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# Bounded rationality: psychological analysis of debt behaviour

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**Abstract.** This paper provides the results of an empirical investigation of decision-making in case of multiple debts. 211 respondents took part in the research. Methodological basis of the research are prospect theory and game theory. As the research method were used computer simulation games. In contrast to following the rational pattern of behavior, the results indicate that individuals tend to pay small loans first and decrease the number of outstanding debts rather than pay debts with the highest interest rate and decrease the total debt amount. Also 50% of respondents prefer to put money on a savings account with a lower interest rate instead of using it to pay the debts. The findings supporting the idea of the rationality of individuals is bounded, when they make decision about the order of debt repayment and are in agreement with findings of other authors.

**Key words:** psychology of debt behaviour, multiple debt, decision-making, prospect theory, game theory, debt aversion.

## Ограниченная рациональность: психологический анализ поведения должников

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**Аннотация.** В статье представлены результаты эмпирического исследования процесса принятия решений в случае множественных долгов. В исследовании приняло участие 211 респондентов. Методологической основой исследования является теория проспектов и теория игр. Методом исследования послужила компьютерная симуляция игр. В отличие от ожидаемого соответствия поведения рациональному образцу, результаты показали, что индивиды склонны сначала возвращать небольшие долги и уменьшать количество остающихся долгов, чем возвращать долги с высокой процентной ставкой и уменьшать общий объем долга. 50% респондентов предпочли внести средства на сберегательный счет с низкой процентной ставкой, вместо того чтобы использовать средства для погашения долгов. Эти выводы подтверждают мысль о том, что рациональность индивидов является ограниченной, когда они принимают решение об очередности возврата долгов, и согласуются с выводами некоторых других исследователей.

**Ключевые слова:** психология поведения должников, множественные долги, принятие решений, теория проспектов, теория игр, долговая аверсия.

## INTRODUCTION

### Relevance of the study

Nowadays more and more people are living in debt, and few of them pay back their loans on time. In September 2014, the average credit card debt of an American household reached \$15,607, and the average mortgage debt increased to \$153,500. Overall, the amount of total outstanding debt in the US now exceeds \$11.5 trillion. In Europe, the percentage of non-repayment of credit card debt approximately equals 7%. Moreover, 4 out of 10 students in Great Britain cannot settle their student loans! The situation in Russia is almost similar: according to the Central Bank, the share of "bad" credits this year has reached 13.3%. That is the highest non-repayment level observed over the last 3.5 years. [18]. Meanwhile, experts say that the amount of overdue debts in Russia is going to increase in the future. Because of social significance and topicality, debt behavior is of great scientific interest, so its causes and consequences should to be investigating.

### Background

Keese, M. & Schmitz, H. (2010) analyzed the impact of household indebtedness on physical and mental health. Using a large and representative panel dataset, they figured out that indebted individuals reported to be less satisfied with their health status, had worse mental health, and were more likely to be obese. A causal effect of debt on obesity has not detected. [8]. J. Gathergood (2012) revealed sizeable causal links and social norm effects in the debt-psychological health relationship [6].

Debt can be analyzed as a choice; that is, a person deciding whether to take a loan is choosing between several alternative outcomes that might take place. In terms of finance, taking a loan implies receiving an amount of money on the condition that it is paid back later in exchange of extra payment for the service. According to S. Lea et al. (1993) "debt implies an obligation that borrower is either unable or is trying to avoid discharging, at least at the time when it should be discharged" [10]. C. Roland-Lévy et al. present the study in which saving behaviors can be saw as an opposite to credit taking since they are often related to postponing

the consumption of goods and services. In that paper, saving and borrowing are studied in the specific context of the major financial crisis of the years 2008 and 2009. The results show that for the participants who are personally afraid of the consequences of the financial crisis, the representation of credit is somewhat influenced by their representation of the crisis, but does not lead to a different type of credit taking behavior; thus, the representation of saving is not influenced by this variable. [12]. Another study looks at the role of attitudes in debt behavior of 2,000 households, selected as a sample in Italy. [2] The results state that a more favorable attitude toward credit increases the likelihood of using consumer credit, even taking into account the simultaneous effect of other factors that may influence family financial decisions, like per-capita income and earnings expectations. Motivations for using credit are also related to people's attitudes towards borrowing.

