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Retesting the Institutional Memory Hypothesis: An Experimental Study

Summary: In this article, we set ourselves a task to test institutional memory hypothesis as a core of endogenous credit cycles. According to this hypothesis, risks taken by creditors depend largely on availability heuristic and experience of loan officers. To assess validity of this hypothesis we construct and estimate a simple VAR model. The data for this model is acquired from results of an experimental study (lasted for 70 rounds), the purpose of which is to identify behavioral patterns of participants while meeting demand for credit, specifics of subjectively weighted assessment of credit risk, based on shock approach. The results of the study allow confirming institutional memory hypothesis. After initial shock of bad debts, number of periods to recover willingness to accept risk has increased by 39%, which supports the hypothesis of availability heuristic's influence. However, with improvement of loan portfolio's quality, willingness to take risk is restoring. In addition, we managed to confirm existence of risk's underestimation and overestimation periods in an experimental manner.

Key words: Institutional memory hypothesis, Credit cycle, Availability heuristic, Credit risk, Bounded rationality.

JEL: E32, E51, G20.

All major bodies of banking supervision and monetary policy around the world recognize the importance of ensuring financial stability. To achieve this goal, it is necessary to ensure an effective management of credit cycles. However, managing credit cycles requires an understanding of their nature, and unity in expert and academic circles is not observed. The proponents of exogenous credit cycles explain them with frictions in the credit market and by shocks of external nature (shocks to demand, technology, and labor productivity). The proponents of the endogenous nature of credit cycles explain cyclical fluctuations by internal imperfections not only inherent to the credit market but also arising from the actions of economic agents. Among a myriad of sources and factors, the nature of credit cycles is quite often reduced to competitive pressures, errors of coordination among banks, and explicit guarantees, giving rise to the problem of limited liability and inefficient contracts. Among the models describing the core of the credit cycle - the sustained process of alternating phases of boom and bust, one can point out the institutional memory hypothesis, explaining the cyclical changes in the periods of underestimation and overestimation of credit risk by banks, the basis of which is the availability heuristic. If this hypothesis is correct, then controlling the cyclical processes of the monetary system, as well as developing tools for managing

the stability of the financial sector, needs to consider the problem of bounded rationality.

It is the verification of the hypothesis that stands as a subject of this study. Given the need to improve the regulation of credit markets, the identification of the nature of credit cycles seems an extremely important and urgent task.

1. Literature Review

Credit cycles as the subject of this study have a long history. The term was first introduced by John Mills (1867) in the 19th century to reflect the periods of alternating trust and distrust among market agents over the business cycle. For more than 100 years, the concept of credit cycles has evolved and in the modern interpretation reflects the alternating periods of boom and bust in lending activity (mainly of banking institutions). The number of models and hypotheses that describe and explain the nature and mechanism of this phenomenon is growing every year. An overview of the most important models is presented, for example, in the work of Dmitry Burakov (2014). For the purposes of this study, it is important to stress that the sources of credit cycles in endogenous models are normally defined as the uncertainty of economic conditions on the one hand and the bounded rationality of economic agents on the other. For us, it is an important position because the institutional memory hypothesis refers to the behavioral models of credit cycles, which explain the shifts between boom and bust in the movement of credit by periods of underestimation and overestimation of credit risk. In other words, the credit cycle appears as a consequence of bounded rationality in relation to the uncertainty of economic conditions. Much work has been made in an effort to strengthen the theoretical positions of endogenous credit cycles stemming from cognitive biases and heuristics, influencing rationality and maximizing the behavior of decision-makers. For example, Tobias Rötheli (2012) developed a model of boundedly rational credit cycles, arguing in favor of the role of bounded rationality in perceiving and processing information when making a decision. Based on the hypothesis of Rötheli (2012), David Peon, Manel Antelo, and Anxo Calvo (2015) developed a dynamic behavioral model of credit cycles, arising from the competition among boundedly rational banks and causing cyclical shifts in the quality of the bank's loan portfolio. Paul De Grauwe and Corrado Macchiarelli (2015) developed a behavioral macroeconomic model, including the banking sector, where agents have limited cognitive abilities (animal spirits) and are prone to waves of optimism and pessimism and where bank agents accelerate and amplify these vicious cycles. Another infamous paper by David Aikman, Andrew Haldane, and Benjamin D. Nelson (2015) also stressed the importance of cognitive limitations in the banker's lending practice, resulting in cycles of underestimation and overestimation of credit risk due to coordination failures.

The institutional memory hypothesis (Allen S. Berger and Gregory Udell 2003) was developed to describe and explain the procyclicity of bank lending. The basis of this model lies on dualistic assumption. On the one hand, the authors of this hypothesis assume that the alternating periods of boom and bust in lending are determined by the horizons of loan officers' memory - the farther away from the previous crisis, the higher the willingness to accept risk. On the other hand, the life cycle of the loan officer is of great importance - diminishing the role of experts with accumulated experience

inevitably leads to the recruitment of new professionals with no relevant experience, which also contributes to decreasing perception and evaluation of risks. Thus, the interaction of these two factors brings to life the procyclicity in the bank lending behavior.

