac{w+b-c+g-J}{b(1-\frac{s}{N})+g-c} - m; \tag{2.4}$$

Where w is wage, b is bonus, c is cost, g is gain, J is jail cost, m is constant, s is quantity of shirkers, N is total amount of agents (the specific values were calculated for the experimental session and accessible for review in the appendix B.

In this case, we receive "Tipping lines" which divides the plane into three parts with optimal strategies. Figure 1 indicates "Tipping lines" and areas with optimal strategies:

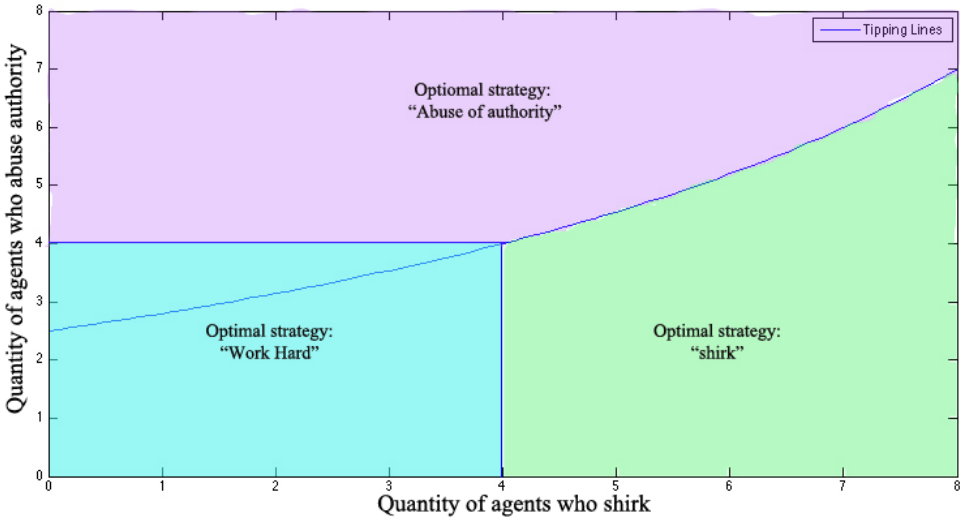


FIGURE 1 "Tipping line" and areas of optimal strategies

We can observe at horizontal axis the quantity of agents who shirk, while at vertical quantity of agents who abuse authority. Here I draw the space of the states of the world, which is divided into tree regions: blue region indicates when strategy “work hard” is optimal; green region shows when strategy “shirk” is optimal; lilac region represents the field when strategy “abuse of authority” is optimal. Lines depicted at the graph imply the set of “Tipping points”, that is points, where strategies “work hard”, “shirk” and “abuse of authority” are equivalent. Equality holds on the line, while not on the line it does not. In the green area the utility is maximized by the strategy to “shirk”. In the blue are it is maximize by the strategy to “work hard”, while in the lilac area-by the strategy to “abuse of authority”.

3. EXPERIMENTAL DESIGN AND PROCEDURES

3.1 Experimental Design

During the experiment participants played the two-stage game described above. Stage one contained three periods and each period had ten rounds. Stage two consisted of only one period, which had ten rounds. Participants were randomly placed in the groups of eight people, where they did not had an opportunity to communicate personally, so the only information they received about the behaviour of the group was what they saw on the display of the computer. Five groups were obtained from during the several experimental sessions. Four of them played identical games, but for the fifth group the treatment in the third period of stage one was different. Participants were told that experimental session is the simulation of real life situation and that were the employees of the large company. Table 1 represents full information about structure of the game and main research questions:

TABLE 1

MAIN RESEARCH QUESTIONS, EXPERIMENTAL DESIGN, NUMBER OF SUBJECTS PER GROUP

Stage	Period	# Rounds	Treatment	Available strategies	Information shown to subjects (labels)	# Subjects per group
A. Does violation of norms cause more violations? (Does shirking bring more of such behaviour in the firm?) Does the "Tipping Point" is passed and how fast it happened? What behaviour of agents before and after the "Tipping Point"?						
1	1	10	Baseline ($p_1(s)$ is a function of quantity of shirkers, $p_1(s)'<0$)	"Work hard" "Shirk"	*s* *r* s_c *pf* *spf*	8
B. Establishing the effects performance incentives through introduction of HR manger: Does "Tipping point" is reset? How quickly has it happened?						
1	2	10	HR Manager (p_1=0.75)	"Work hard" "Shirk"	*s* *r* s_c *pf* *spf*	8
C. Establishing the effects performance incentives through introduction of bonus increase: Does "Tipping point" is passed? How quickly has it happened?						
1	3	10	Bonus increase ($p_1(s)$ is a function of quantity of shirkers, $p_1(s)'<0$) (group 1-4: from 20 to 80 units; group 5: from 20 to 45 units)	"Work hard" "Shirk"	*s* *r* s_c *pf* *spf*	8

D. Does small violation of norms cause sever violations? (Will the agents who shirk abuse authority?)						
2	1	10	Baseline ($p_1(s)$ is a function of quantity of shirkers, $p_1(s)'<0$; $p_2(a)$is a function of agents who abuse authority, $p_2(a)'<0$)	"Work hard" "Shirk" "Abuse of authority"	s r s_c a a_c pf spf	8

In the stage one, participants had to answer the question: "At what quantity of shirkers in the group are you ready to shirk?" Participants had a table with the two columns, the first one represented quantity of shirkers from zero to seven (numbers included only the rest of the group) and the second were empty boxes, where subject should tick the boxes if he/she was ready to shirk at particular amount of shirkers. Participants were able to tick the boxes in any order, for instance, they could tick 0, 1, 2; 4, 5, 6, 7 or 0, 1, 6, 7 and leave other boxes empty. After the table was filled in, the information about the minimum quantity of shirkers at which colleagues in the group on average would shirk was available for participants (AMS). Then players were given an opportunity to make a choice between two strategies: "work hard" or "shirk". After all participants made a decision, new information was available for them (the quantity of shirkers in the round, quantity of participants who receive bonus and who were caught for shirking as well their payoffs for the round and the sum of their payoffs for all previous rounds). Players did not observe the payoffs of others.

The purpose for the revelation of the data, described above, is to detect agents' preferences and calculate coefficient of accordance for each player. This coefficient represents how the actions of the player correspond to his/her preferences. Once the preferences were obtained, one could distinguish people between different types according to these preferences. Information about AMS is given so that agents could make a better prediction about quantity of shirkers in current period and evaluation of general willingness to shirk. AMS was given to participants in order they could, firstly, make a better forecast about the quantity of shirkers in current period and, secondly, better evaluate the general willingness to shirk. The statistics for previous round is provided in so that participants could observe behavior of others in the group and based on it they can form their own behavior on next round. The main purpose of period one was to observe the behavior of participants in dynamics, that is, whether the "Tipping point" was passed, and

if it was, in what round it was passed and what was the tendency of the behavior after the "Tipping point". So, the main hypothesis I intended to test during this period was if with increase in the number of shirkers more agents start to shirk (that is, if violation of norms causes more violation of norms).

In the second period treatment was changed. The participants were told that company hired HR manager to look after their performance at work. As for the rest, routine was similar to previous period. So, it was expected that participants would understand that probability to get caught for shirking and not to get bonus changed and increased on average compared to previous round. Therefore, during this period I planed to investigate introduction of HR manager as an incentive to work harder. Hence, I checked whether "Tipping point" was reset and how quickly this reset happened.

In the third period, participants were informed that HR manager was fired and company decided to increase bonus (from 20 units to 80 units for first four groups and from 20 units to 45 units for the fifth group). As for the rest, routine was identical to the first period. This period was interesting for two reasons. Firstly, I investigated how incentive in the form of increase in bonus influenced "Tipping point", that is whether it was passed again and how fast it happened. I test the hypothesis that "Tipping point" was passed slower compared to the period with low bonus. Secondly, I examined the effect in the amount of bonus. Needless to say, an increase in bonus by different magnitude brings different effects on the "Tipping point".

In the stage two, participants had two answer two questions: 1) "At what quantity of shirkers in the group are you ready to shirk?" and 2) "At what quantity of colleague who abuse authority in the group are you ready to abuse authority?" Participants were given two tables to fill in. The first table is the same to that described above, while the second one is similar. It also had two columns, the first one represented quantity of employees who abuse authority from zero to seven (numbers represented only the rest of the group) and the second one were empty boxes, where subject should tick the boxes if he/she was ready to abuse authority at particular amount of people who abuse authority. Participants again were able to tick the boxes in any order, for example, they could tick 0, 1, 2; 4, 5, 6, 7 or 0, 1, 6, 7 and leave other boxes empty. After both tables were filled in, the values at which minimum quantity of shirkers colleagues and those who abuse authority in the group on average would shirk and abuse authority, were available for participants as well as an opportunity to make a choice between three strategies "work hard", "shirk" and "abuse of authority" (AMS, AMA).As soon as decision was made, participants got more information

such as quantity of those who abused authority, quantity of shirking agents, quantity of agents who received the bonus, quantity of agents who were caught for shirking, quantity of those who abused authority and quantity of people, who were caught for abusing the authority in previous rounds, and received payoffs.

As was mentioned above the data from the tables is aimed to detect agents' preferences and calculate coefficient of accordance for each player. This coefficient represents how the actions of the player correspond to his/her preferences. AMS and AMA were rendered to participants in order they could, firstly, make a better forecast about the quantity of shirkers and the quantity of those who abuse authority in current period and, secondly, make a better evaluation of the general willingness to shirk and abuse authority. Afresh, statistics about this state of the world were given so participants could form their behavior based on actions of others. The most fundamental hypothesis I tested was whether agents who shirk a lot would easily and speedily switch to "abuse of authority" strategy, that means small violation of norms causes sever violation of norms.

After the game session was over, the participants had to answer the questionnaire, which was developed by A. Belianin at National Research University - Higher School of Economic for project on "Tax behaviour and tax compliance in a cross-country perspective" (currently in progress). This questionnaire was modified and few questions were added in order to fit the experiment explained above. Participants answered questions about their background, attitude to the risk and life satisfaction level . Apart from that I asked them to provide their personal estimations or at least their ideas about how probabilities to be caught for shirking and abuse of authority were formed in different periods, what strategies they thought were optimal and what information, from their point of view, was significant in decision making. As the attitude to risk is very important in my further analysis I will add a few comments about what I asked participants in the "risk-attitude detection" part of the questionnaire. I asked the agents how they estimated their attitude to risk-taking in different aspects of life. For example, when they drive a car, in financial matters, at work, during sport activities etc. Asking straightly is not always the best way to learn something, because people do not always clearly realize who they are, and particularly, if they are risky or not. Risk-attitude is the object from the sphere of unconsciousness and asking implicit question is a better way to understand how risky the person is. So, I also used a short question about one risky lottery, which implicitly good shed a light on their attitude to risk. Participants were told that they won 2,500,000 Rub and there was an opportunity to invest some or all of this money into risky project, so they

could earn twice as they invested or lose half of it in two years. This lottery question is a good indicator of how participants act toward money and what level of risk they can take with financial matters. Besides, it is vital to take into account that factors such as age, gender, height, education etc are strongly correlated with risk preferences, which has been shown in the study by T. Dohmen, A. Falk and others (2005)[viii].

Thus, the data from the questionnaire was used in the analysis of participants' behaviour and it played an important role in the determination of types of participants according to the risk attitude. If someone finds a need to acquaint with technical specification of the game, it can be found in the appendix B.

3.2 *Procedures*

I conducted 3 experimental sessions at the Laboratory for Experimental and Behavioural Economics at National Research University Higher School of Economics with a total of 40 participants, majority of them were undergraduates or graduates of economics (75%), mathematical science (15%), humanities (5%) and other (5%). Detailed information is shown in the Table 2 below.

TABLE 2

SOME BASIC CHARACTERISTICS OF SUBJECTS AND GROUPS

	All subjects	Group 1	Group 2	Group 3	Group 4	Group 5
Gender %	Males 87.5% Females 12.5%	Males 62.5% Females 37.5%	Males 50% Females 50%	Males 62.5% Females 37.5%	Males 62.5% Females 37.5%	Males 75% Females 25%
GPA [0,10]	7.29	7.19	7.41	6.81	8.13	6.79
Life satisfaction level [0,10]	7.13	6.13	6.88	6.88	7.63	8.13

Regarding the gender, 87.5% of participants were males, while 12.5% were females. In general, the level of education measured by the GPA [0,10] provided by participants was high, where the GPA among all participants was 7.29 out of 10. Regarding the life satisfaction level, the average level for all of the participants was 7.13 (0 is not satisfied at all and 10 is maximum satisfaction), which represented that agents were quite happy with their lives. In single session 16 participants were presented in one room at the same time. Randomly two equal groups were formed from these participants. Only during the last experimental session, one group was formed out of all 8 participants. So, the total amount of groups was 5. Groups 1, 3 and 4 had the same percentage of males and females, 62.5% and 33.7%, respectively. However, average level of life satisfaction and

GPA (both measured from 0 to 10) were different: 6.13 and 7.19 in group 1; 6.88 and 6.8 in group 3; 7.63 and 8.13 in group 4, respectively. Group 2 had equal percentage of males and females, while level of life satisfaction and GPA were 6.88 and 7.41. Finally, group 5 had quite large percentage of males 75% and only 25% of females, it also showed the highest life satisfaction level among all groups 8.13, however the GPA was the smallest compared to other groups (6.79). Subjects were informed that they play in the group of 8 people, but they did not know precise who they were playing with.