Our previous studies were devoted to the problem of debt and credit attitudes [14] and to the role of objective and subjective factors in debt repayment [16] in Russia; but the research samples included only students, [15, 17] so the study needs to be extended.

Despite the fact that many factors influencing consumer debt have been proposed in literature, we can agree with other authors that a clear and conceptual model of consumer indebtedness has not yet emerged [9].

### Root causes of the problem of bad debt

What is the cause of the problem that makes a 'debt' becomes a 'bad debt'? Well, it is widely believed that banks are to blame, because they provide subprime loans to indigent people. However, regulations applied to lenders and borrowers have obviously become more rigid. The set of documents necessary to get a loan has enlarged considerably over the last years; new rules regarding pledge and surety have come into force. What is more, the amount of available information about borrowers is growing rapidly and new computerized systems are being introduced to process it. Undoubtedly, from the technical point of view the process of risk assessment has advanced greatly over the last few years. However, what about the results of risk assessment? Have they become more accurate? Why do banks face

non-repayment of credits, despite all preventive measures?

Ergo, the problem of our study can be formulated as follows: we must model the situation, consider the relations between the lender and the borrower, and examine their behaviors. The basis for modeling and analyzing optimal communication strategies in this case will be game theory.

Let us consider a situation when a person has several debts, but the resources available for covering these debts are limited. Consequently, the borrower must decide what debt to pay off first. Facing multiple debts is a complex situation, and the decision-making process in this case can be viewed with the help of prospect theory. We have already conducted research that showed that people tend to make mistakes when choosing one option over several alternatives. In addition, these mistakes do not depend on the respondent's education or occupation. [1, 3] While making a decision, the person assesses complex options by generating an intellectual system of ideas, which are used to evaluate the benefits and drawbacks associated with a particular option. The resulting value of the choice is then derived by comparing the prospective benefits and drawbacks with the checking characteristics of the initial state. Thus, the option is acceptable, if the sum of the benefits exceeds the total value of the drawbacks. This kind of analysis assumes the psychological (but not physical) ability to differentiate between benefits and drawbacks attributable to any option. The concepts of utility and value can be used here in two flavors:

- experience value — the level of pleasure or pain, satisfaction or suffering one gets in a real-life situation;
- decision value — the contribution made by the expected outcome into the overall attractiveness or repulsiveness of a particular alternative/option.

It is pretty hard to feel the difference between these two concepts, because the decision-making theory generally suggests that the real value of the choice coincides with its expected value. This assumption is a part of the idealistic concept of a purely rational individual, who is able to forecast events and evaluate available options in the most accurate way. However, a real-life decision-maker does not perceive the coincidence between the real and expected value of the

choice. [7] Some factors that affect the situation cannot be forecast, and the influence of others is too weak to be accounted for.

Financial decision-making is affected by a cognitive bias called “framing effect”. Frame is the way in which the problem or question is stated. People often come up with different solutions to problems that are equivalent in terms of profit or loss but are formulated in different ways. When the statement of a problem puts an emphasis on prospective gain, people tend to avoid risk. However, when the problem is formulated in terms of potential loss, people are more willing to take risks. [7]

Framing effect plays a crucial role in understanding debt behaviour. Firstly, a decision about whether to repay a loan or not can be viewed as a choice between an inevitable loss and a game of chance which provides an opportunity to avoid losses. In other words, a debt repayment decision is regarded as the one that involves risk, and people tend to choose the chance not to pay anything (accompanied by the likelihood of paying more money at the end due to huge fines and penalties) over covering the debts. Secondly, if we say that preferring prosperity to poverty, avoiding risks and using probability theory and mathematical statistics to make decisions under uncertainty are all components of rational behaviour then the rational choice would be to pay off the loan. Moreover, in case of multiple debts, the order of debt repayment also matters. Here, the optimal strategy would involve distributing some money among all debts (to get rid of fines) and paying off the loans in decreasing order of the interest rate. In other words, a rational borrower would use all available money to settle the debt with the highest interest rate then he'd pay off the debt with the second highest interest rate, and so on.