The core of this hypothesis is availability heuristic, which presents itself as a cognitive shortcut to different pieces of information, held in short-term memory. The farther a piece of information is from reality, the harder it is to recall. The breakpoint for behavioral economics (and biases as well as heuristics being its subject) lies in the beginning of the 1970s. An important role of availability heuristic, as well as the role for memory in the resulting behavior of economic agents, was stressed by Amos Tversky and Daniel Kahneman (1973), arguing the importance of the availability effect in judgments and evaluation of probabilities. This paper gave rise to much research in the field, especially in studying the linkages and mechanism of short-term memory affecting risk attitude (e.g., Thorsten Pachur, Ralph Hertwig, and Florian Steinmann 2012; Pamela R. Haunschild, Francisco Polidoro Jr., and David Chandler 2015).

The institutional memory hypothesis is very common and popular and has been repeatedly verified in a variety of ways based on data sets taking into account the national specificities of different countries.

For example, in the work of Christa Bouwman and Ulrike Malmendier (2015), an analysis of the credit inspectors' reports of U.S. banks is presented. The results of the analysis confirm the institutional memory hypothesis. Also, in some empirical studies by Malmendier and Stefan Nagel (2011) and Malmendier, Geoffrey Tate, and Jon Yan (2011) an importance of the overconfidence effect influencing the quality of loans granted is stressed. To similar conclusions come a number of other authors (see, e.g., Sendhil Mullainathan 2002; Rötheli 2012). The influence of experience on the formation of confidence in current and future periods in banking activity also points to the paper of Chia-Pin Chen et al. (2012). Based on the analysis of data of the credit activity of commercial banks in Taiwan over the period from 1991 to 2007, the authors of the study also come to the conclusion about the existence of periods of underestimation and overestimation of credit risk, which is potentially associated with the effects of institutional memory, disaster myopia, or herd behavior. However, the exact answer about the reasons for the underestimation and overestimation of credit risk is not presented in the study. Similar results on the role of experience in risk perception and risk-taking behavior were obtained by other authors (e.g., Yao-Min Chiang et al. 2011; Anjan Thakor 2015; Sergey Chernenko, Samuel G. Hanson, and Adi Sunderam 2016). A special role for future beliefs and expectations based on past and current experiences points to the study of Costas Azariadis, Leo Kaas, and Yi Wen (2016), assuming an interaction of availability and representativeness heuristics.

Taking into account a huge number of empirical tests of the institutional memory hypothesis, none of them unfortunately allows giving a clear answer about the nature of this effect. In other words, the statistical data for empirical tests only indirectly confirm the existence of the institutional memory hypothesis and the role of availability heuristic in it. Our study differs from all previous tests of this hypothesis using experimental methods of research, which allow to not only confirm or refute the hypothesis but also to determine the mechanism of the institutional memory effect as

well as whether the cyclical underestimation and overestimation of credit risk by credit agents really takes its place.

It is also important to notice that research on the availability heuristic making decisions under uncertainty and risk was conducted repeatedly and this served as an additional argument in favor of the institutional memory hypothesis. However, studies of this heuristics in the context of financial markets and specifically credit cycles were not conducted.

In contrast to existing studies of the institutional memory hypothesis, first, our study is based on the use of experimental research methods. Second, unlike other studies on the role of the availability heuristic, the experiment is carried out in the lending environment, where loan solicitation and confirmation are separated in such a way that the loan officer who approves the loan is not in contact with the borrower. Thus, we eliminate the potential effects associated with the reaction in the system of interpersonal relations.

These facts determine the relevance and purpose of our research. Our main objective is testing the institutional memory hypothesis on the subject of its viability. In addition, we try to identify the sources of procyclical lending behavior. Our assumption at the core of the institutional memory effect lays the availability heuristic, *ceteris paribus* generating a cyclical effect of underestimating risk on the phases of recovery and overestimating risk during the recession phase.

The remainder of this study is organized as follows. Section 2 reveals the methods and algorithm of this study. Section 3 presents the results of the experimental study and the results of the regression analysis. Section 4 presents the conclusion.

2. Research Methodology

2.1 Experimental Design: Underlying Assumptions

To test the institutional memory hypothesis, we use two methods of research: experimental and econometric. Combining these methods helps to ensure the reproducibility and reliability of the results.

Unlike most tests of the institutional memory hypothesis, based on the collection of empirical data, we start from the use of the experimental method of research. For data acquisition, we developed an experimental setting that simulates the decision-making process of a loan officer.