As soon as participants were under experimental conditions, before each period they were given an instruction to read (each period the instruction was updated since new treatments were introduced). The translated sample of the instruction can be found in the appendix A. Then experimental adviser read the instructions to the participants and answered personally all individually asked questions. Some exercises were solved with participants in order they had full understanding of how AMS, AMA and payoffs are calculated. The experiment did not start until all participants understood instructions and all calculations. In order to interpret the context of the instructions correctly, participants were asked to think of themselves as employees of one large company, where they can earn wages, bonuses, bear cost etc. Also it was accentuated that all answers and actions of participants given during the experimental sessions were anonymous.

The experiments and questionnaire were carried out on the software "z-Tree"[ix]. One experimental session lasted about 1.5 hours. Before participants begin to play, they were told that during the experiment experimental currency (Tokens) is used and the exchange rate is 1 Token = 0.08 Rubles. The average payoff for the whole experimental session was 6,250 Tokens (500 Rub) per subject.

4. RESULTS

I organize the analysis in the following order. In the section 4.1 I explain how groups according to risk attitude were formed. Then in the section 4.2 I perform analysis about "Tipping point" and agents behaviour under baseline. In section 4.3 I investigate the effect of incentives such as introduction of HR manager and bonus increase. Afterwards, in section 4.4 I conduct analysis of how quantity of shirkers and point estimation of probability to get caught for shirking influence proportion of shirkings in different groups according to risk attitude. In section 4.5 I provide the analysis of agent's behaviour through augmented utility function. In section 4.6 I compare how the information from pre-round questionnaire corresponds with agents' actions and, finally, in section 4.7 I consider the relation between shirking and abuse of authority.

4.1 *Distribution into groups according to risk attitude*

I distinguish between three types of agents according to their risk attitude: risk-averse, risk-neutral and risk-lovers. I use both information about the agents from the questionnaire and the information about their behavior from the experiments' data. I believe the risk attitude is determined by two components: by attitude to personal risk (which depends on how many times the agent was caught at time *t* and how many time he/she shirked to time *t*) and, by the attitude to impersonal risk (which depends on quantity of shirkers at time *t-1*, quantity of shirkers caught at time *t-1*). Hence the following coefficients of personal (r_t) and impersonal (r_t^*) risk attitude can be defined:

$$r_t = \sum_{1}^{t} a_i x_i; \tag{2.5}$$

$$a_i = \frac{\sum_{1}^{i-1} x_{cj}}{\sum_{1}^{i-1} x_j}; \tag{2.6}$$

$$r_t^* = \sum_{1}^{t} b_i x_i; \tag{2.7}$$

$$b_i = \frac{\sum_{1}^{i-1} s_{cj}}{\sum_{1}^{i-1} s_j}; \qquad (2.8)$$

where x_i is the indicator of whether agent shirked or not in current round (1-yes, 0-no), x_{cj}-indicator whether agent was caught for shirking in current round (1-yes, 0-no), s_j - quantity of shirkers in j round ($s_j \in [0,8]$), s_{cj}-quantity of shirkers who were caught ($s_{cj} \in [0, s_j]$).

So, from these two coefficients I calculated 6 parameters, which describe the level of riskness, that means I calculated personal and impersonal coefficient to risk attitude for the first two periods in stage one and for one period in stage two.

I also added one more parameter, which played an important role in determination of risk attitude. It was calculated using data from the questionnaire. This parameter represented weighted average of some answers, for instance, (1) of the participants' responds towards risk attitude and the level of satisfaction in different aspects of life, (2) of responses about income level, gender and height and finally, (3) of the answers for the "lottery question". Weights used in the calculation of this parameter were based on the study of individual risk attitudes by Huffman, Sunde and others (2010). As soon as all parameters were calculated *K-means* clustering technique[x] was used to get three clusters according to risk preferences. Before running the algorithm of this technique we enter initial coordinates of centroids, which characterized as benchmarks of groups risk-averse, risk-neutral and risk-loving agents. Then the first part of the algorithm is launched, which arranges each agent to specific centroid using Minimum distance rule. So, the clusters that represent the initial fragmentation are formed in this way. The next step of the algorithm finds the optimal centroid for each of the generated clusters by the least sum of the squares of the distancefrom elements of clusters to centroids. After that previous step of the algorithm is launched and so on until convergence. The algorithm converges since at each step sum of squares of the distance from entry points to corresponded centroids can only decrease, while quantity of different fragmentations is finite. In such a way *K-means* guarantees convergence to the local minimum. Therefore, this algorithm was improved and later used, so there was convergence to global minimum. As a result I received segmentation of all subjects by three groups: risk-averse, risk-neutral and risk lovers.

4.2 *"Tippping point"and Dynamic Agents' Behaviour under Baseline*

I lay the foundation for my analysis by observing the results from the baseline treatment. I particular interested in the behaviour dynamics of agents and "Tipping point" observation. Previously I have predicted that with increase in shirking agents there will be agents who will switch from strategy "work hard" to "shirk". The results vary with different observed groups. First, I explain the results obtained from groups 1 and 2 then group 3 and 4, finally, group 5. Figure 2, figure 3, figure 4, figure 5 and figure 6 are graphs of quantity of shirkers and time (rounds per period) in the different groups:

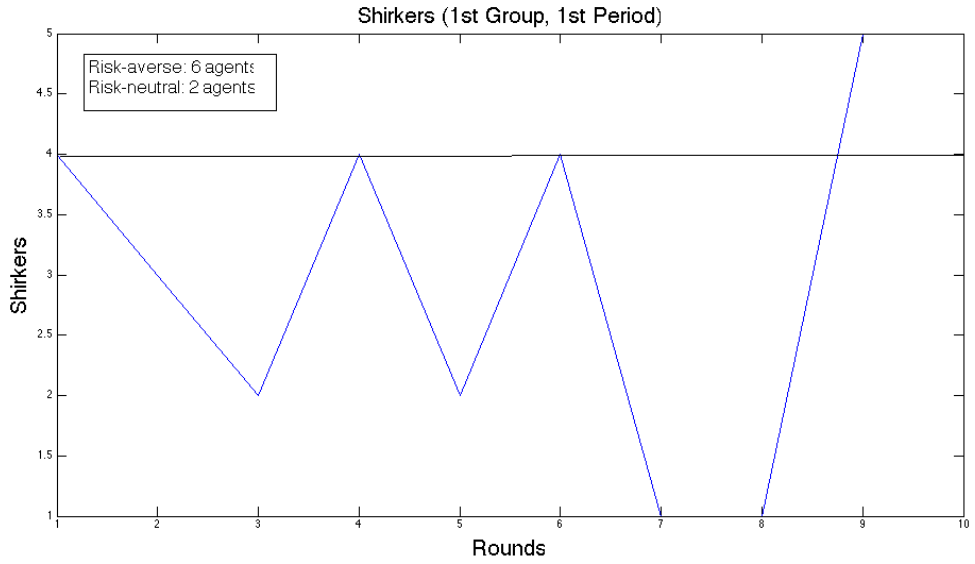


FIGURE 2: Change in the quantity of shirkers within rounds in group 1

As can been seen in the figure 2, calculated "Tipping point" (it was calculated using values from the experiments, which were obtained from the model explained previously in the paper, and equals to 4 (CTP)) was passed in the round 9 and retained in the last round. The repeated fluctuations in quantity of shirkers from period 1 to 8 can be explained by relatively large amount of risk-averse agents in this group (6 out of 8) as well as learning process. Learning has become a wide spread feature in the explaining behaviour of agents in different kinds of games, for instance, Selten, Stoecker (1985); Kandori, Mailath and Rob (1993); Shogren, List and Hayes (2000). Group one needed 8 rounds to realize that cooperation on the strategy "shirk" is optimal when majority follows this strategy. The latter especially can be observed from agents' preferences, initially, more than half of the agents in this group had not consistent with the model preferences, that is they preferred to shirk only if they see small amount of shirkers in the group. Thus, the round one started in quantity of shirkers 4 and this was a signal for agents how to behave in the next round,

hence, according to their preferences, majority chose to work hard and this tendency repeated until round 7. After that preferences took correct form, that is agents started to prefer shirk only if they observe others shirk, so that is why, small amount of shirkers in periods 7, 8 and dramatic increase in periods 9 and 10.

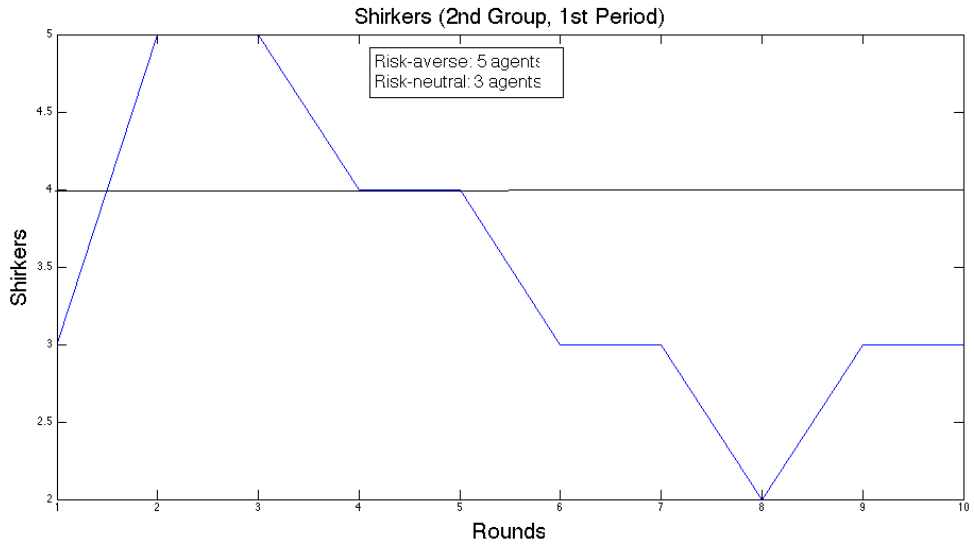


FIGURE 3: Change in the quantity of shirkers within rounds in group 2

Group 2 does not differ greatly from group 1 in proportion of agents, according to risk attitude (5 risk-averse and 3 risk-neutral agents). However, there is abnormally behavior in this group. As can be observed, CTP is passed in the second and remains in the third round, but then amount of shirkers decrease stable until round 8 and only small leap has happened in round 10. The effect seen in the first two rounds can be explained by misleading point estimation of probability to get caught since in round 1 no one of 3 shirkers were randomly caught. What is particularly interesting about this group that learning process in this group is very slow, that is the speed of it is almost zero. So, in general preferences and beliefs are inverse to the state of the world of this game in the group 2 and only small effect of preferences and beliefs correction can be observed in the last two rounds. Possibly, if this period contained more rounds we could observe how preferences and beliefs are corrected and then CTP would be achieved and remained afterwards.

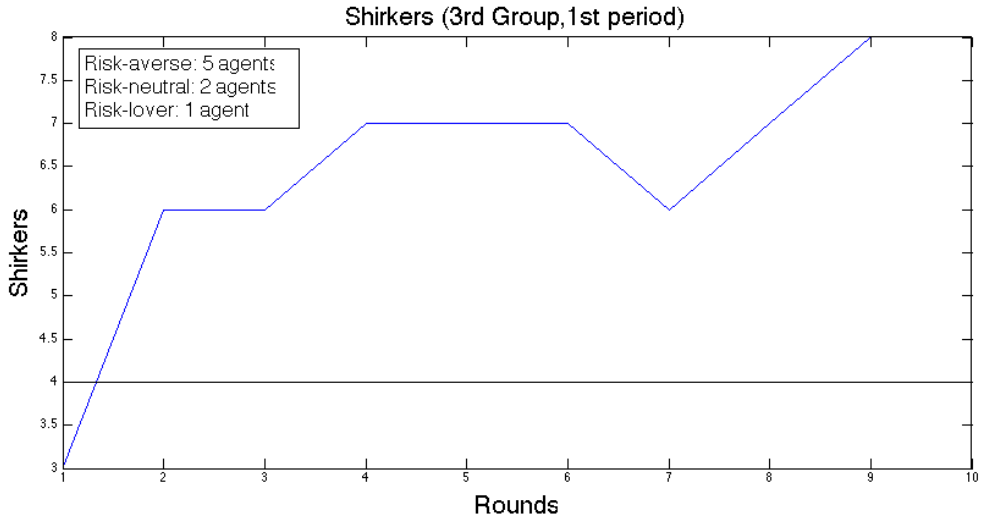


FIGURE 4: Change in the quantity of shirkers within rounds in group 3

The dynamics of agent's behaviour is entirely consistent with my point of view based on "Broken windows" theory and the definition of "Tipping point". As can be noticed CTP is passed in the second round and further quantity of shirkers has never dropped lower it. There is one risk-lover in this group who accelerated the speed of quantity of shirkers. Besides, this group had salient learning abilities regards to decision making and cooperation. Some fluctuations in the graph can be explained by the fact that there are risk-averse agents in the group who does not like risk, so after they lose bonuses the immediately switch to strategy "work hard". However, the equilibrium is achieved from round nine, indicating that preferences and belief adjusted correctly.