Thus, our research aims at studying the decision-making about repaying multiple debts. The following hypothesis is stated: while making a decision about debt repayment, respondents will stick to those strategies that deviate from the optimal one.

Objectives of our research are:

- examine the market of credit cards in Russia; estimate the average size of the loan and the annual interest rate;
- design an experiment that simulates the relationship in the lender-borrower dyad;

- conduct the experimental investigation and process the results.

## METHODS

The methodological framework for our research is the prospect theory [7] and game theory. The method by which our study was carried out was borrowed from the authors of the article “Winning the battle but losing the war: the psychology of debt management” [1]. We adapted the method to domestic conditions of Russia. With the help of Excel (computer application), we created a small ‘debt game’ – a kind of a simulator modeling a real-life situation. The essence of the game is as follows: the participant receives a credit portfolio that consists of six credit cards (*Table 1*). The game lasts 25 rounds; each round shall be one year. Each year the participant receives 50,000 rubles. He/she must use the entire sum to cover the credit card debts. In addition to this, during the game the participant gets additional bonuses that must be used to settle the debts as well. The aim of the game is to get the smallest amount of overall debt at the end.

To make the situation as close to real life as possible, we have significantly improved the game model offered by foreign scholars. Firstly, all conditions of the game match the relevant features of Russian financial markets. We have chosen the interest rates in accordance with the real-life rates charged by Russian banks. Secondly, financial resources provided to participants in our experiment enable them to repay the debts in full. Thus, not only can we consider the debtors’ behaviour, but we can also involve the creditors in our analysis and explain the situation when loans are granted but never paid back.

All in all, the lending process can be presented as a simple positional game, where the bank – the lender (L) – is the first player, and the borrower (B) is the second player. All positions of the game are shown on the tree below (*Figure 1*).

As you can see from the scheme, the lender is to make the first “move” in the game: the bank decides whether to lend the money out to a potential borrower or not. The decision is usually based on the analysis of the potential borrower’s solvency. If the bank concludes that the person is able to repay the loan, it gives him/her the money. Then, the turn comes of the second player. As well as the lender, the borrower has to choose: he/she can either pay off the credit or not. In the latter case, the borrower becomes a debtor. [10]

At first sight, the game appears to be very primitive. Obviously, the preferred final position for both players is the repayment of the loan. With this outcome, the bank gets back the money and earns profit from the interest on the loan, while the borrower does not have to lose the collateral, receive phone calls from collectors or go to the court. In practice, however, the game is complicated by several factors. Firstly, both the bank and the borrower face incomplete information: they do not know about each other’s intentions and, as a result, they cannot say for sure what positions they occupy on the game tree. Secondly, our research has shown that the lender and the borrower use completely different evaluation principles and methods while selecting their positions.

What factors does the bank focus on while making a decision about lending out the money? Simply put, it evaluates the ability of a potential borrower to repay the loan. A wide variety of methods is being used for that: the bank considers the potential borrower’s sources of income; his/her credit history, purpose of the loan, etc. Of course, in the case of long-term credit lines it is very difficult to make an accurate forecast for several years, so the ultimate score can be misleading. To make our model less complicated, though, let us assume that the bank is fully informed about the borrower’s future income and it is even able to work out the exact scheme of debt repayment. As a specialized financial institution, the bank carries out its calculations

*Table 1. Initial debt amounts and interest rates*

	Debt 1	Debt 2	Debt 3	Debt 4	Debt 5	Debt 6
Initial debt amount	10,000	25,000	30,000	35,000	150,000	200,000
Interest rate	20%	19%	24%	21%	28%	30%