The design of our experimental setting is close to the real conditions of lending practices in developing countries. The essence of the experiment is to study the loan approval process of low-documentation loans. In this connection, it is necessary to note several features of this experiment. First, the use of experimental research methods in the field of finance is increasing every year because this method allows more precisely to determine the causation. Our experimental approach, which involves the observation and analysis of the behavior of credit department employees in the process of screening and evaluation of applications under controlled laboratory conditions, allows to track the features of the behavior of loan officers that cannot be observed for banking professionals or researchers-econometricians, which will also allow to determine a causal relationship between the willingness to take risk and the experience of

lending in both short-term and long-term periods. Second, using a sample of participants with a real experience in the field of credit relations allows to take into account one of the main requirements when using the experimental method of the study: established empirical fact according to which behavior of professionals can differ significantly from the behavior of nonprofessionals in a controlled experimental environment (see, e.g., Ignacio Palacios-Huerta and Oscar Volji 2008). Third, our experimental study is focused only on decision-making concerning the approval of credit applications. In this case, we introduce the assumption of information or stimulus vacuum.

First, the elimination of the direct contact between the lender and the borrower allows to neutralize the effects influencing the expectations of the lender from the information obtained from direct contacts with the borrower (emotional, gender, religious incentives). Second, the separation of the decision-making process on a credit application from bonus payments or reputational concerns also enables to eliminate additional effects on the willingness to take risks. Third, each participant was in an information vacuum and did not know the activities of the other participants. The absence of contact between loan officers allows to clear the resulting behavior of conformity and competition factors and following the herd behavior effect. Otherwise, the results of this study might be prone to the "herding" effect, according to which the resulting choices of the participants become a function of others' behavior similar to "following the trend" effect.

2.2 Experimental Setting

For the purposes of this study, we developed an experimental setting close to the practical conditions of the process of issuing unsecured loans to small and medium businesses in Russia. The study involved graduate students who were also employees of credit departments of various commercial banks. A necessary condition to pass the selection of the participants was the experience of screening loan applications for at least 1.5 years. There were 362 individuals selected to participate in the study. The median loan officer in our sample was an employee of a public commercial bank, with an age of 29.3 years and an experience of 3.8 years. All participants were male. Every effort was made to meet the requirement of sample homogeneity (excluding cross-gender differences and differences in intertemporal choice due to age variation). All study participants had previously undergone one session in a test mode before the start of the study.

The experiment is an assessment of credit applications by the participants in the context of a controlled experimental environment under the influence of the introduced exogenous stimuli.

Loan application presents itself as typical for most Russian banks' form, including all required information on the institutional, legal, and economic status of the borrower. The experimenters filled the credit application in a way to meet the requirements of real credit applications. The distribution of loan applications among the participants wore a random character and a pool of applications included low-risk, high-risk, and default applications. The division of credit applications in three categories is not accidental. The first type of applications is a high-quality demand for credit. Credit applications "doomed to default" represent initially low-quality loans and being

approved; in the next session, the participants receive information about the borrower's default on the loan. The second category of applications is a credit demand with a high level of risk accumulating in the process. The main difference between high-risk and low-risk applications is quantifiable: with greater risk of the application, the expected rate of return is increasing. In other words, at the beginning of the following session with a probability of 50%, the loan could be qualitative or defaulted. Thus, we are trying to reproduce the condition of limited capacity of creditors to assess the risk (see, e.g., Aikman, Haldane, and Nelson 2015). Experimenters in forms of shocks exogenously set the status of high-risk applications (repayment or default).

The study was conducted for more than 70 sessions, wherein all participants received 30 loan applications of varying qualities. The size of the loans ranged from 1,000,000 to 10,000,000 rubles. The loans were given only to new borrowers; thereby, a situation of establishing schemes of affiliate or partnership lending, as well as its potential impact on the willingness to take risks, was excluded. The proportion of loan applications of high quality, low quality, and default was changing throughout the sessions to ensure the reliability of the research results simulating cycles on the credit market. The median loan in our database had a size of 4,591,381 rubles.

The experiment lasted for 70 sessions and was divided into two stages. Each session lasted an average of 2.5 hours per day. The median gap between sessions was 2.4 days.

The first "control" phase consisted of 25 sessions. In each session, the participants received a package of loan applications (30 pieces). Their task was to evaluate each submission to ensure the profitability and probability of loan repayment and ultimately to make a decision on the application in the form of "Approve/Reject". At the end of each round, the participants passed the application to the experimenters. At the beginning of a new round with a new batch of applications, the participants received data with the results of the success of the previous round (how many loans in total were repaid and what was the share of nonperforming loans (NPL)). The process was repeated in each session.