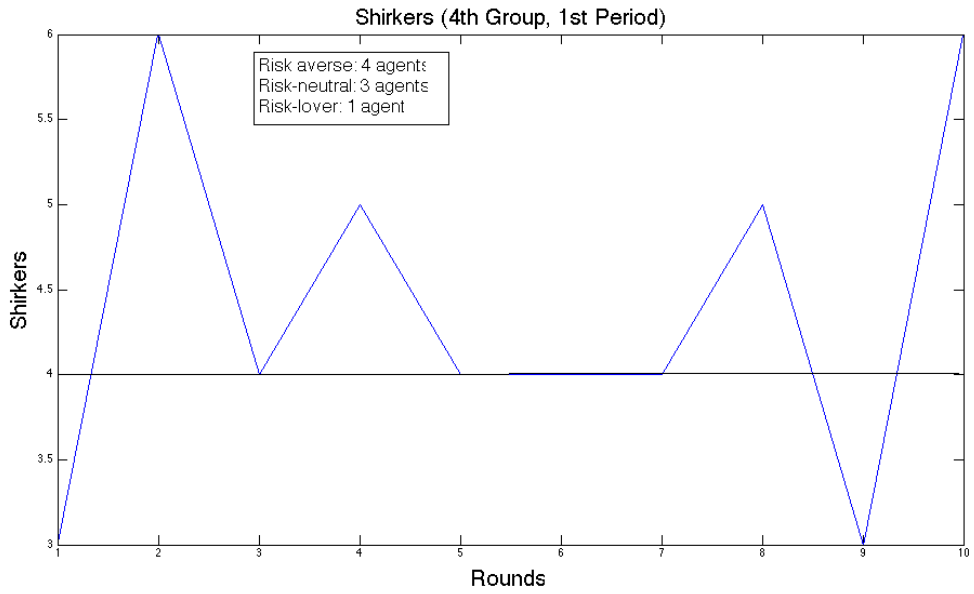


FIGURE 5 Change in the quantity of shirkers within rounds in group 4

Despite of manifest fluctuations in the growth of quantity of shirkers over time, this group is more prone to risk then the previous one. It might be explained by the fact that as a result of the generation of random numbers, quantity of shirkers caught in this group exceeded the expected value in most cases, nevertheless, quantity of shirkers seldom fell below CTP. That is why, coefficients of personal and impersonal risks are high for this group. No doubt that this group would achieve equilibrium of 8 shirkers if there were larger amount of rounds.

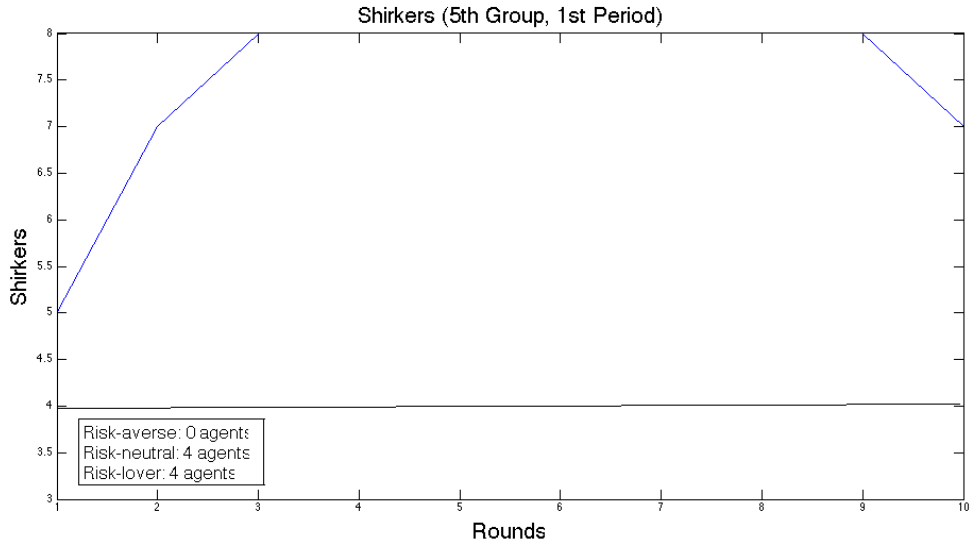


FIGURE 6 Change in the quantity of shirkers within rounds in group 5

This group is contained only from risk-neutral and risk-loving agents. Therefore, risk-lovers hauled the group to the equilibrium. The exit from the equilibrium in the last round might be explained by the fact that one of risk-lovers decided to try a new strategy guided solely by curiosity. This is a good demonstration one of the main qualities of risk-lovers: the search for risk, which does not exist in equilibrium.

From the analyze above, it is shown that in four out of five groups the hypothesis, that violation of norms causes even more violations, is confirmed. The behaviour of agents in abnormal group was explained through slow learning process, hence, they required more rounds to learn. If we had had the possibility to observe the bahaviour of agents at more rounds then the hypothesis would have been supported even for this group.

4.3 *The Behavioral Effects of Incentives: Introduction of HR manager and Bonus increase*

Here I start the analysis by observing the behavioral effects from incentives such as introduction of HR manager and bonus increase. I consider poor effect of such incentives, that is each of these treatments were appeared in different periods. Almost all groups showed identical results. So, I start to explain each group in ascending order describing effects from both incentives at the same time. Figure 7, Figure 8,Figure 9,Figure 10,Figure 11 are graphs of quantity of shirkers and time (rounds per period) in the different groups for all three treatments: baseline, introduction of HR manager and bonus increase:

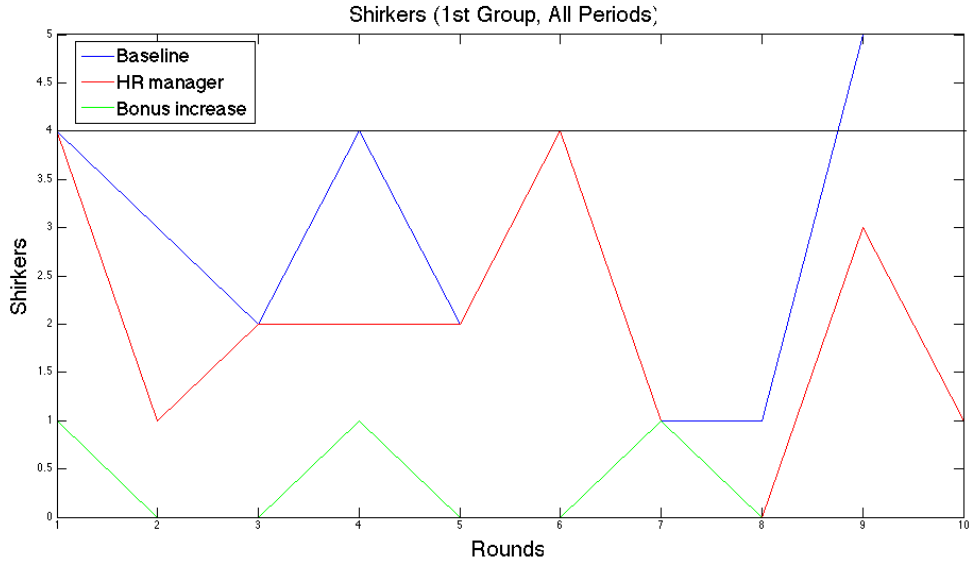


FIGURE 7 Change in the quantity of shirkers within rounds in group 1

Both incentives work well for this group, however, bonus increase is more effective comparing to introduction of HR manager. First of all, both incentives reset CTP, but it achieved again in the round six when HR manager looked after agents and then reset until

the end of the period. The difference in the effects can be explained by the fact that agents were not notified about exact probability to be caught when HR manager was introduced, so their could not estimate their losses precisely. Nevertheless, they knew exactly by how much the bonus increased when this treatment was set, hence, agents could evaluate their benefits with certainty.

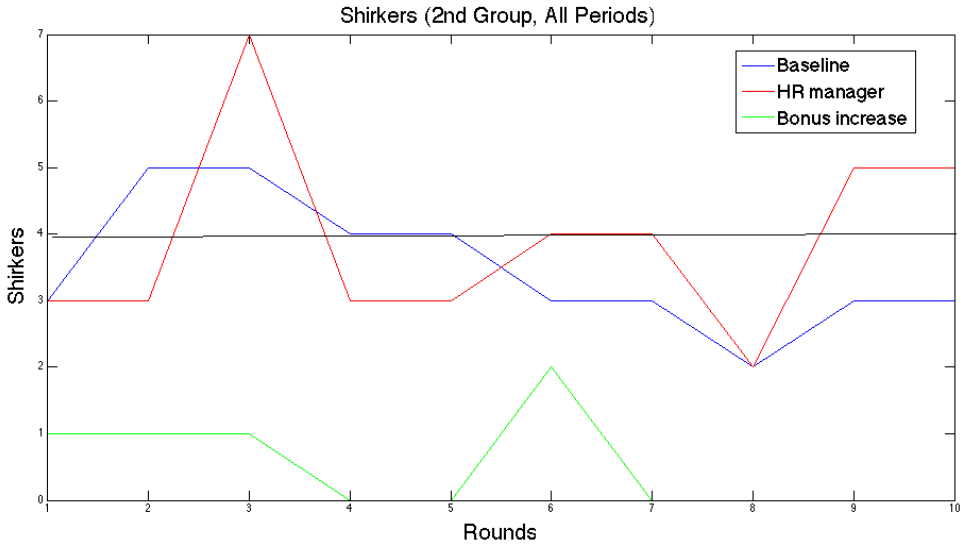


FIGURE 8 Change in the quantity of shirkers within rounds in group 2

Group 2 even in the second period, when HR manager was introduced, shows not expected results. This is the conformation that agents in this group have essentially different preferences and beliefs from which have been established in my model as has been noticed in the first period. Moreover, second period (HR manager) had an aim to show whether CTP was reset and how fast has happened, the latter one check the speed of learning process of agents in this group. As in the baseline (first period), we can observe, frequent fluctuations in the second period. CTP is passed and resets a few times what proves again that learning process in this group is creeping and agents need more rounds to understand the logic and laws of the game, however, effect of small sample also influence the outcome. Undoubtedly, agents would have achieved the equilibrium of zero shirkers in the long-run if had a chance. As for the bonus increase, it has significant impact on agents' behaviour and brings them into equilibrium at round 7 until the end of the period.

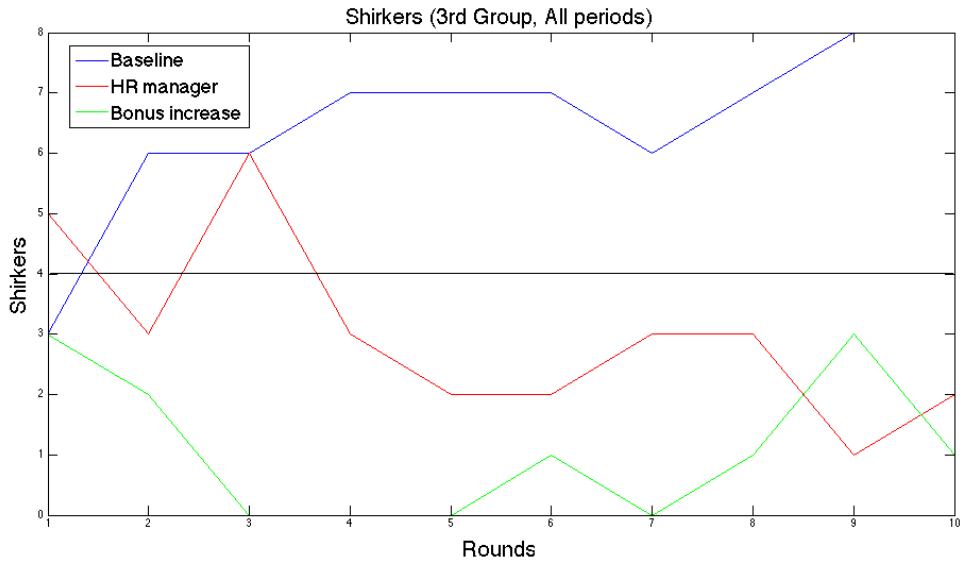


FIGURE 9 Change in the quantity of shirkers within rounds in group 3

Group three again showed outstanding learning abilities. Obviously, the decreasing trend was seen in quantity of shirkers for the second period (HR manager). CTP was reset in round 3, irrevocably. However, small leap in rounds 7 through 8 and fluctuations in the beginning can be explained by the presents of risk-lover in this group. Moreover, she/he is also a reason for the rising trend in quantity of shirkers from rounds 5 to 9, when bonus was increased. In this group the effect on bonus increase is smaller comparing to the groups without risk-lovers. Nevertheless, in most rounds agents shirked less when bonus was increased but not when HR manager was introduced.