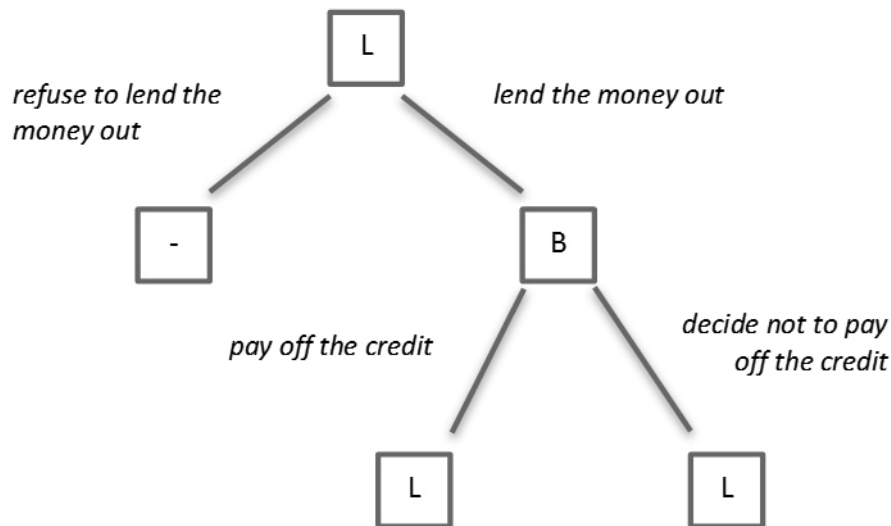


Figure 1. All positions of the game

in accordance with a rational approach, taking into account the future value of money. Thus, the debt with the highest interest rate has to be repaid first. To model the situation, let's define a payoff matrix  $A = (r_j; a_{ij})$ , where  $r_j$  is the percentage interest rate on the loan,  $a_{ij}$  is the current amount of debt. In fact the game involves 2 players (the lender and the borrower), but since the game is positional (you can see its two major stages in the tree *Figure 1*), the players work with the matrix alternately and make their moves in turns. The game lasts 25 rounds for each player; each round the player repays his/her current debt using the money at his/her disposal. The bank "runs in" (tests) the game to make sure that the borrower is able to repay the loan; meanwhile, the borrower plays in and makes payments after receiving the money. The main problem is that the strategies of the players can differ dramatically.

In the initial position of the game tree, the payoff matrix looks as follows:

[(0.2; 10,000) (0.19; 25,000) (0.24; 30 000)  
0.21; 35,000) (0.28; 150,000) (0.3; 200,000)]

As we have already said, while checking the potential borrower's ability to repay the loan the bank sticks to the optimal repayment strategy, according to which the debt with the highest interest rate is supposed to be paid off first (see *Figure 2*). This means that the sixth credit card debt has to be settled first; then the fifth credit card debt must be repaid; after that comes the third one, the fourth one and the second one respectively. Thus, the

bank minimizes the debt with the highest interest rate, or, using mathematical language, it employs the "minimax" strategy:

$$\alpha = \min a_{ij} \max r_j \tag{1}$$

The strategy the bank uses in fact leads to the optimal outcome of the game, because it enables the borrower to repay all loans in full. This scheme can be visualized using a loan calculator designed in Excel, or with the help of a scatter diagram displaying the rounds of repayment of each debt. Based on our assumption that the bank takes into account only the potential borrower's ability to repay the loan when making a lending decision, we can conclude that in this particular case the borrower will receive the money.

Now comes the turn of the second player to make the move. As we have already understood from the bank's calculations, the borrower is able to repay all loans using the money at his/her disposal. Unlike banks, however, people do not always behave in a rational way. If the borrowers' actions always coincided with those of the lenders', the problem of bad loans would not have become a burning issue. This gives us a reason to assume that people tend to stick to some other schemes of loan repayment. In order to identify these schemes, we have conducted an empirical study of the "potential debtors" behaviors, giving them an opportunity to play our "debt game".