The peculiarity of this stage lies in the fact that, with each new round (starting at the 10^{th} round especially), a number of high-risk applications with 50% probability of default gradually increased, whereas those of the low-risk ones declined. The participants were able to learn about this only after shock in NPL and adjust their lending standards and risk behavior. In other words, until the shock of bad debts in the 21^{st} session, all high-risk loans were set as high quality, which corresponded to the speculative type of financing, according to the financial fragility hypothesis: incoming cash flows are sufficient to cover interest payments and part of the debt. The only information for NPL that the participants had were the data on the default type of loans. Thus, we tried to recreate the cyclical effect of financial markets (the accumulation of risk on the recovery phase and the crisis of bad debts on the recession phase).

Also, at the beginning of each session (excluding first), we asked the participants, based on the received information about the quality of loans, to assess their perception of risk on the market using the grade system from 0 (low) to 5 (very high). In the result of the experiment, we averaged the results of the subjective assessment of risk and compared them to our unbiased risk curve - objective risk trend based on the

knowledge of low-quality applications' share (hidden risk applications) in a set presented to participants. The subjective assessment of risk by the participants on a scale from 0 to 5 was measured similarly to the objective trend of risk. The objective risk curve in quantitative terms is the ratio of the high- to poor-quality loans on a scale from 0 (low) to 5 (high).

The first "control" stage is completed with the simulation of a shock on the credit market - a sharp increase in the share of overdue debt on approved credit applications.

The second stage of the experiment is designed to evaluate the effect of the institutional memory and to determine how long the lessons of the crisis will last in the memory of participants. To this end, the duration of the second stage was consciously increased from 25 to 45 rounds to identify the effect of availability heuristic. The second stage of the experiment also ended with a crisis phenomenon by a steady increase in a share of hidden-risk applications presented to the participants and simulating a shock of bad debts at the 61 round.

Derived from experimental research, statistical data sets were used to build a regression model, reflecting a dependence of credit supply from data on outstanding debt - NPL (previous periods) and subjectively weighted the assessment of risk by the participants of the experiment.

For regression analysis, we used a simple unrestricted VAR model that reflects the relationship between the above mentioned variables:

$$Y_t = a_0 + a_1 Y_{t-1} + \ldots + a_p Y_{t-p} + b_1 X_{t-1} + \ldots + b_p X_{t-p} + c_1 Z_{t-1} + \ldots + c_p Z_{t-p} + u_t, \quad (1)$$

where Y_t is the average number of credit applications approved by loan officers (resulting variable) at period t, X_t is the average share of NPL out of sample (explanatory variable 1), and Z_t is the average score of subjective risk perception by loan officers (explanatory variable 2).

The main purpose of building this model is the determination of causal relationships between variables as well as the determination of the dependence of resulting variable from the lagged explanatory variables. According to our assumptions, the average number of approved loan applications is equivalent to the credit supply. Moreover, credit supply includes both high- and low-risk loan applications. The total amount of approved credit applications in period t and the share of high-risk loans are dependent on *ex post* changes in the share of NPL in period t-1. We assume that the shock in the NPL should lead to a statistically significant reestimation of willingness to take risks. On the contrary, credit supply is a function of subjective risk perception. Therefore, in the case of deteriorating expectations regarding the repayment of loans, we assume credit supply to drastically fall. The key variable in our experiment, defining expectations, is a known *ex post* quality of approved credit applications in previous periods. Thus, in the framework of our experimental setting, credit supply is relieved from any context conditions and depends on the current level of NPL on the one hand and the previous experience on the other as well as on the knowledge that the accumulation of risk may not be overt (in case of its underestimation or uncertainty of economic conditions) and to emerge in a form of a shock after a number of periods.Thus, the shock in the NPL serves as an additional

source of information for the participants of the experiment and allows to estimate the duration of the learning effect.

To build the model, all variables were first differenced to eliminate problems with stationarity (all the variables passed the test for the presence of a unit root - advanced Dickey-Fuller test).

The next step was to determine the optimal lag length. The constructed model is also subject to all necessary diagnostic tests on heteroscedasticity of the residuals, serial correlation, and so on. We also performed a test to check the stability of the model. To check the existing causal relationship and its magnitude between resulting and explanatory variables, we use variance decomposition and impulse response techniques.

Based on the results of the model, we analyzed the distribution of quantiles serving to detect the presence or absence of the learning effect. To assess the hypothesis of the existence of periods of underestimation and overestimation of credit risk, we used data on subjective risk assessments and objective risk curve (created by the experimenters based on the pool of loan applications), which were analyzed using quantile distribution.

3. Research Findings and Discussion

The analysis of hypotheses, as we have put forward, involves identifying the relationship between the conditional quality of the loan portfolio and the perception of risk within loan applications. The descriptive statistics reflecting the main aspects of the results is presented in Table 1.