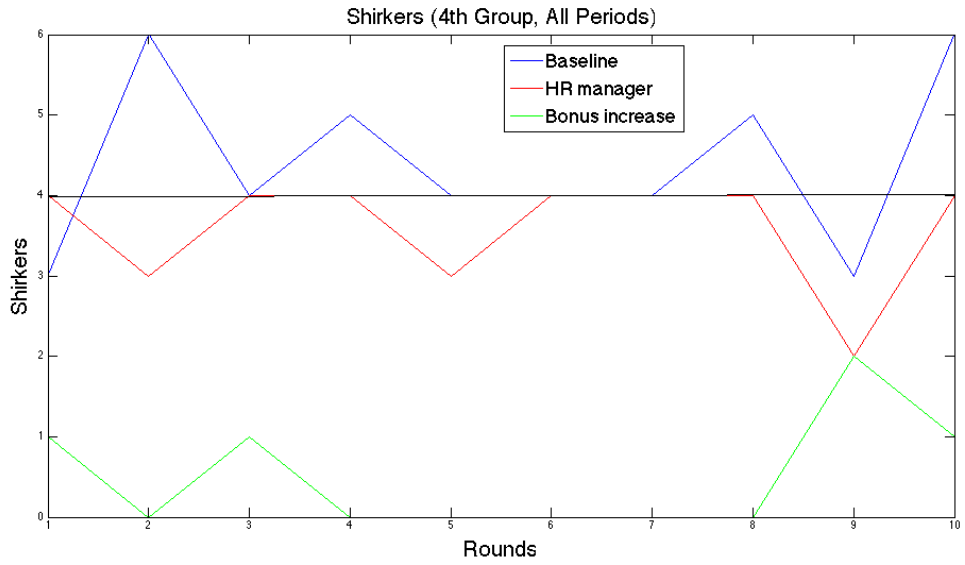


FIGURE 10 Change in the quantity of shirkers within rounds in group 4

Group 4 had even more risk-loving agents and, thus, we observe that HR manager did not frighten them so much. Agents reset CTP very reluctantly and came back to it quite often. For these 10 rounds, agents have never reset CTP without returning back to it. So, more than 10 rounds are needed to see that agents switch to equilibrium in zero. Bonus increase had more impact on this group and brought it quite fast to equilibrium in zero, however, the fluctuations in the last two periods were cause of risk-lovers' influence.

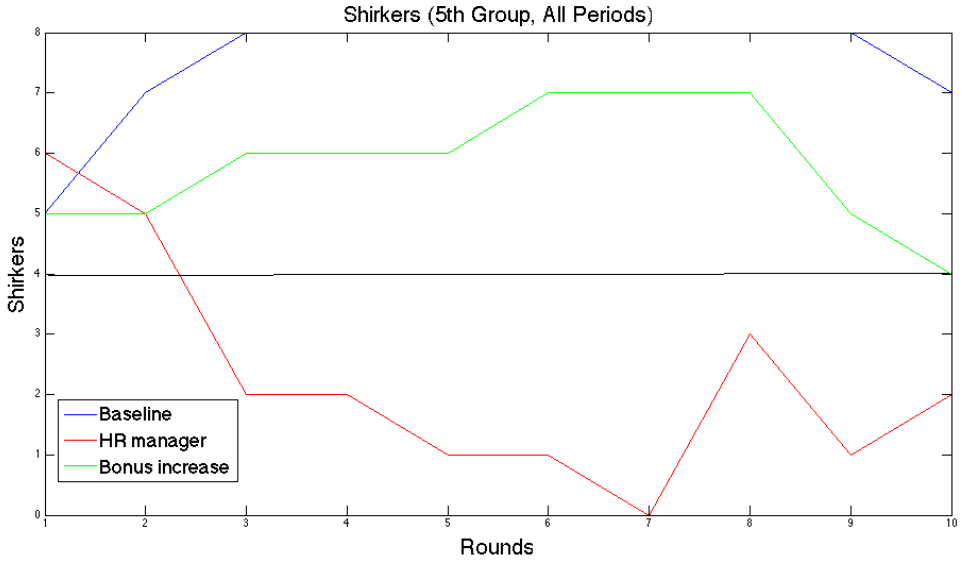


FIGURE 11 Change in the quantity of shirkers within rounds in group 5

Bonus increase treatment in group 5 differed from other groups. Bonus was increased almost twice less in this group comparing others. So, we can see that such rise in bonus is not enough to reset CTP in the short-run as was seen in other groups. Nevertheless, from round 8 to 10 there were stable decrease in quantity of shirkers and in the long-run they should reset CTP. As regards HR manager treatment, we observe abnormal effect for this group, this can be explain that despite the fact risk-lovers enjoy risk, they were caught to many times successively. So, even for them strategy to shirk became not optimal.

According to the analysis above both incentives increase the agents' work effort. In general bonus increase impact agents much faster then introduction of HR manager in the short-run. But still in the long-run both incentives will bring the same effect that is improvement in work performance. However, the size of bonus increase is important as well as a composition of the group according to the risk attitude. Too small increase in bonus in the group with many risk-lovers will not give desirable effect in the short-run, while in the group with many risk-averse agents this effect will take more time to be achieved.

4.4*Analysis of how Quantity of Shirkers and Point Estimation of Probability to get Caught for Shirking Influence Proportion of Shirkers in different groups according to Risk Attitude*

The structure of the analysis in this section is following: I explain the impact of quantity of shirkers and influence of point estimation of probability to get caught for shirking, first, for risk-averse group then for risk-neutral group and, finally, for risk-loving group.

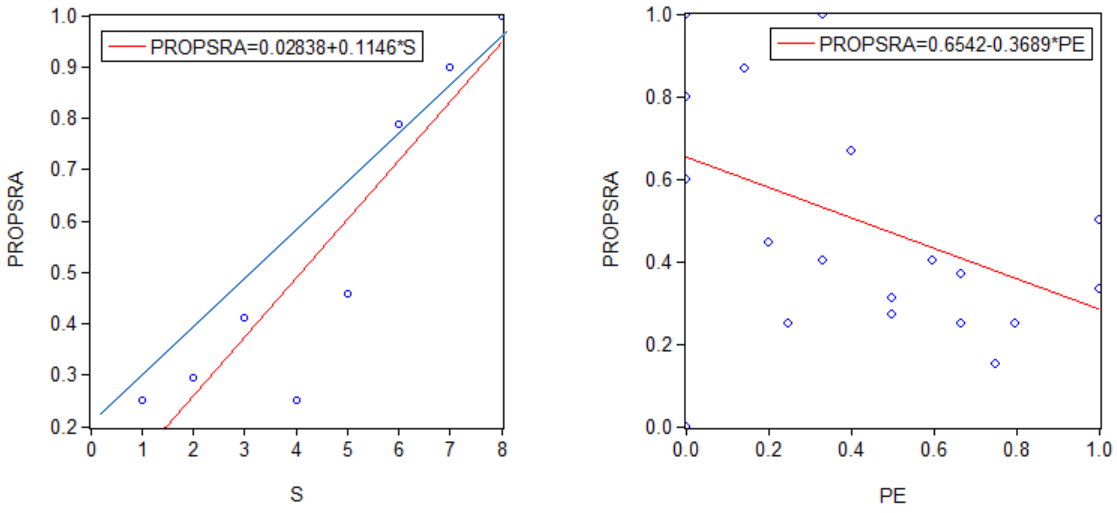


FIGURE 12 Relationship between quantity of shirkers and proportion of shirkings in risk-averse group for models with and without constant (left); Relationship between point estimation of probability to get caught and proportion of shirkings in risk-averse group (right)

On the Figure 12 (left) we can observe a clear positive correlation between quantity of shirkers (S) and proportion of shirkings in risk-averse group (PROPSRA). It is determined by the fact that estimation of risk directly depends on its actual performance, which by-turn directly depends on quantity of shirkers.

From FIGURE 12 (right) we notice that there is significantly negative correlation between point estimation of probability to be caught for shirking (PE) and proportion of shirkings in risk-averse group (PROPSRA). This can be explained by the fact that when risks are very small, risk-averse agents could risk sometimes, however, as risk increases they shirk less and, finally, switch to strategy "work hard" when between point estimation of probability to be caught for shirking (PE) is almost 100%.

TABLE 3

Dependent Variable: PROPSRA
Method: Least Squares
Date: 06/18/13 Time: 13:19
Sample: 1 8
Included observations: 8

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.028379	0.102589	0.276625	0.7914
S	0.114588	0.020316	5.640400	0.0013

R-squared	0.841329	Mean dependent var	0.544025
Adjusted R-squared	0.814884	S.D. dependent var	0.306008
S.E. of regression	0.131660	Akaike info criterion	-1.004868
Sum squared resid	0.104006	Schwarz criterion	-0.985008
Log likelihood	6.019473	Hannan-Quinn criter.	-1.138819
F-statistic	31.81412	Durbin-Watson stat	1.312101
Prob(F-statistic)	0.001331		

The model represented, analytically, this way:

$$PROPSRA = \underset{(0.103)}{0.028} + \underset{(0.020)}{0.115} * S \qquad (2.9)$$

This model with a constant (see Table 3) yields a high F-stat with corresponding p-value of 0.0013, thus this model is significant on 1% significance level (SL). R^2 is high, that is about 84% of variation can be explained by the model. We have no statistical evidence to suppose that constant is different from zero. At the same time the coefficient before quantity of shirkers (S) is positive and significant at any reasonable SL. Thus, we can observe that quantity of shirkers (S) has a positive effect on proportion of shirkings in risk-averse group (PROPSRA). On average increase in quantity of shirkers (S) by one is supposed to raise proportion of shirkings in risk-averse group (PROPSRA) by 0.11.

TABLE 4

Dependent Variable: PROPSRA
Method: Least Squares
Date: 06/18/13 Time: 13:25
Sample: 1 8
Included observations: 8

Variable	Coefficient	Std. Error	t-Statistic	Prob.
S	0.119596	0.008589	13.92513	0.0000

R-squared	0.839305	Mean dependent var	0.544025
Adjusted R-squared	0.839305	S.D. dependent var	0.306008
S.E. of regression	0.122668	Akaike info criterion	-1.242195
Sum squared resid	0.105333	Schwarz criterion	-1.232265
Log likelihood	5.968781	Hannan-Quinn criter.	-1.309170
Durbin-Watson stat	1.302200		

The model without constant can be introduced this way:

$$PROPSRA = \underset{(0.020)}{0.115} * S \tag{3.0}$$

An inclusion of irrelevant variables might lead to higher standard errors so we can estimate a model without a constant (see Table 4). The only difference is that the coefficient before quantity of shirkers (S) has slightly increased, thus, the line would be a bit steeper (see Figure 12). Also Akaike and Schwarz information criterions have declined, which suggests that the model has become generally better.

TABLE 5

Dependent Variable: PROPSRA
Method: Least Squares
Date: 06/18/13 Time: 13:54
Sample: 1 21
Included observations: 21

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.654153	0.095294	6.864603	0.0000
PE	-0.368863	0.171860	-2.146301	0.0450

R-squared	0.195141	Mean dependent var	0.493560
Adjusted R-squared	0.152780	S.D. dependent var	0.293797
S.E. of regression	0.270425	Akaike info criterion	0.312745
Sum squared resid	1.389459	Schwarz criterion	0.412224
Log likelihood	-1.283825	Hannan-Quinn criter.	0.334335
F-statistic	4.606609	Durbin-Watson stat	1.720696
Prob(F-statistic)	0.044976		

Analytically, model is presented this way:

$$PROPSRA = \underset{(0.095)}{0.654} - \underset{(0.179)}{0.369} * PE \qquad (3.1)$$

Regressing the proportion of shirkings in risk-averse group (PROPSRA) on point estimation of probability to be caught for shirking (PE) and the constant using OLS method yields that equation is significant at 5% SL (see Table 6 for detailed results). The R^2 is 19.5%, which means the only 19.5% of variation in data can be explained by the model. The constant is positive and highly significant: when point estimation of probability to be caught for shirking (PE) is zero we expect the proportion of shirkers in the risk-averse group to be around 0.65. We observe that an increase in point estimation of probability to be caught for shirking (PE) has a significantly negative (5% SL) effect. It means that when point estimation of probability to be caught for shirking (PE) rises by 10% we suspect that proportion of shirkings in risk-averse group (PROPSRA) will decrease on average by 3.7%.