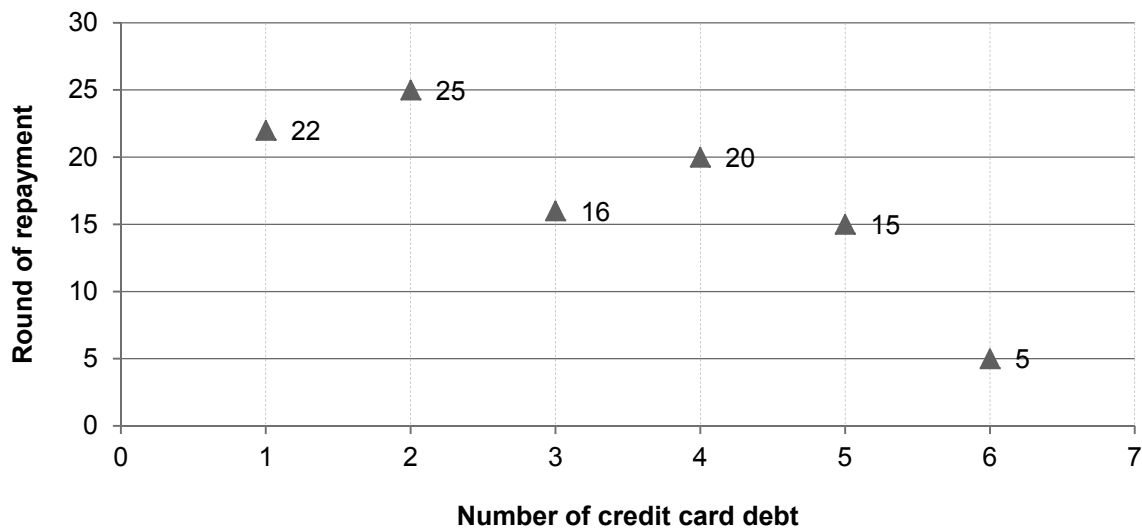


Figure 2. The strategy of debt repayment proposed by bank

The sample included 211 participants, aged from 18 to 67 (Mean = 24.2); among them 118 were females and 82 males; in other cases sex was not mentioned. The respondents were undergraduate students as well as adults with higher education, specializing in economics, techniques and humanities.

**RESULTS**

From our analysis have been excluded uncompleted games and games with mathematical errors, so the final number of respondents equaled 171.

From the rational point of view, borrowers should have an incentive to understand the terms on which consumer credit was priced in order to make well-informed decisions about borrowing and repayment. However, our results show that people tend to make wrong decisions

about the order of debt repayment in case of multiple credits, and that leads to growing debts (Table 2).

We can see that the participants were more likely to completely pay off small debts (Debt 1, 2, 3, 4 Median = 0) by the end of the game than to pay off the entire amounts of Debt 5 and 6.

The minimal total debt at the end of the game achieved through the rational repayment strategy equals -5,185 rub (which means that the individual paid off the entire debt and achieved a positive cash balance). However, only four respondents from our sample followed this strategy. The mean total debt was 25 million and the maximum total debt equaled 73 million rubles. For analysis, all the respondents were categorized according their total debt (see Figure 3).

The distribution of total debts among players is similar to normal but has two extremes: in the

Table 2. Descriptive statistics of debts at the end of the game 1

	M (₽)	Med (₽)	Min (₽)	Max (₽)	SD (₽)
Debt 1	154,703	0	0	953,962	312,101
Debt 2	234,694	0	0	1,934,702	539,506
Debt 3	393,413	0	0	6,496,260	1,124,745
Debt 4	288,822	0	0	4,108,680	789,420
Debt 5	9,704,604	1,352,630	0	53,895,542	12,412,080
Debt 6	14,293,118	4,085,612	0	73,985,358	18,220,396
Total debt	25,052,749	27361897	-5,185	73,985,355	18,640,152

interval from 0 to 5 million and in the interval from 30 to 35 million. We explored the strategies of debt payments corresponding with these extremes.

Extreme from 0 to 5 million debt corresponds with a strategy close to rational. A half of respondents (19) from this group began the game by paying off the debt with the highest interest rate and closed this debt at round 5. 14 respondents out of 19 continued to follow the financially rational strategy and started paying off the debt with the next highest interest rate (Debt 5), but then deviated from this strategy. They either closed all small debts or distributed cash among several accounts.