Table 1 Descriptive Statistics of Experimental Study

Variable	Applications accepted	Subject's risk estimation	NPL share in loan portfolio
Mean	10.59155	2.320423	7.098592
Median	9.000000	1.500000	4.000000
Maximum	26.00000	5.000000	18.00000
Minimum	2.000000	0.500000	2.000000
Std. dev.	7.316474	1.776425	5.374955
Skewness	0.622706	0.634072	0.898062
Kurtosis	2.161767	1.627787	2.143306
Jarque-Bera	6.667149	10.32800	11.71495
Probability	0.035665	0.005719	0.002858
Sum	752.0000	164.7500	504.0000
Sumsq. dev.	3747.155	220.8979	2022.310
Observations	71	71	71

Source: Author's calculations on experimental data.

The analysis of averages, as well as the minimum and maximum values, shows the presence of significant dispersion as in the assessment of risk so as in its share in the loan portfolio. A significant value of standard deviation for indicators "applications accepted" and "NPL share in loan portfolio" allows speaking in favor of the volatility of these variables and the significant amplitude of changes in these indicators.

The purpose of this study is to investigate whether the availability heuristic and a decrease in sensitivity of the participants to the experience of previous periods are the main causes of procyclical behavior of the participants in the experiment. In other words, we aim to find the periods of underestimation and overestimation of credit risk lying at the heart of the institutional memory hypothesis.

To test this hypothesis, we turn to the methods of regression analysis and build a simple unrestricted VAR model that reflects the dependence and relationship among the three variables.

When dealing with regression models, the problem with stationarity of time series quite often occurs. To eliminate it, the differentiation is used to prevent the distortion of the results of the model. The results of testing of time series obtained based on the experimental studies are presented in Table 2.

Table 2 Results of Unit Root Test

Variable	*T*-statistics	*p*
ADF test at the level with intercept and trend		
Applications accepted	-4.24	0.109
NPL share in loan portfolio	-3.69	0.367
Subject's estimation of loan portfolio quality	-2.84	0.193
ADF test at the first difference with intercept and trend		
Applications accepted	-5.24	0.000
NPL share in loan portfolio	-5.62	0.000
Subject's estimation of loan portfolio quality	-6.44	0.000

Source: Author's calculations on experimental data.

After differencing the variables and confirming that the time series used for the VAR model are stationary, we turn to identifying the optimal lag structure for our model (Table 3).

Table 3 Optimal Lag Selection Criteria

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-361.5148	NA	14.912	11.215	11.316	11.255
1	-314.0679	89.054	4.5708	10.032	10.434	10.191
2	-310.5009	6.3656[a]	5.4135[a]	10.200[a]	10.902[a]	10.477[a]

Notes: Lag order selected by the criterion; LR - sequential modified LR test statistic (each test at the 5% level); FPE - final prediction error; AIC - Akaike information criterion; SC - Schwarz information criterion; HQ -Hannan-Quinn information criterion.

Source: Author's calculations on experimental data.

The value of each information criterion speaks in favor of choosing two lags as an optimal number for the model. After determining that the time series used to construct the model are stationary, setting the optimal number of lags for the model, we can proceed to the construction of the model itself.

Before we start the analysis of the obtained results, it is necessary to ensure that the serial correlation and heteroscedasticity are absent as well as that the model meets

the requirement of normality and stability. For this, we conduct tests of the residuals; the results of which are presented in Table 4. As can be seen from Table 4, the model we have built meets the requirement of normality and is characterized by the stability and absence of serial correlation as well as heteroscedasticity.

Table 4 Results of Model's Diagnostic Testing

Type of test	Results		
	Lags	*LM-stat*	*p*
VAR residual serial correlation LM test	1	5.5048	0.7883*
	2	11.7135	0.2299*
Stability condition test	All roots lie within the circle. VAR satisfies stability condition.		
Heteroscedasticity test (White)	0.4060**		
Normality test	0.0129***		

Notes: * Rejection of the null hypothesis (H_0: serial correlation does not exist). ** Rejection of the null hypothesis (H_0: residuals are homoscedastic). *** Rejection of the alternative hypothesis (H_1: distribution is not normal).

Source: Author's calculations on experimental data.

To assess the results of the constructed VAR model, we turn to the analysis of variance decomposition and impulse response functions. The results of variance decomposition are shown in Tables 5 and 6. Because the aim of this study is to analyze the short-term responses of the participants to shocks in NPL, we limited the time span to four periods when assessing the variance decomposition of credit supply.

Table 5 Variance Decomposition of Credit Supply

Period	S.E.	ACA	NPL	SRP
1	2.127485	100.0000	0.0000	0.0000
2	2.546151	25.4587	58.8435	15.6978
3	2.990993	26.4893	57.8931	15.6176
4	3.297640	25.1253	59.1528	15.7219

Notes: S.E. - standard error; ACA - share of approved credit application; NPL - share of non-performing loans; SRP - subject's risk perception.

Source: Author's calculations on experimental data.

