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DEVELOPMENT OF P2P LENDING IN TERM OF CRISIS

Abstract. The article is devoted to definition content, disadvantages, advantages and features of P2P (person to person) lending under ordinary circumstances and in times of crisis. The main problem of P2P lending in the period of significant changes in environmental factors is a high risk of non-repayment of credit. Recommendations to reduce the risk of investors through the use of technology in neural models of individual credit risk assessment (scoring) an individual borrower. In actual credit history defined performance using qualitative and quantitative indicators to determine the level of solvency of borrowers individual. Interrelation researched the credit risk of the borrower-class individual, the interest rate (price) and maximum size P2P loan. Recommended consider the impact of environmental factors in the decision to grant consumer loans to individuals P2P.

Keywords: P2P lending, risk assessment, crisis, the probability of default, investors

JEL Classification: E51; G32; H12

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РОЗВИТОК P2P КРЕДИТУВАННЯ В УМОВАХ КРИЗИ

Анотація. В роботі запропоновано підхід до вирішення проблеми результативного визначення індивідуального кредитного ризику позичальника-фізичної особи у процесі надання P2P кредиту. Викладений підхід спрямований на зменшенні ризику інвестора та стабільний розвиток P2P кредитування у період економічної нестабільності (кризи). Цей підхід засновано на теоретико-методологічному інструментарії теорій ігор та нейронечіткого моделювання.

Ключові слова: P2P кредитування, ризики, оцінка, криза, ймовірність дефолту, інвестори

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РАЗВИТИЕ P2P КРЕДИТОВАНИЯ В УСЛОВИЯХ КРИЗИСА

Аннотация. В работе предложен подход к решению проблемы результативного определения индивидуального кредитного риска заемщика-физического лица в процессе предоставления P2P кредита. Изложенный подход направлен на уменьшение риска инвестора и стабильное развитие P2P

кредитования в период экономической нестабильности (кризиса). Этот подход основан на теоретико-методологическом инструментарии теории игр и нейронечеткого моделирования.

Ключевые слова: P2P кредитования, риски, оценка, кризис, вероятность дефолта, инвесторы

1. Introduction. Under increasing economic volatility, investors face the challenge of safe and efficient placement of financial resources. Especially, this issue arises in providing consumer loans to individuals, which have a significant repayment risk under ordinary circumstances (during a relatively stable environment), and in times of crisis become generally high-risky product. For this reason, a relevant task is to assess the solvency of an individual borrower under ordinary circumstances and in a crisis efficiently.

Banking institutions use different techniques and approaches to assess the credit risk of borrowers that help determine its class and create some reserves. But in a crisis financial institutions are mostly trying to reduce the amount of active transactions. In order to reduce the credit risk and liquidity risk they cut credit portfolios or significantly raise the interest rate. On the other hand, the social distrust of financial stability of banks grows, affecting deposit volatility and increasing the credit cost.

One of the solutions to the problem of lack of public broad access to bank loans is the development of P2P lending (person to person), which is carried out via the Internet and has a number of advantages compared with traditional lending, namely:

- Contacts between investors and borrowers are established faster as fully implemented on a specialized Internet platform;
- Members of a credit agreement (investors and borrowers) are equal parties that are not linked to each other with business ties;
- An investor places resources at the higher interest rate than bank deposits;
- Lack of extra commission fees (members need to pay a commission fee for the online platform to use its services only);

- A borrower receives a consumer credit at a relatively low interest rate because of a lack of traditional intermediaries (banks);
- An investor determines a borrower and the loan amount independently.

First P2P loan was granted in Britain by Zopa (Zone of Possible Agreement), whereof volume of loans in 2016 amounted to more than 930 million euros. Subsequently, it was joined by other companies, namely: Avant, SoFi, Funding Circle, Trustbuddy and Thincats. Currently, platforms for P2P lending can be found in Australia, Germany, China, India, Norway, Sweden and Finland.

Analysts at Morgan Stanley in 2016 rated the global volume of such lending in the amount of 112 billion euros, and in 2017, according to forecasts, the value of P2P loans could reach 177 billion euros, 214 billion euros in 2018, 265 billion euros in 2019, and 278 billion euros in 2020. Estimated total annual global growth rate during 2014-2020 amount to 51% [1].

Some banks in Ukraine have also started using the P2P lending instrument offering higher yields (in average +5% per annum on the base rates on deposits). This enabled to get interested a significant number of customers and P2P lending volume amounted to 0.05 billion euros as of April 1, 2016 [2].

But meanwhile, experts reveal the underlying problems of the development of P2P lending, namely, the lack of collateral and reserves formed for credit risks; complexity of the procedure of debt collection; no liability of intermediaries; a low level of public awareness about potential risks; high probability of loan default.

Main countering action against “bad” debtors is to provide information on bank loan default to the credit record bank and denial of further loans.

But it is possible to reduce the risk of consumer credit default at the stage of applying for a loan, when the Internet platform launches an algorithm for determining the solvency of a borrower, who should to be effective both under ordinary circumstances and amid crisis.