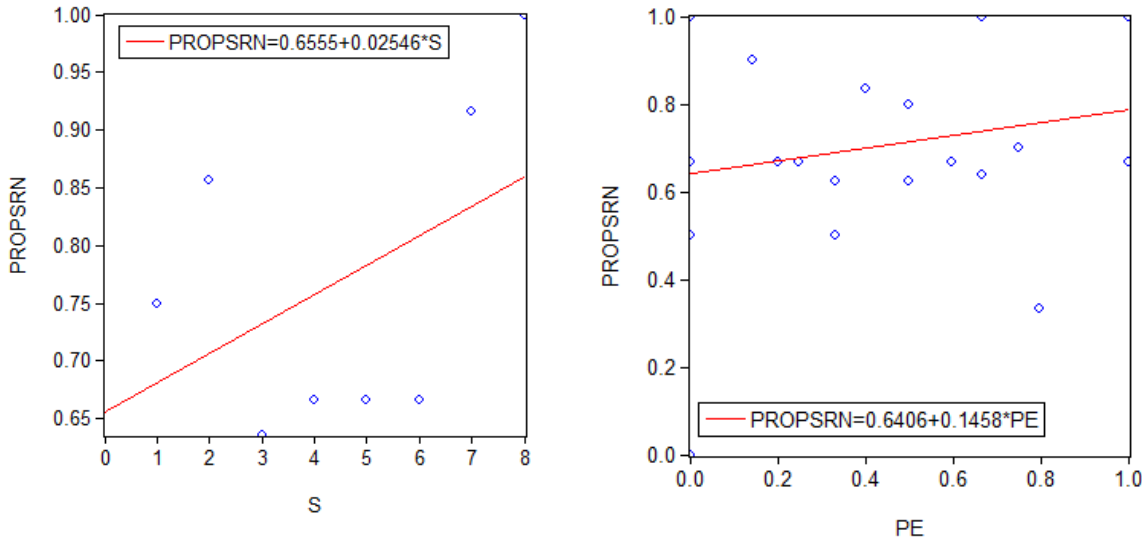


FIGURE 13 Relationship between quantity of shirkes and proportion of shirkings in risk-neutral group (left); Relationship between point estimation of probability to get caught and proportion of shirkings in risk-neutral group (right)

As can be seen on the Figure 13 (left), there is weak positive correlation between quantity of shirkers (S) and proportion of shirkings in risk-neutral group (PROPSRN) since starting from 3 shirkers, risk-neutrals prefer to choose strategy "shirk". Hence, I confirm the initial

understanding that risk-neutral group contains from agents who most likely pay attention to the behaviour of others but not to the estimation of risk.

As can be noticed on the Figure 13 (right) there is not significant correlation between point estimation of probability to be caught for shirking (PE) and proportion of shirkings in risk-neutral group (PROPSRN). Initially, it was obviously that we would obtain such results due to the nature risk-neutral group, meaning that risk-neutrals do not consider point estimation of probability to be caught for shirking (PE) as a vital signal for their actions.

TABLE 6

Dependent Variable: PROPSRN
Method: Least Squares
Date: 06/18/13 Time: 14:26
Sample: 1 8
Included observations: 8

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.655454	0.103096	6.357701	0.0007
S	0.025463	0.020416	1.247210	0.2588

R-squared	0.205880	Mean dependent var	0.770037
Adjusted R-squared	0.073527	S.D. dependent var	0.137461
S.E. of regression	0.132311	Akaike info criterion	-0.995003
Sum squared resid	0.105037	Schwarz criterion	-0.975143
Log likelihood	5.980013	Hannan-Quinn criter.	-1.128953
F-statistic	1.555532	Durbin-Watson stat	1.164756
Prob(F-statistic)	0.258795		

The model represented analytically below:

$$PROPSRL = \underset{(0.103)}{0.655} - \underset{(0.020)}{0.025} * S \qquad (3.2)$$

From the table 6 we conclude that for the group of risk-neutral agents there is no significant relationship between proportion of shirkings in risk-neutral group (PROPSRN) and quantity of shirkers (S) as was expected. The p-value of coefficient of quantity of shirkers (S) is 0.26, thus, we have not statistical evidence to suppose that it influences proportion of shirkings in risk-neutral group (PROPSRN). F -stat for the whole equation yields the p-value of 26%, which indicates insignificance of the model.

TABLE 7

Dependent Variable: PROPSRN
Method: Least Squares
Date: 06/18/13 Time: 14:31
Sample: 1 21
Included observations: 21

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.640626	0.088192	7.264004	0.0000
PE	0.145821	0.159052	0.916815	0.3707

R-squared	0.042365	Mean dependent var	0.704113
Adjusted R-squared	-0.008037	S.D. dependent var	0.249271
S.E. of regression	0.250271	Akaike info criterion	0.157846
Sum squared resid	1.190074	Schwarz criterion	0.257325
Log likelihood	0.342614	Hannan-Quinn criter.	0.179436
F-statistic	0.840550	Durbin-Watson stat	1.138320
Prob(F-statistic)	0.370731		

Analytically, the model is written below:

$$PROPSRN = \underset{(0.09)}{0.640} - \underset{(0.159)}{0.146} * PE \qquad (3.3)$$

Regressing the proportion of shirkings in risk-neutral group (PROPSRN) on point estimation of probability to be caught for shirking (PE) and the constant, we do not observe any significant relationship between these two values as again was expected. The p-value of coefficient PE is 0.37, thus, we have not statistical evidence to suppose that it somehow influences proportion of shirkings in risk-neutral group (PROPSRN). F -stat for the whole equation yields the p-value of 37%, which indicates insignificance of the model.

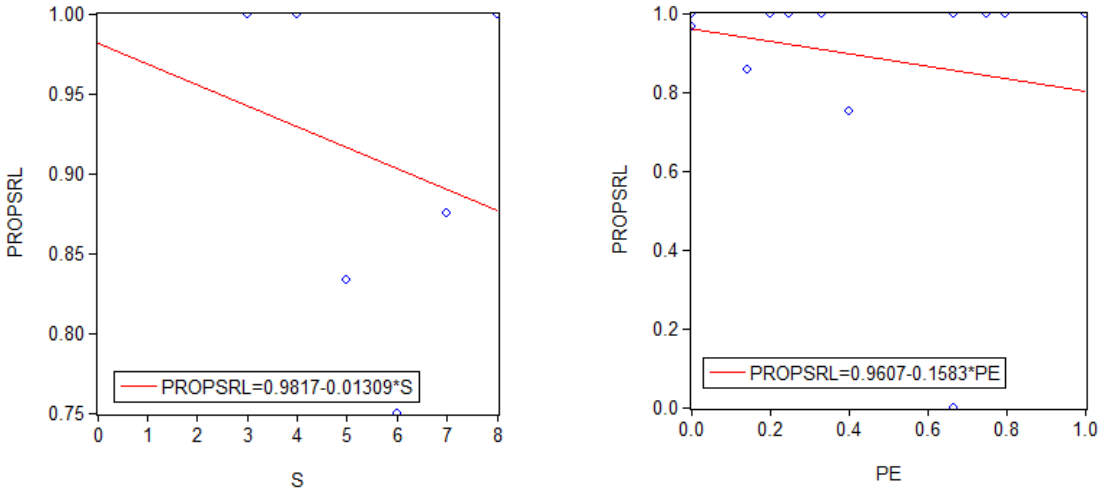


FIGURE 14 Relationship between quantity of shirkes and proportion of shirkings in risk-loving group (left); Relationship between point estimation of probability to be caught and proportion of shirkings in risk-loving group (right)

As can be seen on Figure 14, risk-lovers have weak correlation with quantity of shirkers (S) since the main motivation for them is risk, however, this contradicts the behaviour of majority quite often. Risk-loving agents have also weak correlation with point estimation of probability to get caught (PE). This can be explained by the fact that when risks are small or moderate, point estimation of probability to get caught (PE) does not change and it is close to one. It only starts to decrease when the risk estimation is high and risk causes indubitable losses. Undoubtedly, coefficients are insignificant due to small sample since it is not common case to observe risk-lovers in the sample, especially in the sample of 40 participants.

TABLE 8

Dependent Variable: PROPSRL
Method: Least Squares
Date: 06/18/13 Time: 14:38
Sample: 1 6
Included observations: 6

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.981735	0.159965	6.137169	0.0036
S	-0.013094	0.027776	-0.471418	0.6619

R-squared	0.052634	Mean dependent var	0.909717
Adjusted R-squared	-0.184207	S.D. dependent var	0.106778
S.E. of regression	0.116197	Akaike info criterion	-1.205860
Sum squared resid	0.054007	Schwarz criterion	-1.275274
Log likelihood	5.617580	Hannan-Quinn criter.	-1.483728
F-statistic	0.222235	Durbin-Watson stat	1.237530
Prob(F-statistic)	0.661905		

The model represented analytically below:

$$PROPSRL = \underset{(0.156)}{0.982} - \underset{(0.020)}{0.013} * S \tag{3.3}$$

For the group of risk-loving agents we do not observe any significant relationship between proportion of shirkings in risk-loving group (PROPSRL) and quantity of shirkers (S) as was expected (see Table 8). The p-value of coefficient of quantity of shirkers (S) is 0.66. Therefore, have not statistical evidence to suppose that quantity of shirkers (S) some influences proportion of shirkings in risk-loving group (PROPSRL). F -stat for the whole equation yields the p-value of 66%, which indicates insignificance of the model.

TABLE 9

Dependent Variable: PROPSRL
Method: Least Squares
Date: 06/18/13 Time: 14:46
Sample: 1 14
Included observations: 14

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.960729	0.117452	8.179751	0.0000
PE	-0.158320	0.231731	-0.683207	0.5075

R-squared	0.037441	Mean dependent var	0.898047
Adjusted R-squared	-0.042772	S.D. dependent var	0.268697
S.E. of regression	0.274383	Akaike info criterion	0.382982
Sum squared resid	0.903434	Schwarz criterion	0.474276
Log likelihood	-0.680876	Hannan-Quinn criter.	0.374531
F-statistic	0.466772	Durbin-Watson stat	2.119446
Prob(F-statistic)	0.507453		

Analytically the model is shown below:

$$PROPSRL = \underset{(0.117)}{0.961} - \underset{(0.23)}{0.158} * PE \tag{3.4}$$

From the Table 9 we can see that there is no any significant relationship between proportion of shirkings in risk-loving group (PROPSRL) and point estimation of probability to get caught (PE) as was expected. The p-value of coefficient of point estimation of probability to get caught (PE) is 0.51. Thus, there is no statistical evidence to suppose that point estimation of probability to get caught (PE)influences proportion of shirkings in risk-loving group (PROPSRL). F -stat for the whole equation yields the p-value of 51%, which indicates insignificance of the model.

4.5 *Augmented Utility Function*

In a game with incomplete information, the crucial role in decision making process of an agent is played by his subjective estimate of the current situation and his perception of the game that is constantly changing with time. The best-estimate of the probability to get caught for shirking in current period was point estimate since agents was informed that probability to get caught for shirking (not to receive the bonus) varied with amount of shirkers but they did not know under what law this variations occurred. The point estiomation of probability to get caught for shirking (not to receive the bonus) is represented below:

$$\hat{p}_t = \frac{s_{c,t-1}}{s_{t-1}}; \tag{3.5}$$

Correspondingly, the best estimate of expected utility function when choosing strategy "shirk" is the following:

$$w + b(1 - \hat{p}_t); \tag{3.6}$$

However, agents not always behave in accordance with these estimates. Other factors also influence decision of the agents, for example, attitude to risk, moral principles, willingness to cooperate, conformity, "the effect of recent punishment", general willingness of teammates to shirk based on the preliminary questionnaire which was held before each round (in form of the table, where participants had to put in ticks).Thus, in order to interpret the decisions of the agents, I introduce augmented components to estimated utility function, which will help to explain decisions made by agents and, possibly, to predict their behaviour in the future.

Let us assume that agents from the group with the same risk attitude make decisions in the similar manner. Then I introduce augmented utility function ψ_A and ψ_L for risk-averse and risk-loving agents, respectively. These functions have similar structure but different coefficients:

$$\psi_A = c_s^A * s_{t-1} + c_c^A * c_{t-1} + c_{s_c}^A * s_{c,t-1} + c_s^A * \hat{p}_t^2; \tag{3.7}$$

$$\psi_L = c_s^L * s_{t-1} + c_c^L * c_{t-1} + c_{s_c}^L * s_{c,t-1} + c_s^L * \hat{p}_t^2; \tag{3.8}$$

where s_{t-1}, $s_{c,t-1}$, c_{t-1}- factors from the previous period, which observed by the agent. That is quantity of shirkers, quantity of agents caught for shirking and indicator, which shows whether agent was caught or not, respectively.

For risk-averse group, I add ψ_A to payoff of strategy "work hard", for the risk-loving group, ψ_L is added to payoff of strategy "shirk". The allocation augmented utility function is not fundamentally important, however, it is vital for understanding as can be seen later.