The results in Table 5 confirm our assumption: a shock of bad debts (NPL) allows to explain almost 60% of the changes in variance of credit supply in the short-term. At the same time also, a significant impact (about 15%) has expectations of the participants (SRP), which is generally consistent with the existing theoretical propositions. Own credit supply shock (ACA) also has an impact on the credit supply in future periods, and its impact in the first period reaches 100%. The explanation for this peculiarity lies in the presence of delayed reaction to the change in NPL and short-term stickiness (low elasticity) of expectations when a negative signal is not perceived objectively or not perceived at all. In behavioral economics, this effect is associated with the manifestation of cognitive dissonance when part of the information (a signal) is discarded as unreliable, unlikely, or not appropriate to the beliefs or views of the decision-maker.

In the case of variance decomposition of subjective risk assessment of the participants (Table 6), the response of variance to shocks is stable. More than 70% of the changes in variance of the subjective perception of risk is due to a shock in the NPL. At the same time, about 30% of the variance in risk perception is explained by the shock in the attitude towards risk. This result seems very interesting. We find experimental confirmation of the fact that perception and evaluation of risk based on past experience affects current perception. The shock in credit supply has almost no effect on risk perception because it itself is a consequence of the latter.

Table 6 Variance Decomposition of Subjective Risk Perception

Period	S.E.	ACA	NPL	SRP
1	4.441925	71.2356	28.4555	0.3088
2	4.882173	70.9854	28.6453	0.3693
3	5.230411	71.4593	28.4212	0.1195
4	5.617907	71.7788	27.4341	0.7870

Notes: S.E. - standard error; ACA - share of approved credit application; NPL - share of non-performing loans; SRP - subject's risk perception.

Source: Author's calculations on experimental data.

The next step in the analysis of the VAR model is related to the analysis of the response of certain variables to shocks. The results of the variables' analysis through impulse response functions are presented in Tables 7 and 8.

Table 7 Results of Impulse Response Analysis for Approved Credit Applications

Period	NPL	SRP
1	0.2458	0.1582
2	-3.1547	-1.9318
3	0.0941	-0.3457
4	-0.0003	-0.0015

Notes: NPL - share of non-performing loans; SRP - subject's risk perception.

Source: Author's calculations on experimental data.

Table 8 Results of Impulse Response Analysis for Subjects' Risk Perception

Period	NPL	SRP
1	0.0618	0.0421
2	0.0001	0.0185
3	0.0103	0.0028
4	-0.0007	0.0001

Notes: NPL - share of non-performing loans; SRP - subject's risk perception.

Source: Author's calculations on experimental data.

Overall, the analysis of the results of the impulse response confirms our assumptions and previous findings. Therefore, a positive shock to the NPL results in statistically significant reduction in the total supply of credit during the first three periods, that is, the logical result of the reassessment of risk. Similar is the reaction of credit to a shock in the perception of risk by the participants of the experiment. A positive shock in risk assessment (perception of risk growth on the market) leads to a statistically significant reduction in the supply of credit. An interesting feature of the reaction of credit supply to shocks in these variables is their short-term nature, which implies a

constant (from session to session) reassessment of parameters affecting the supply of credit.

The analysis of reactions of perception and evaluation of risk for shocks to NPL and own shock shows a similar picture: for one and two periods (sessions), a positive shock in NPL and its own expectations leads to, on the one hand, to an increase in perception of risk on the market and, on the other, to a gradual decrease of this effect. In other words, the impact of NPL shock on risk perception is temporary and decreasing in nature. The same is true for the shock in risk perception for its subjective assessment (own shock). The important point is that the shock in risk evaluation leads to the preservation (albeit in the short-term) of deteriorating market conditions' expectations.

Given the above, we can make several important conclusions. First, regression analysis allows to prove the correlation between the selected variables. Thus, the supply of credit reflected through the number of satisfied loan applications is in a statistically significant relationship with the share of NPL with lag of one period. This confirms empirical laboratory observations and is explained by the presence of dependency between the decisions made by the participants of the experiment and the success of previous rounds of the experiment. In other words, the supply of credit in this period depends on the success of the applications' approval process in the previous period. In addition, there is a statistically significant relationship between the level of NPL and the subjectively weighted assessment of risk by creditors. The greater the volume of bad debts, the higher the risk assessment and the lesser the supply of credit.

Second, the results of regression analysis of subjective risk assessment do not allow directly confirming or refuting the impact of the availability heuristic when assessing the risk - a core of the institutional memory hypothesis.

However, this limitation of the approach can be easily eliminated when comparing the trends of subjective risk assessment and objective level of risk set by the architect of the experimental setting. If the assessment of the loan portfolio's riskiness significantly deviates from the objective trend and the effect of risk accumulation after the initial shock of bad debts is observed, one can talk about the presence of the availability heuristic.