2. Analysis of literature data and problem setting. The problem of determining the individual credit risk in P2P lending at a scientific level was started to be thoroughly explored together with the development of the theory of risk

management. Such modern scientists as Yanhong Guo, Wenjun Zhou, Chunyu Luo, Chuanren Liu and Hui Xiong argue that the traditional (statistical) models of credit risk assessment cannot meet the needs of individual investors in P2P lending because they do not provide a clear mechanism for asset allocation [3]. Lixin Cui¹, Lu Bai¹, Yue Wang¹, Xiao Bai, Zhihong Zhang, Edwin R. Hancock agree herewith and claim that the use of statistical methods is difficult because of the problem of defining relationships between various factors that affect the final value of the credit risk (the probability of the borrower default) [4]. Other researchers (I-Cheng Yeh, Che-hui Lien) suggest using the approaches based on artificial intelligence (e.g., classifier tree) in scoring models [5]. But the initial data for these techniques are multidimensional and unstable, which adversely affects the efficiency of determining the solvency of a borrower.

Unlike previous studies that seek to determine the probability of default, Carlos Serrano-Cinca and Begoña Gutiérrez-Nieto offer to evaluate the estimated returns of P2P loans (the higher the risk of loan default is, the more profitable it should be). In this case, the factors that determine the profitability of a P2P loan are different from the factors that determine the probability of default. [6] These authors found that the use of evaluation system of estimated profit in scoring models by means of a multivariate regression approach is more efficient than using a traditional credit scoring system based on a logistic regression. In addition to profitability, scoring systems, according to S.Arya, C.Eckel and C.Wichman, should be correlated with indicators of impulsivity, temporary benefits and reliability [7].

In the work by Carlos Serrano-Cinca, Begoña Gutiérrez-Nieto and Nydia M. Reyes it is offered to use not only financial figures, but also take into account the social and environmental consequences of P2P lending in the scoring models [8]. Assessment of creditworthiness of a borrower shall be aligned with the social mission of lending that is the use of a multi-criteria approach in the assessment is suggested. Herewith, Yuejin Zhang, Hengyue Jia, Yunfei Diao, Mo Hai and Haifeng Li believe that the assessment of social and environmental consequences of P2P lending may take place through both social media and social information of mass media [9].

An analysis of sources of literature allows us to come to a conclusion that the modern development of P2P lending is connected with the problem of formation of an effective model of credit risk assessment of an individual borrower. In this case, not only financial and non-financial indicators of borrower's solvency assessment, but also environmental factors during such an assessment are important. Assessment of individual credit risk under ordinary circumstances is typologically different from similar assessment amid crisis. The theoretical basis in terms of the development of P2P lending amid crisis is not enough developed at the present time. There are also issues such as the definition of qualitative and quantitative indicators of credit risk assessment, characteristics of the classes of borrowers and the impact of environmental factors on the level of borrower's default are not sufficiently elaborated.

3. Paper objective and research tasks. An objective hereof is to develop models for determining the individual credit risk of a borrower in P2P lending amid crisis.

To achieve this objective, the following tasks were set:

- To identify the financial (quantitative) and non-financial (qualitative) indicators for assessing the credit risk of an individual borrower who applies for a P2P loan;
- To explore the interrelation of a credit risk level with a class of an individual borrower and the cost of P2P loan;
- To determine the impact of environmental factors on the level of the borrower's default.

4. Methodology of study of individual credit risk in P2P lending. A rule of thumb states that the use of traditional methods to assess individual credit risk of a borrower is inefficient under significant changes in environmental factors, in the absence of reliable data, incomplete and fuzzy statistical information about an object. Amid crisis, it is advisable to use neural technology, which empower modelling of complex economic processes, in scoring systems.

Construction of a neural model consists of several stages. At the first stage, a fuzzy knowledge database that reflects the dependence of the output from the input using linguistic rules “IF-THEN” generated from experimental data is formed. At the second stage, there is a parametric identification: a search for specific parameters of a fuzzy knowledge database that minimize deviations of theoretical indicators (calculated with a model) from the actual results [10].

5. Research results. Under IFRS, credit risk is determined as a risk that one party to a financial instrument contract will not meet its obligations, and it will cause a financial loss of the other party. [11] However, any contract that gives rise to a financial asset of one business entity and a financial liability or capital instrument of another business entity shall mean a financial instrument [12].

Banks use in the evaluation of individual credit risk of a borrower both their techniques and techniques of the national regulator, which has the right to control the impact of this assessment. A credit risk level is directly connected with an amount of the reserves to be formed by a bank for a certain lending transaction. Online P2P lending platforms, just like banks, also have the right to develop and use different scoring models.

The procedure for determining the credit risk of an individual borrower begins immediately after completing a certain form by an applicant for a loan and undergoing the identification phase. Then, the Internet platform invites information on a borrower from the credit record office. After the scoring, a borrower is assigned with a class (ranking), on which the interest rate (cost) of a loan and the maximum possible loan amount depend (Fig. No.1.).