In order to find explanatory coefficients c_s^A, c_c^A, $c_{s_c}^A$, c_s^A, which determine augmented utility function (AUF), I form penalty functional. In this case, the penalty is called the expected loss of utility if agent chooses strategy with lower expected utility. Let us see it analytically:

$$p_t^{A,i} = \begin{cases} (w+b-c+\psi_A)-(w+b(1-\hat{p}_t)), & if\ \ (w+b-c+\psi_A)>(w+b(1-\hat{p}_t))\ \ and\ \ agent\ \ shirks \\ (w+b(1-\hat{p}_t))-(w+b-c+\psi_A), & if\ \ (w+b-c+\psi_A)<(w+b(1-\hat{p}_t))\ \ and\ \ agent\ \ works\ \ hard \\ 0, & , else \end{cases} \quad (3.9)$$

where $p_t^{A,i}$ is a penalty for *i*-th agent from risk-averse group in round *t*.

$$p_t^{L,j} = \begin{cases} (w+b-c)-(w+b(1-\hat{p}_t)+\psi_L), & if\ \ (w+b-c)>(w+b(1-\hat{p}_t)+\psi_L)\ \ and\ \ agent\ \ shirks \\ (w+b(1-\hat{p}_t)+\psi_L)-(w+b-c), & if\ \ (w+b-c)<(w+b(1-\hat{p}_t)+\psi_L)\ \ and\ \ agent\ \ works\ \ hard \\ 0, & , else \end{cases} \quad (4.0)$$

where $p_t^{L,j}$ is a penalty for *j*-th agent from risk-loving group in round *t*.

It is important to notice that penalties non-linearly depend on coefficients of AUF and total penalty functional equals to the sum of penalties of all agents in the risk-averse group/ risk-loving group and all rounds per period. Analytically, this can be observe below:

$$p^A = \sum_{i\in A}\sum_{t=1}^{10} p_t^{A,i}; \quad (4.1)$$

$$p^L = \sum_{j\in L}\sum_{t=1}^{10} p_t^{L,j}; \quad (4.2)$$

Coefficients of AUF can be found as solutions to the following maximization problem:

$$p^A \to min \text{ and } p^L \to min$$

To solve the problem I used gradient descent with numerical calculation of the gradient and in-built function of finding global minimum of Matlab. Both methods yielded similar results, so this might be interpreted as a conformation of their accuracy. First of all, I calculated penalty functional based on experimental data without using AUF that is when $\psi_A \equiv 0$ and $\psi_L \equiv 0$, thus, I got following results:

$$p^A = 304 \text{ and } p^L = 51.8$$

Then the described above problem was solved and solutions from optimization problems were placed into AUF. Analytically, this represented below:

$$\psi_A^* = -1.3093 * s_{t-1} + 0.1108 * c_{t-1} + 1.8304 * s_{c,t-1} + 7.859 * \hat{p}_t^2; \quad (4.3)$$

$$\psi_L^* = -1.2474 * s_{t-1} - 0.3227 * c_{t-1} + 1.8003 * s_{c,t-1} + 8.129 * \hat{p}_t^2; \quad (4.4)$$

Again penalty functional was calculated. Obtained numerical values are shown below:

$$p^A = 155.9278 \text{ and } p^L = 5.3145$$

So, we can see that penalty functional decreases. In penalty functional each agent's decision is considered separately in the context of current situation, that is due to the fact that each agent play 10 rounds per period and, thus, he/she is considered considered more precisely. Therefore, the negative effect due to small sample disappears, which is strong hindrance in previous in section 4.4. Hence, this is an advantage of AUF.

Obviously, that augmented utility function considerably increases the set of possible explanations of agents' behaviour. Given the correct separation of players in group according to the risk attitude and to the moral preference and give there is enough experience of using the models described in this paper, it is possible to find such augmented utility functions that will let effectively forecast and analyze solutions that are

made by real people. In today's informational society, the prediction of behaviour of large groups as well as problems of impact on public consciousness are quite topical, especially in the fields of human resources, marketing and politics. It is vital to notice that most reliable information for analysis of people's behaviour can be only obtained in natural or close to natural conditions of group interaction. Questionnaire and survey are quite weak instruments for investigation of social behaviour due to lack of motivation. To obtain valid data it is essential to distract the attentions of players from the self-observation and make them believe in the reality of the situation as much as possible. This is what I tried to achieve in the experiments.

4.6 *How does the Information from Pre-round Questionnaire correspond with Agents' Actions?*

In the beginning of each round agent had to answer question: "At what quantity of shirkers in the group are you ready to shirk?" Most of the agents changed their answers almost in every round. This can be explained by the fact that agents received new information and adjusted to the reality of the experiment by changing their preferences and beliefs. However, the majority of agents (possibly every agent at least one time) made decisions in the current round, which did was controversial to the answers they gave before this round. Simple analysis showed that among all decisions only 68% were made according to the previously given answers. In this light it is rational to suspect that agents distinguished between answers on question that did not affect the game outcome form the game itself. The question when they were honest remains, yet, unanswered. Table 10 represents correspondence of answers to the pre-round questionnaire and actions of agents for each group:

TABLE 10

# of the group	% of agents who has corresponded in behaviour with their answers
1	72.5%
2	70.8%
3	72.5%
4	60.4%
5	63.8%

4.7 *Relation between Shirking and Abuse of authority*

To investigate the relation between shirking and abuse of authority, I start by looking how the same agents behave in the first three periods and compare with their behavior in the stage two, to be exact how they behave regarding to the strategy "abuse of authority". Consistent with the second tested approach there is a clear positive correlation between shirking and abuse of authority. Figure 12 represents the relation between shirking and abuse of authority for the same agents and detailed results are shown in Table 3 Table 4.

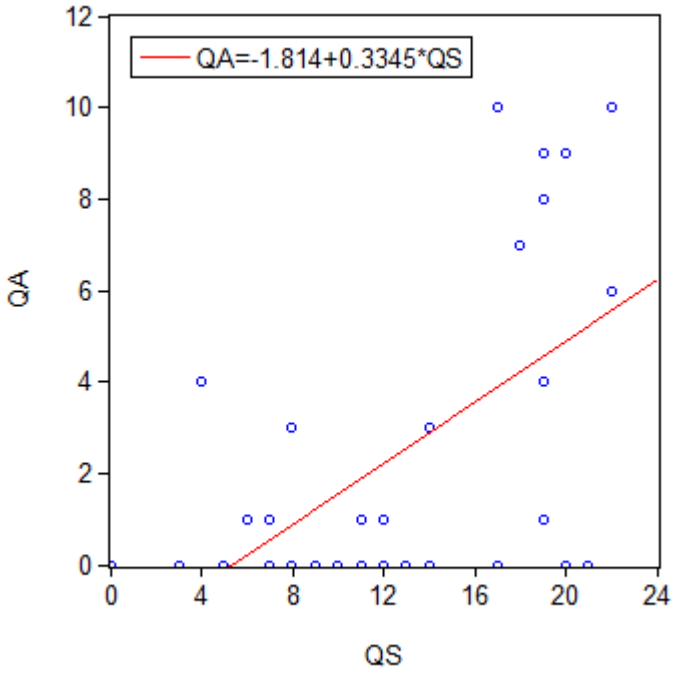


FIGURE 15 Relation between shirking and abuse of authority

TABLE 11

Dependent Variable: QA
Method: Least Squares
Date: 06/18/13 Time: 06:26
Sample: 1 40
Included observations: 40

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-1.813624	0.969516	-1.870649	0.0691
QS	0.334469	0.072123	4.637454	0.0000

R-squared	0.361409	Mean dependent var	2.200000
Adjusted R-squared	0.344604	S.D. dependent var	3.413397
S.E. of regression	2.763369	Akaike info criterion	4.919485
Sum squared resid	290.1759	Schwarz criterion	5.003929
Log likelihood	-96.38970	Hannan-Quinn criter.	4.950017
F-statistic	21.50598	Durbin-Watson stat	1.235897
Prob(F-statistic)	0.000041		

TABLE 12

Dependent Variable: QA
Method: Least Squares
Date: 06/18/13 Time: 06:30
Sample: 1 40
Included observations: 40

Variable	Coefficient	Std. Error	t-Statistic	Prob.
QS	0.214029	0.033529	6.383431	0.0000

R-squared	0.302602	Mean dependent var	2.200000
Adjusted R-squared	0.302602	S.D. dependent var	3.413397
S.E. of regression	2.850540	Akaike info criterion	4.957576
Sum squared resid	316.8975	Schwarz criterion	4.999798
Log likelihood	-98.15152	Hannan-Quinn criter.	4.972842
Durbin-Watson stat	0.902532		

Analytically, the model looks this way:

$$QA = \underset{(0.0721)}{0.3345} * QS - \underset{(0.9695)}{1.814} \qquad (4.5)$$

In general, the model is highly significant, as F-stat yields p-value of almost zero that means there is only 0.004 probability that such a relationship appeared by chance. The constant is significant at 10% significance level, however it has no meaningful interpretation. The coefficient before quantity of shirking is significant at any reasonable level of significance. We suspect that an increase in amount of shirking by one will increase quantity of abuse of authority by 0.33 on average. R^2 is 36%, so the model can explain 36% of variation on average. However, if we exclude constant from the model the general fit of the model decreases, firstly because R^2 falls to 30%, secondly, because we observe a increase in Akaike information criterion, which rise from 4.92 to 4.96.

The graph in the Figure 15 represents that an agent who commits a lot of small violations will, generally, commit sever violations. This is true except for risk-lovers who were in more cautious groups, that means composed mostly of risk-averse and risk-neutral agents. In latter groups the strategy “abuse of authority” either was not used or used quite seldom. Thus, we can conclude that the second hypothesis of “Broken windows” theory has been confirmed, that is small violations of norms causes severe violations of norms. This conclusion is based on the behaviour of individual agents. A part from that it can be based on the behavioral dynamics of a group as a whole. That means if players were shirking a lot, in general, abuse authority a lot then in the group in which the strategy to

“shirk” was popular, the strategy “abuse of authority” will also be in the top list of most popular strategies.

4. CONCLUSION

This paper was aimed to analyze two approached of “Broken windows” theory in the context of behavioural economic issues. The first one is that violations of norms cause more violations of norms, the second one is that small violations cause sever violations of norms. So, we test these hypotheses using dynamic game with imperfect information in the context of shirking and abuse of authority. Even for a small sample study, we obtained empirical evidence, supporting approaches of “Broken windows” theory. During the experimental sessions it became apparent that higher number of shirkings in the previous round causes on average higher number of shirkings in the next round generally in the long-run. We still could observe frequent fluctuations in the behaviour of participants in the short-run, but this can be explained by the difference in their risk-attitude, their preferences and learning abilities. Treatment in the form of higher bonus and hiring HR manager appeared to be effective, as it lead to almost complete extinction of shirkers. Needless to say, increase in bonus in general lead to a faster decrease in the number of shirking compared to the hiring of a manager. It should be taken into account that both the size of the bonus and the risk-attitude of the players in the group influence the speed and effectiveness of the treatment. Apart from that we observed that agents who had a general loving for shirking, often easily switched to a more severe strategy of abuse of authority.

The initial model base on risk-neutral agents should be modified to obtain more reliable interpretation of results, since in reality all type of agents according to risk-attitude could found. That is why the augmented utility function is the best tool to interpret the received data.

APPENDIX A: Istructions

Here I represent instructions of the experiment. Initially instrucions were written in Russian and here liberal translation is presented.

All experiments were personally financed.

[Participants received new copy of instruction in before each new period.]

We welcome you on the experiment!

We sincerely ask you to follow the rules and the instructions.

The experiment will last approximately for 4 periods, total of 40 rounds. You will be able to earn money which are measured in the unit of experimental currency (TOKENS).

1 TOKEN=0.08 rubble

You will be randomly divided in the groups of 8 people and you will not know who is also in your group.

Do you have any questions?

Let us start!

Period 1

You are working in a big company with 7 teammates. Each round you can choose between two strategies:

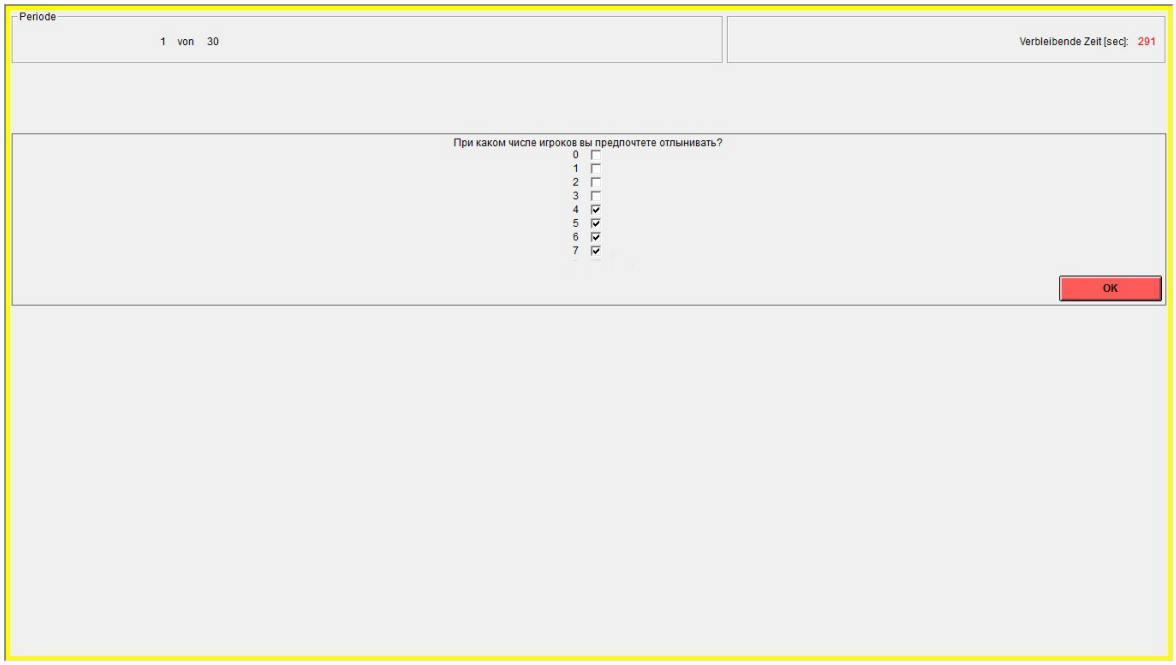
1. **Work hard**. In this case you get a wage of 120 TOKENS, bonus of 20 TOKENS and bear costs of 10 TOKENS. So, your income is 130 TOKENS.
2. **Shirk**. In this case you get a wage of 120 TOKENS, bonus of 20 TOKENS and bear costs no costs.