To assess these claims, we turn to the analysis of the quantile distribution, reflecting the trends of objective and subjective risks hidden in loan applications. As can be seen from Tables 9 to 11, there is a strong cyclical pattern, reflecting the periods of underestimation and overestimation of credit risk, allowing to verify the presence of availability heuristic and to argue that the participants of this study are boundedly rational when making decisions.

The essence of the analysis of quantiles in our case reduces to determining the points of quantiles and their distribution relative to the trend. Given the fact that we aim to highlight the trends of subjective and objective risk and also to identify if availability heuristic can serve as a core of the institutional memory effect, we compare gaps between the obtained trends from the available points of the quantiles. The gap between trends shows the degree of gap between objective risk (the number of low-quality loans) and subjective risk (the participants' evaluation of the risk). The smaller the gap between the trends of quantiles, the less subjective (more objective) risk is assessed. The more the gap, the more subjective is risk perception.

As can be seen from Tables 9 to 11, a cyclical pattern can be traced quite clearly. Two control periods, in which shocks of bad debts were embedded (21-22 and 61-62 periods), are the main control points of the experiment. An opening of the problem of bad debts leads to a break in the trend and a reduction in the supply of credit (the willingness of the participants to meet the credit demand), and it is parallel to the growth of the NPL, followed by the adjustment of risk evaluation, hidden in the applications. As can be seen from the results of the first part of the experiment, the participants' evaluation of the quality of the market (subjective risk assessment) is closely related to the level of NPL, which partly confirms our assumption about the existence of the relationship.

Table 9 Analysis of Credit Risk Trends ("Controlled" Period, 1-27 Rounds)

Round	ORT	SRT	Deviation*
1	1,4574	1,5173	0,0599
2	1,5732	1,5214	-0,0518
3	1,5143	1,5375	0,0232
4	1,5908	1,5613	-0,0295
5	1,6707	1,6313	-0,0394
6	1,7843	1,8407	0,0564
7	1,7641	1,861	0,0969
8	1,8305	1,9823	0,1518
9	1,8942	2,0143	0,1201
10	1,9754	2,0897	0,1143
11	2,0704	2,1594	0,089
12	2,1329	2,2143	0,0814
13	2,0781	2,2813	0,2032
14	2,1174	2,2619	0,1445
15	2,1404	2,3102	0,1698
16	2,1454	2,3805	0,2351
17	2,1981	2,4187	0,2206
18	2,2457	2,5814	0,3357
19	2,3216	2,6415	0,3199
20	2,3189	2,7905	0,4716
21	2,5843	2,1209	-0,4634
22	2,5672	1,4503	-1,1169
23	2,5801	1,4718	-1,1083
24	2,6745	1,6813	-0,9932
25	2,5971	1,7813	-0,8158
26	2,6392	2,0134	-0,6258
27	2,6427	2,3459	-0,2968

Notes: ORT - objective risk trend; SRT - subjective risk trend; * Positive deviation means underestimation of credit risk, negative deviation means overestimation of credit risk.

Source: Author's calculations on experimental data.

As can be seen from Table 9, the first phase of the experiment is characterized by a significant separation of subjective risk from objective risk evaluations and a

significant gap between the trends as well. An important feature of a rise in credit supply is an increase in the share of high-risk applications in the pool of applications. This observation suggests that the perception and assessment of risk by the participants varied from session to session based on the experience of previous periods and data on NPL. In other words, we can assume that, when making decisions, the experience of previous and current periods has an impact on the willingness to take risks in the direction of its underestimation, which is indirectly confirmed by various psychological theories of economic cycles and studies of behavioral economists. The logical conclusion of the first phase of this study is provoked by the experimenters' shock of bad debts as reflected in an increase in the share of NPL. The shock of bad debts lasts for several sessions to enhance the effect in the memory given the time gaps and lags between the sessions. This information is provided at the beginning of the next session to the participants. When NPL shock is simulated at the 20th round, a gap between trends as well as quantile distribution becomes negative in sign, indicating that the subjective approach to risk assessment is getting closer to the objective values.

Diminishing the gap between the values of quantiles in the "stable" period (Table 10) gives an indication to the role of previous experience when making decisions in the current periods.

Table 10 Analysis of Credit Risk Trends ("Stable" Period, 28-45 Rounds)

Round	ORT	SRT	Deviation*
28	2,6231	2,1294	-0,4937
29	2,5813	2,0814	-0,4999
30	2,6108	1,9915	-0,6193
31	2,7238	2,0314	-0,6924
32	2,8921	1,9312	-0,9609
33	2,9145	1,8804	-1,0341
34	2,4453	1,9301	-0,5152
35	2,6893	1,9021	-0,7872
36	2,9431	1,9409	-1,0022
37	3,0421	1,9002	-1,1419
38	3,1214	1,8875	-1,2339
39	3,2307	1,9999	-1,2308
40	3,2481	2,0114	-1,2367
41	3,3104	2,0589	-1,2515
42	3,3801	1,9431	-1,437
43	3,4103	1,9322	-1,4781
44	3,4971	1,9548	-1,5423
45	3,5142	1,9843	-1,5299

Notes: ORT - objective risk trend; SRT - subjective risk trend; * Positive deviation means underestimation of credit risk, negative deviation means overestimation of credit risk.