The other extreme (22 respondents) is an interval from 30 to 35 million. This interval corresponds with an irrational strategy, which involves reducing number of outstanding debt or distributing the available resources among several accounts. All the participants of this group except for 3 respondents totally paid off all small debts (Debt 1–4). 21 respondents finished the game with Debt 5 open, and 8 respondents had Debt 6 unpaid at the end of the game. These results support the idea of loss aversion [7] and “debt account aversion” (the latter described by Moty

Amar, Dan Ariely, Shahar Ayal and co-authors [1]). Other errors worth mentioning are: mathematical mistakes, uncompleted games and ignorance of small numbers – players considered a debt closed while tenth (kopecks) remained unpaid.

We also observed reactions of the participants during the game. Such exclamations as “You have a mistake in program, because I put money on the account but my debt is still growing!” or “Why do we have annual percentage rate annually (every round)?” illustrate that people tend to underestimate how interests accumulates over time. They may know about interest rates in general but do not have enough experience in operating them. These aspect leads to poor debt management.

We were also interested in the influence of possibility to save money on debt behavior. We added a “saving” option to the game described above – that is, players could put money on a savings account with an annual interest rate of 8.4%. The results presented in *Figure 4*.

In such circumstances it was not financially rational to put money on a savings account before all the debts are completely paid off, but more than 50% of our respondents chose that option.