   However, if you are caught you get zero bonus and your income is 120 TOKENS. If you are not caught, you get the bonus and your income is 140 TOKENS. Probability to get caught for shirking (or not to receive a bonus) depends on actions of each member of the group.

Before each round you will have to answer a question:

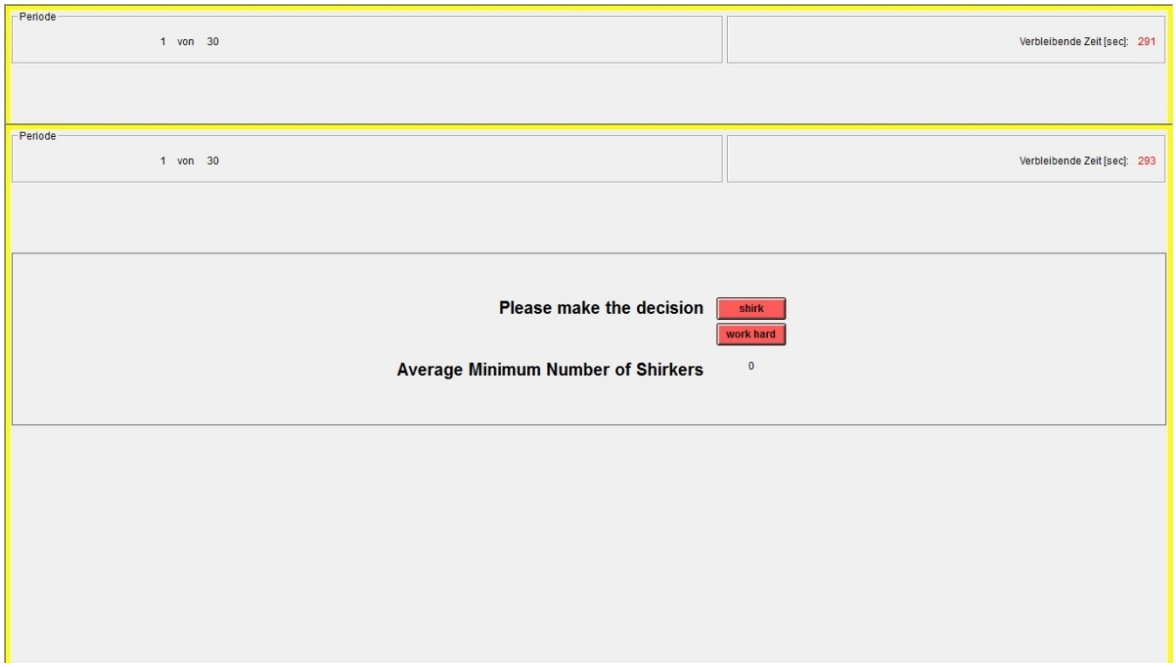
"At what quantity of shirker in the group you are ready to shirk?"

You should put ✓ in the box if you are ready to shirk, and live a blank box if you are not ready to shirk. You can put ticks in any box, or leave any box blank.



Then you will be given information about the minimum number of shirkers at which your colleges are on average ready to shirk. [Example was given and discussed with participants]

After that you shall choose a strategy for the period, which would look like:



As soon as you make your choice you will see the following information:

- Number of players that actually shirked during this round
- Number of players that received a bonus during this round
- Number of shirkers that were caught for shirking in this round
- Your profit for the round
- Your cumulative profit for all rounds

There will be 10 rounds in the 1st period

Do you have any questions?

Period 2

The company you are working work hired a HR manager who very diligently observes your activities.

Each round you can choose between two strategies:

3. **Work hard**. In this case you get a wage of 120 TOKENS, bonus of 20 TOKENS and bear costs of 10 TOKENS. So, your income is 130 TOKENS.
4. **Shirk**. In this case you get a wage of 120 TOKENS, bonus of 20 TOKENS and bear costs no costs.

   If you are caught you get zero bonus and your income is 120 TOKENS. If you are not caught, you get the bonus and your income is 140 TOKENS.

Before each round you will have to answer a question:

"At what quantity of shirker in the group you are ready to shirk?"

You should put ✓ in the box if you are ready to shirk, and live a blank box if you are not ready to shirk. You can put ticks in any box, or leave any box blank.

Then you will be given information about the minimum number of shirkers at which your colleges are on average ready to shirk and you have to choose one of two strategies.

As soon as you make your choice you will see the following information:

- Number of players that actually shirked during this round
- Number of players that received a bonus during this round
- Number of shirkers that were caught for shirking in this round
- Your profit for the round
- Your cumulative profit for all rounds

There will be 10 rounds in the 2st period

Do you have any questions?

Period 3.

Company dismissed the HR manager and decided to increase the bonus to the worker from 20 to 80 units [for the 5th group, bonus increased from 20 to 45 units]

Each round you can choose between two strategies:

1. **Work hard**. In this case you get a wage of 120 TOKENS, bonus of 80 TOKENS and bear costs of 10 TOKENS. So, your income is 190 TOKENS.
2. **Shirk**. In this case you get a wage of 120 TOKENS, bonus of 80 TOKENS and bear costs no costs.

If you are caught you get zero bonus and your income is 120 TOKENS. If you are not caught, you get the bonus and your income is 200 TOKENS. Probability to get caught for shirking (or not to receive a bonus) depends on actions of each member of the group.

Before each round you will have to answer a question:

"At what quantity of shirker in the group you are ready to shirk?"

You should put ✓ in the box if you are ready to shirk, and live a blank box if you are not ready to shirk. You can put ticks in any box, or leave any box blank.

Then you will be given information about the minimum number of shirkers at which your colleges are on average ready to shirk and you have to choose one of two strategies.

As soon as you make your choice you will see the following information:

- Number of players that actually shirked during this round
- Number of players that received a bonus during this round
- Number of shirkers that were caught for shirking in this round
- Your profit for the round
- Your cumulative profit for all rounds

There will be 10 rounds in the 3st period

Do you have any questions?

Period 4

Each round you can choose between two strategies:

1. **Work hard**. In this case you get a wage of 120 TOKENS, bonus of 20 TOKENS and bear costs of 10 TOKENS. So, your income is 130 TOKENS.
2. **Shirk**. In this case you get a wage of 120 TOKENS, bonus of 20 TOKENS and bear costs no costs.

   If you are caught you get zero bonus and your income is 120 TOKENS. If you are not caught, you get the bonus and your income is 140 TOKENS. Probability to get caught for shirking (or not to receive a bonus) depends on actions of each member of the group.
3. **Abuse of authority.** When you choose this strategy, remember, there is a chance to get caught. You do not know precisely this probability, all you know is that it depends on your behavior, and the behavior of other people from your group, and it does not depend on the probability to get caught for shirking. If you are not caught, you get a wage of 120 TOKENS, bonus of 20 TOKENS, bear costs of 10 units and earn additional income of 30 TOKENS. That is, your income is 160 TOKENS. If you are caught you bear costs of 30, so your loss is equal to 30 TOKENS.

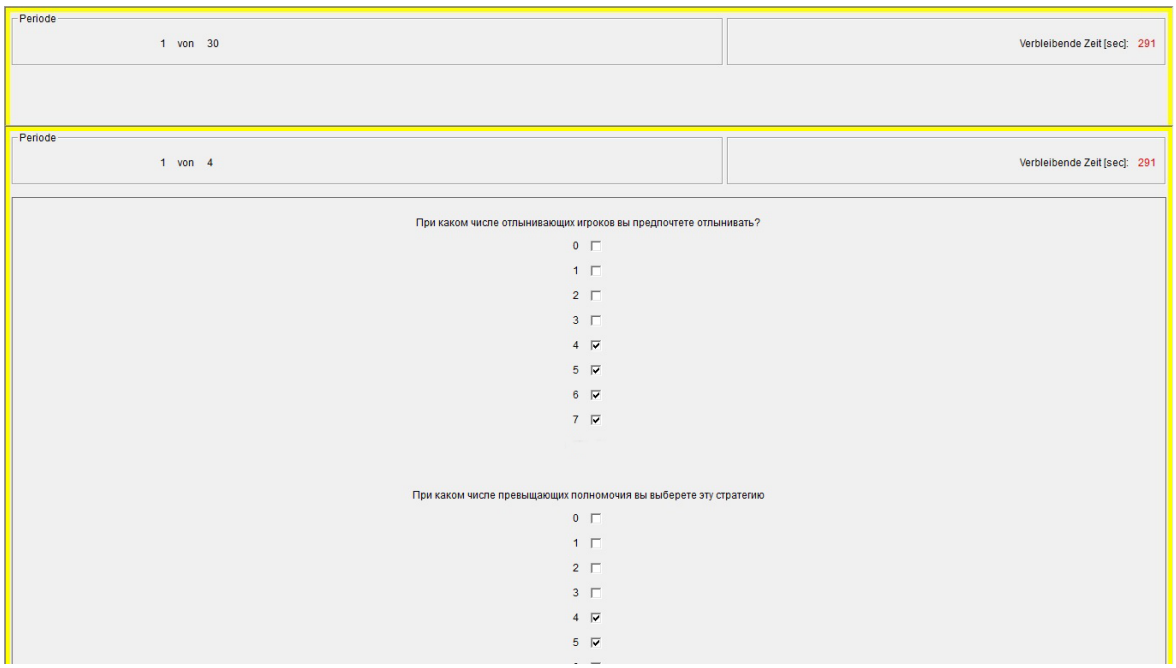
Before each round you will have to answer on 2 questions:

1. "At what quantity of shirker in the group you are ready to shirk?"

You should put ✓ in the box if you are ready to shirk, and live a blank box if you are not ready to shirk. You can put ticks in any box, or leave any box blank.

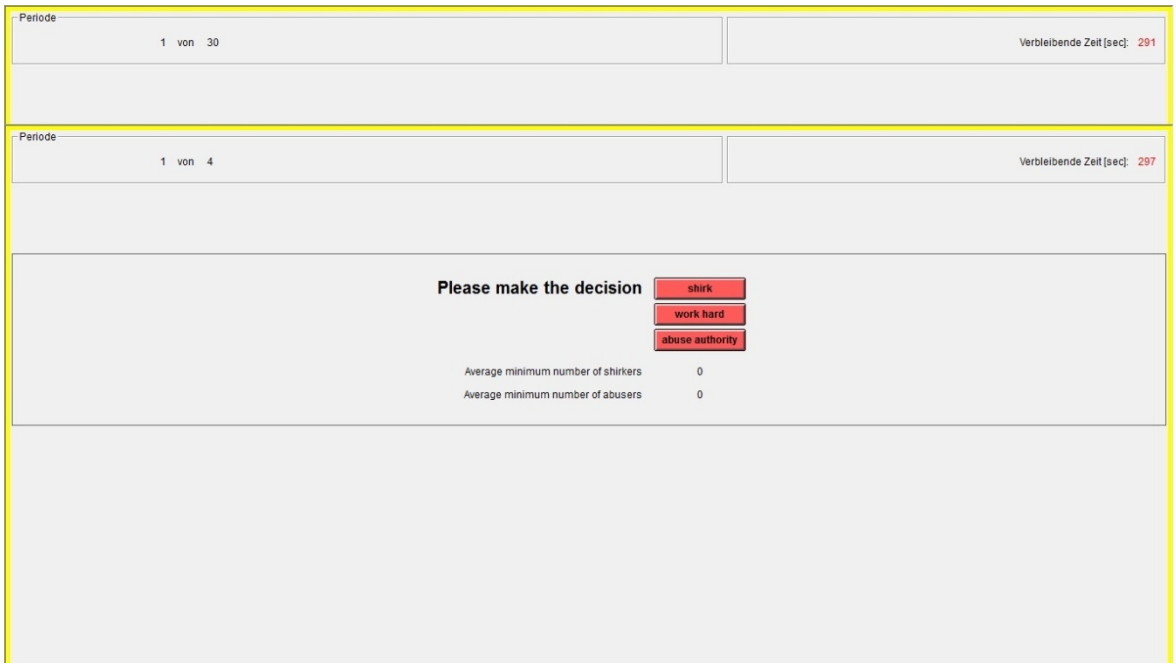
2. "At what quantity of players, who abuse authority, you are also ready to abuse authority?"