Source: Author's calculations on experimental data.

Table 11 Analysis of Credit Risk Trends ("Short Memory" Period, 46-71 Rounds)

Round	ORT	SRT	Deviation*
46	3,7001	2,5495	-1,1506
47	3,7983	2,8994	-0,8989
48	3,8241	3,1598	-0,6643
49	3,9142	3,8934	-0,0208
50	3,9842	4,0595	0,0753
51	4,0142	4,1815	0,1673
52	4,1184	4,3298	0,2114
53	4,1619	4,5514	0,3895
54	4,2213	4,6904	0,4691
55	4,2984	4,8542	0,5558
56	4,3101	4,9043	0,5942
57	4,37835	4,9542	0,57585
58	4,43052	5,0184	0,58788
59	4,48269	5,0832	0,60051
60	4,53486	5,3298	0,79494
61	4,58703	5,8925	1,30547
62	4,6392	3,3591	-1,2801
63	4,69137	3,3208	-1,37057
64	4,74354	2,8932	-1,85034
65	4,79571	2,0741	-2,72161
66	4,84788	2,2142	-2,63368
67	4,90005	2,1075	-2,79255
68	4,95222	2,1454	-2,80682
69	5,00439	2,0584	-2,94599
70	5,05656	2,2914	-2,76516
71	5,10873	2,2123	-2,89643

Notes: ORT - objective risk trend; SRT - subjective risk trend; * Positive deviation means underestimation of credit risk, negative deviation means overestimation of credit risk.

Source: Author's calculations on experimental data.

However, as the distance from the negative events and positive reinforcement of current practices develops, the availability heuristic is beginning to play a reverse role, weakening the attention of creditors and contributing to the limitation of rationality of decision-makers (Table 11). Consequently, the acceptance of excessive risks rises (however, it declines with the second shock in NPL).

The results of the analysis allow to confirm the importance of the time factor in the perception and assessment of risk (the availability heuristic) and thereby confirm viability of the institutional memory hypothesis.

4. Conclusion

In our research, we were able to experimentally test the institutional memory hypothesis on the subject of its viability.

According to this hypothesis, the procyclicity of the credit policy of commercial banks is a consequence of the limited memory horizons, which are the result of the availability heuristic. The latter, being part of the forces that create the bounded rationality of economic agents, leads to the formation of tendencies to underestimate the risks on upward phases of the cycle and to overestimate them on the phase of recession.

Unfortunately, until now, there has not been any experimental study that determines the source of institutional memory hypothesis - the availability heuristic. In this study, we have set a goal for the first time to test this hypothesis in an experimental manner and to determine the place of availability heuristic in the formation of a cyclical trend on the credit market. Given the requirement of the reality and conformity of the experimental setting to business conditions, we attempted to simulate the process of loan applications' evaluation by the participants who are employees of the credit departments of commercial banks with the necessary experience in this area. The study involved 362 participants. The experiment was conducted for more than 70 sessions. The main objective of this study was to identify the behavior of the participants towards risk-taking in a controlled experimental environment that simulates the screening activities of the commercial bank.

On the contrary, we aimed to find out how long the effect of negative experiences in the approval of loan applications will last. In other words, we set ourselves a task to determine how long a previous negative experience (in the form of a shock of bad debts) will influence willingness to take risk and its subjective assessment. Under assumptions of the institutional memory hypothesis, over time, the experience of previous periods is starting to play a lesser role in decision-making - lessons of the crisis are forgotten under the influence of the availability heuristic.

Experimental research allows making some conclusions. First, a negative shock of bad debts does lead to a reassessment of willingness to accept risks on the one hand and affects its perception on the other. Second, an additionally conducted econometric study also confirms the presence of the credit supply's sensitivity to negative shocks of bad debts and risk perception but only in the short-term. The essence of the institutional memory hypothesis is the need to identify the medium-term relationship between experience and willingness to take risk. Third, a comparison of the objective and subjective risk trends as well as their quantile distribution allows to confirm that, in the medium-term, an effect of NPL shock is significantly reduced (forgotten) and the willingness to take risk increases again, bringing to life the natural cyclical fluctuations on the credit market.

The importance of confirmation of this hypothesis lies in the fact that the development of approaches and tools to ensure the financial stability of national economies and the bounded rationality of economic agents must be accounted on a mandatory basis. Otherwise, the results of the countercyclical policy can have an impact that would not bring modern monetary authorities of different countries to the achievement of their key objectives.

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