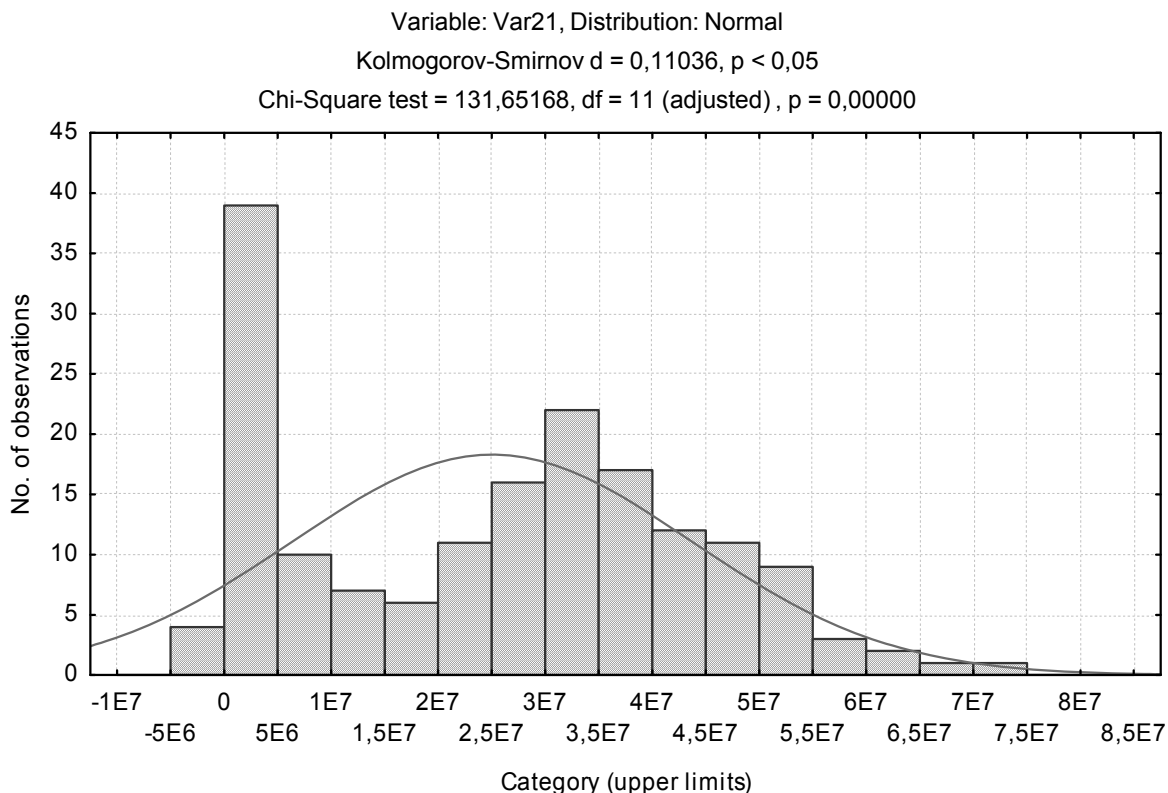


Figure 3. Categorization of respondents according to their total debt

Table 3. Descriptive statistics of debts at the end of the game 2

	M	Med	Min	Max	Std. Dev.
Debt 1	254,253	0	0	953,962	391,383
Debt 2	422,850	0	0	1,934,702	731,699
Debt 3	822,126	0	0	6,496,260	1,903,810
Debt 4	683,853	0	0	4,108,680	1,304,073
Debt 5	10,375,782	564,537	0	71,835,728	15,888,471
Debt 6	17,428,861	57	0	141,128,200	28,908,183
Savings	1,418,387	20,000	0	98,254,000	7,347,237
Total debt	29,987,587	23,355,633	-5,185	218,026,609	35,045,621

In comparison with the no-saving game we observed a slightly larger total debt and a higher diversity.

The diversity in game with the saving option can be explained by two opposite trends. Firstly, having passed the first game, participants obtain some knowledge about interest accumulation and gain a better understanding of the rational pattern of debt repayment. However, at the same time, the use of the saving option led to an increase in total debt. The distribution of total debt among players is presented

in Figure 4. Three respondents with a total debt over 200 million were excluded from analysis.

Financially rational strategy for this game is the same as for the previous one and gives positive balance of 5,185 rub. Five respondents followed this strategy. The extreme from 0 to 10 million includes the players with a strategy that slightly deviates from rational; none of those 5 players used the saving option.

In contrast, respondents with a total debt over 110 million put large sums (about 10 million) on saving accounts.