You should put ✓ in the box if you are ready to abuse authority, and live a blank box if you are not ready to do it. You can put ticks in any box, or leave any box blank.



Then you will be given information about the minimum number of shirkers at which your colleges are on average ready to shirk.

After that you shall choose a strategy for the period, which would look like:



As soon as you make your choice you will see the following information:

- Number of players that actually shirked during this round
- Number of players that received a bonus during this round
- Number of shirkers that were caught for shirking in this round
- The number of players who abused authority
- The number of players caught for the abuse of authority

- Your profit for the round
- Your cumulative profit for all rounds

There will be 10 rounds in the 4st period

Do you have any questions?

APPENDIX B: Technical Task

Programming in the experimental software "z-tree" was performed by Michael Freer, researchassistentat the Laboratory for Experimental and Behavioural Economics at National Research University Higher School of Economics.

Numerical values:

c=10 (costs)

b=20 (bonus)

m=2 (const)

w=120 (wage)

g=30 (extra gain)

J=20 (jail costs)

k=10 (number of rounds)

N=8 (number of players per group)

Stage I:

1) Inizialization

$w^1 = w$

$c^1 = c$

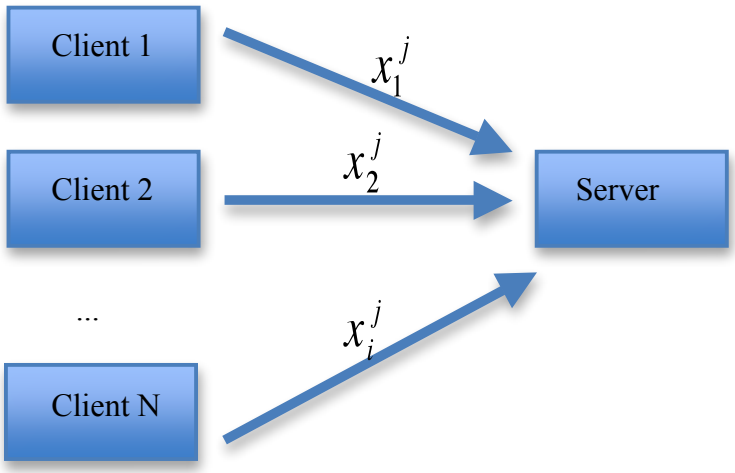
$b^1 = b$

$Payoff_i = 0,\ i = 1,...,N$

w, c, b, k, N -globals

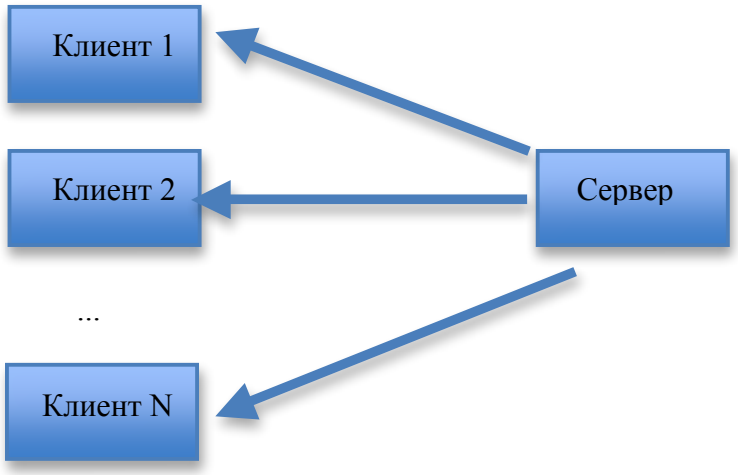
2)

j-раундов



$x_i^j \in \{0,1\}$

$x_i^j = 0$ *if work hard and* $x_i^j = 1$ *if shirk*



$w^j = w$ *(wage)*

$c^j = c$ *(cost)*

$b^j = b$ *(bonus)*

$N - s_c^j = r^j$ *(palyers who have got bonus)*

$payoff_i^j$ *(payoff for one round)*

$Payoff_i$ *(sum of payoffsf or previous rounds)*

$s^j = \sum_{i=1}^{N} x_i^j$ *(number of shirkers)* ; $p^j = 1 - \frac{s^j}{N}$ *(probability to get caught for shirking)*

if $x_i^j = 1$ *then* $catch_i^j$ *is random value:* $Bi(1, p^j)$

if $x_i^j = 0$ *then* $catch_i^j = 0$

$$s_c^j = \sum_{i=1}^{N} catch_i^j$$

$$I^j = \left\{ 0 \text{ if } s^j < (1 - \frac{c}{b})N;\ 1 \text{ if } s^j \geq (1 - \frac{c}{b})N \right\}$$

$$payoff_i^j = \begin{Bmatrix} w^j + b, \text{ if } x_i^j = 1 \text{ and } catch_i^j = 0 \\ w^j + b - c, \text{ if } x_i^j = 0 \\ w^j, \text{ if } x_i^j = 1 \text{ and } catch_i^j = 1 \end{Bmatrix}$$

$Payoff_i = Payoff_i + payoff_i^j$

3) Interface

j-rounds

Round	Quantity of shirkers (s)	Quantity of shirkers caught (s_c)	Quantity whi receive the bonus (r)	Payoff for current round (payoff)	Sum of payoff for all previous rounds (Payoff)
1	s^1	sc^1	r^1	$payoff^1$	$Payoff^1$
...	...	...	...	...	...
j	s^j	sc^j	r^j	$payoff^j$	$Payoff^j$

Buttons:

4) Output data

two-dimensional array $\begin{cases} x_i^j \\ payoff_i^j \\ catch_i^j \end{cases}$

one-dimensional array $\begin{cases} Payoff_k \\ s^j \\ p^j \\ s_c^j \\ r^j \\ I^j \end{cases}$

ichanges from 1 to N

jchanges from 1 to k

StageII:

1) Initizialization

$w^{k+1} = w$

$c^{k+1} = c$

$b^{k+1} = b$

$g^{k+1} = g$

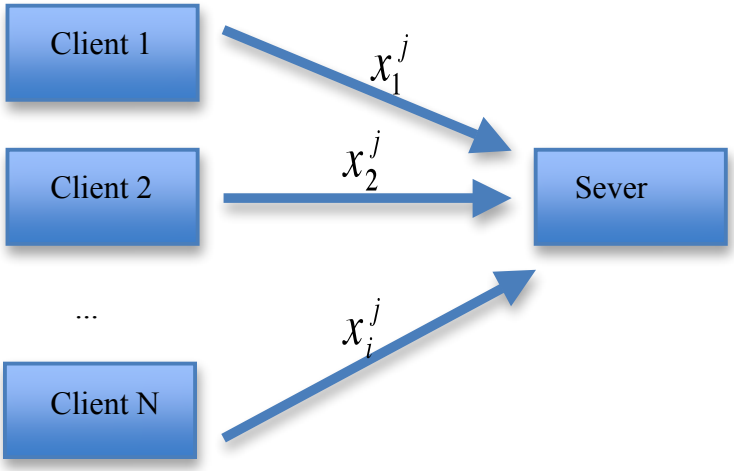
$J^{k+1} = J$

$m^{k+1} = m$

w,c,b,g,J,m,k,N -глобальные переменные

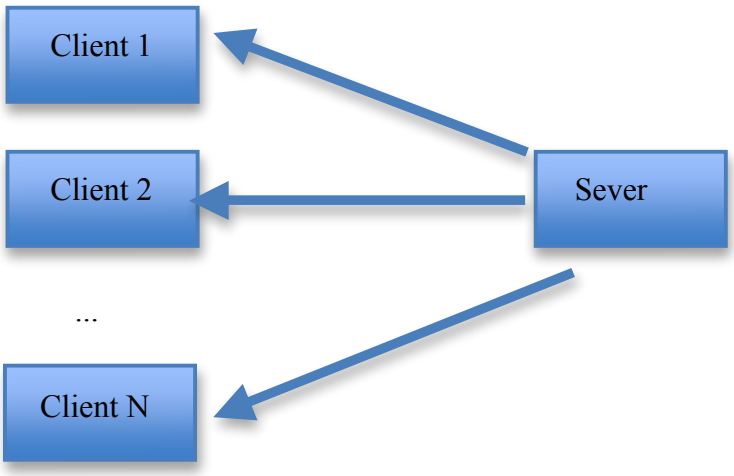
2)

j-rounds



$x_i^j \in \{0,1,2\}$

$x_i^j = 0 \;\; if \;\; work \;\; hard; \;\; x_i^j = 1 \;\; if \;\; shirk; \;\; x_i^j = 2 \;\; if \;\; abuse \;\; authority$



$w^j = w\ (wage)$

$c^j = c\ (cost)$

$b^j = b\ (bonus)$

$g^j = g\ (extra\ \ gain)$

$J^j = J\ (jail\ \ costs)$

$N - s_c^j = r^j\ (palyers\ \ who\ \ have\ \ got\ \ bonus)$

$payoff_i^j\ (payoff\ \ for\ one\ \ round)$

$Payoff_i\ (sum\ \ of\ \ payoffsfor\ previous\ \ rounds)$

$s^j = \sum_{i=1}^{N} x_i^j\ (number\ \ of\ \ shirkers)\ ;\ p^j = 1 - \frac{s^j}{N}\ (probability\ \ to\ \ get\ \ caught\ \ for shirking)$

$a^j = \sum_{i=1}^{N} (x_i^j == 2)\ (number\ \ of\ \ players\ \ who\ \ abuse\ \ authority);$

$d^j = \frac{1}{m^j + a^j}\ (probability\ \ to\ \ be\ \ caught\ \ for abusing\ \ authority)$

$if\ \ x_i^j = 1\ \ then\ \ catch_i^j\ \ is\ \ a\ \ random\ \ value:\ \ Bi(1, p^j)$

$if\ \ x_i^j = 0\ \ then\ \ catch_i^j = 0$

$s_c^j = \sum_{i=1}^{N} catch_i^j$

$a_c^j = \sum_{i=1}^{N} acatch_i^j;\ acatch_i^j\ \ is\ \ a\ \ random\ \ variable:\ \ Bi(1, d^j)$

$$I^j = \begin{cases} 0\ \ if\ \ s^j < (1 - \frac{c}{b})N\ \ and\ \ a^j < \frac{w + b - c + g + J}{g} - m; \\ 2\ \ if\ \ a^j \geq \frac{w + b - c + g + J}{g} - m\ \ and\ \ a^j > \frac{w + b - c + g + J}{b(1 - \frac{s}{N}) + g - c} - m; \\ 1\ \ if\ \ else \end{cases} \Bigg\}\ (Tipping\ point)$$

$$payoff_i^j = \begin{cases} w^j + b,\ if\ \ x_i^j = 1\ \ and\ \ catch_i^j = 0; \\ w^j + b - c,\ if\ \ x_i^j = 0; \\ w^j,\ if\ \ x_i^j = 1\ \ and\ \ catch_i^j = 1; \\ w^j + b - c + g\ \ if\ \ x_i^j = 2\ \ and\ \ acatch_i^j = 0; \\ -J\ \ if\ \ x_i^j = 2\ \ and\ \ acatch_i^j = 1; \end{cases} \Bigg\}$$

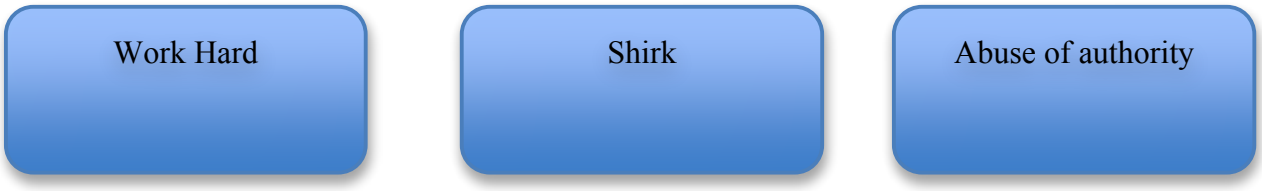
$Payoff_i = Payoff_i + payoff_i^j$

3) Interface

Round	Quantity of shirkers (s)	Quantity of shirkers caught (s_c)	Quantity wh receive the bonus (r)	Quantity who abuse the authority	Quantity of those who abuse authority	Payoff for current round (payoff)	Sum of payoff for all previous rounds (Payoff)
1	s^1	sc^1	r^1	a	a_c^1	$payoff^1$	$Payoff^1$
...	...	...	...	…	…	...	...
j	s^j	sc^j	r^j	a	a_c^j	$payoff^j$	$Payoff^j$

j-rounds

Buttons:



4) Outcome data

two-dimentional array $\begin{cases} x_i^j \\ payoff_i^j \\ catch_i^j \\ acatch_i^j \end{cases}$

one-dimentional array $\begin{cases} Payoff_i \\ s^j \\ p^j \\ s_c^j \\ r^j \\ I^j \\ a^j \\ a_c^j \\ d^j \end{cases}$

ichanges from 1 to N

jchanges from k+1 to 2k

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