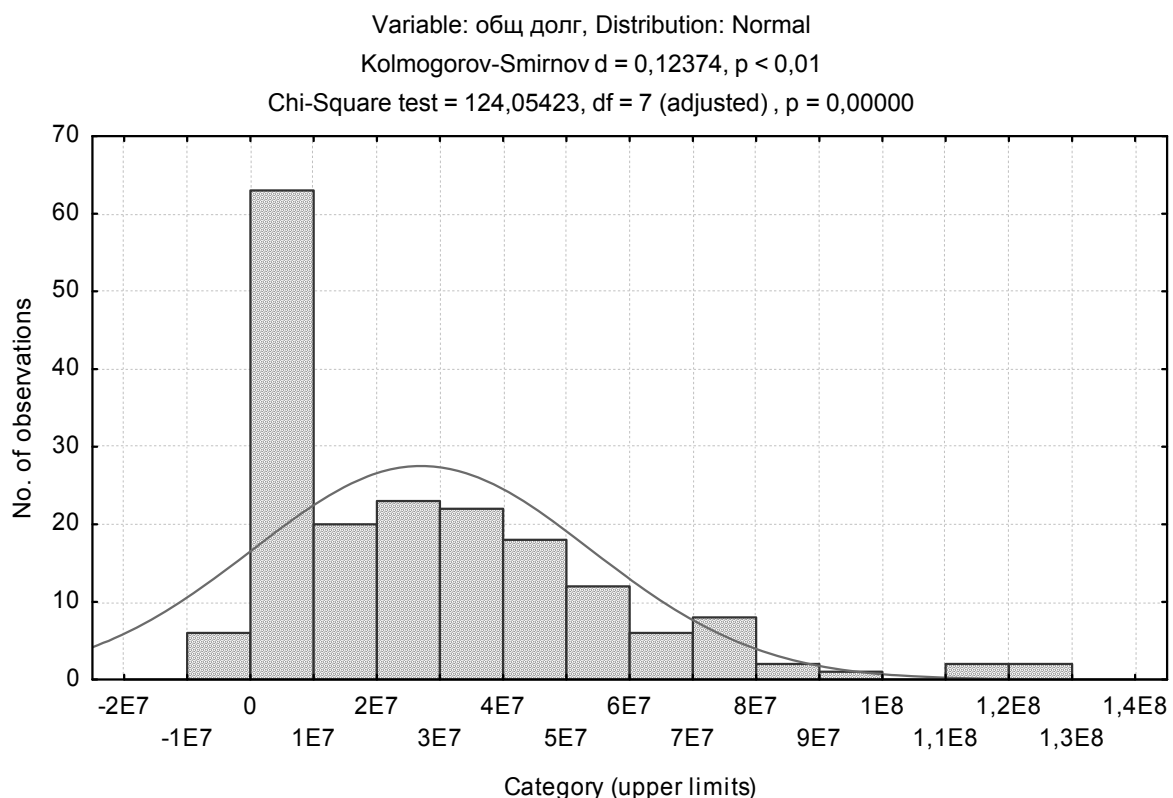


Figure 4. Influence of possibility to save money on debt behavior



## DISCUSSION

The results can be interpreted in accordance with the game theory. The two main strategies can be distinguished. Firstly, looking at the behavior of most payers, we found a straight connection between the size of the debt and the round when it was closed: the higher the debt, the later it was started to be paid. In other words, instead of paying large debts with high interest rates players paid small debts with lower interest rates. Mathematically it leads to decreasing the number of credits with the smallest debt and can be described as “minimin”:

$$\beta = \min \min \alpha_{ij} \quad (2)$$

Minimin strategy gives the player a sense of progress, but it is an illusion. The player decreases number of credits, but the total amount of debt continues to grow. What minimin strategy gives a person is the sense of progress, and this sense makes people feel comfortable. The problem is that the feeling of progress can sometimes backfire and draw people away from their goals. [11] In our case the players listened to their feelings instead of sticking to their ultimate goal, and they were misled by the sense of progress they got from reducing the number of credits during the first rounds of the game, while the ultimate goal remained unachieved. Investors who lose money in the stock market make the same mistake. If the losses an investor suffers decrease, he or she might even think that the situation is gradually improving. From the mathematical and economic points of view, however, the total amount of losses increases, so the situation is actually becoming worse. [5]. Another possible cause of using the minimin strategy might be the desire of people to better control the process of debt repayment. When you keep paying down one loan and you see that the five other debts keep growing, you become anxious and you feel tempted to do something about it. Perhaps players associate the growing amounts of debt with losing money, and they feel themselves more comfortable, facing one “loss” instead of five. Finally, the use of minimin strategy is likely to be attributed to certain cognitive limitations that affect our perception of information, particularly to mental accounting. It refers to the tendency of people to break a large complex problem into several

small pieces called mental accounts and analyze them separately. However, the optimal solution to the initial problem might not be achieved through the sum of solutions to those small sub-problems [13]. Here, the players break the multiple debt repayment problems into a series of subtasks associated with repaying each debt, and they simply do that without taking into account the relationships between the debts and the impact of the differences in interest rates.

Another frequently used strategy is 1/n heuristic. Player just split money among different debts. In fact, the vast majority of our participants used this strategy at a certain point in the game. The problem is that people view debt repayment as resource allocation. However, despite the fact that 1/n strategy may diminish risks through hedging when keeping assets on several accounts, it does not work for debt repayment. Paying off a loan is not an investment decision; although both concepts utilize the notion of interest rate, it works differently in each case. When you allocate your resources, you are paid interest on your investment; when you repay the debt, you are charged for using someone else’s money, and you have better minimize the amount of interest you pay. The primary reason behind the use of 1/n strategy is that people do not actually understand the way interest rate works. This conclusion is supported by the fact that 1/n strategy was used more often when only two large debts remained or when there was some money left after closing a debt on a particular round. People simply do not know what to do next, and they behave in the way they believe to be the safest.

## CONCLUSION

In general, repaying multiple debts is a difficult task, so people simplify it by splitting the problem into small more manageable parts or use the solutions they found to be efficient in the past. All in all, subjective psychological factors such as loss aversion and the desire to experience a sense of progress (even when it’s actually false) are more instrumental in driving the debt behaviour than objective economic factors such as annual percentage rates on loans. These findings indicate that debt behaviour significantly deviates from the rational pattern. It is pointed out not only in our laboratory experiment, but it is also observed on individuals who participate in consumer credit markets: they actually display, on average, a poorer level of financial

literacy, compared to those people who do not get consumer loans, even conditioned on characteristics such as income and education [3].

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