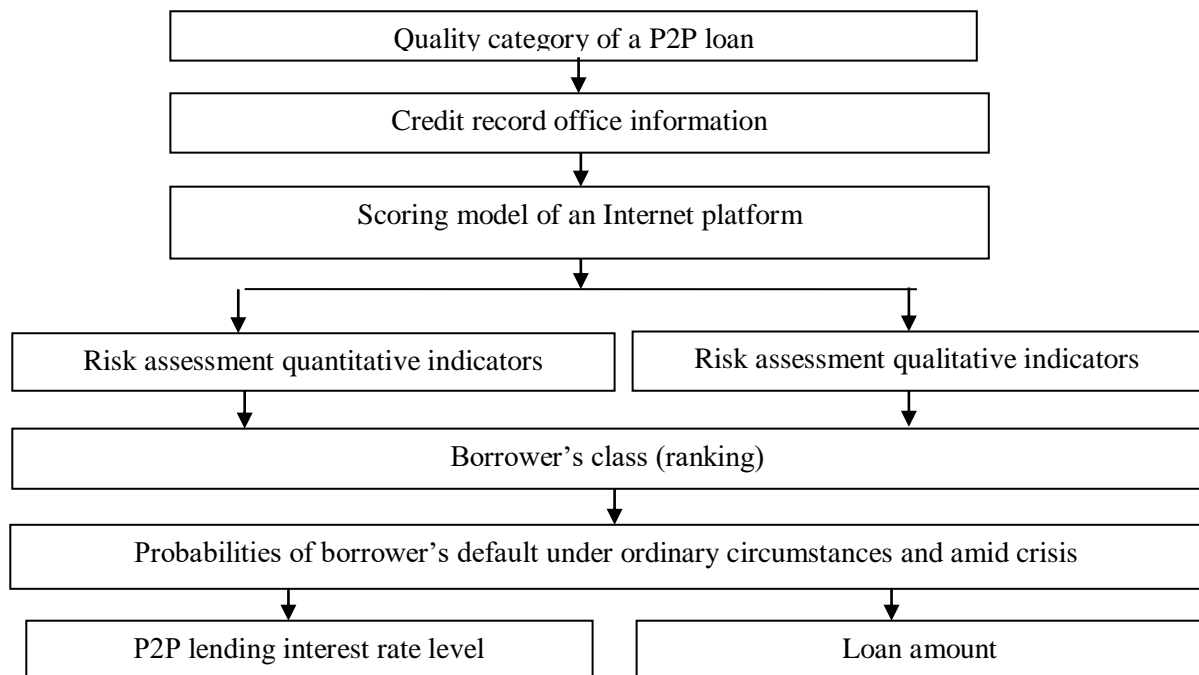


Fig.1. Algorithm for Determining Credit Risk, Amount and Interest Rate of P2P Lending

Source: Prepared by authors

As Figure 1 shows, the choice made by an Internet platform in terms of quantitative and qualitative indicators to be used in the scoring model is important in the assessment of P2P lending quality category. In order not to complicate the information processing, the number of indicators should be limited and data which are used in their calculations should be open for verification.

For this purpose, for credit scoring of an individual borrower (other than an individual who is a business entity) we suggest using the following quantitative and qualitative indicators:

1. Quantitative indicators: K1 shall mean the ratio of net income of an individual borrower to consumer loan payments (the higher the indicator, the easier for a borrower to get a loan); K2 shall mean the ratio of a debt amount under a loan to the market or appraised value of a credit facility (the lower the indicator value, the more likely it is that in case of collection from a borrower, sales revenue from a credit facility, which serves as collateral, will allow an investor to compensate a loan).

2. Qualitative indicators: K3 shall mean the age of a borrower; K4 shall mean the availability of a regular job; K5 shall mean the common employment experience; K6 shall mean repaid or outstanding loans in the past.

Assessments of individual credit risk of an individual borrower are done by the formula 1:

$$y=f(K1, K2, K3, K4, K5, K6) \quad (1)$$

To determine the effectiveness of the suggested assessment model of individual borrower's credit risk, let us take 20 real credit records of PJSC CB ZEMELNY KAPITAL (the bank's assets amounted to 10 million euros, the liabilities amounted to 4 million euros, the equity capital amounted to 6 million euros, the profit amounted to 4 million euros as of April 1, 2017), and calculate the above qualitative and quantitative indicators therewith. We would like to note that 10 loans out of 20 have been granted by the bank during the crisis period (Table. 1).

Table 1

Initial Data for Individual Borrower's Credit Risk Assessment

Borrower's Number	Qualitative and Quantitative Indicators to Assess Individual Borrower's Credit Risk						Y*
	Quantitative Indicators		Qualitative Indicators				
	K1	K2	K3	K4	K5	K6	
Under Ordinary Circumstances							
1	1,30	0,71	54	Job available	30	No past loans	1
2	1,23	0,75	36	Job available	15	Repaid in time	1
3	1,25	0,81	55	Job available	20	No past loans	1
4	1,35	0,73	47	No job	15	Repaid in time	1
5	1,44	0,70	41	Job available	20	No past loans	1
6	1,18	0,72	33	Job available	15	No past loans	0
7	1,16	0,74	23	Job available	5	Breaches	0
8	1,13	0,80	55	Job available	37	Repaid in time	0
9	0,93	0,70	34	No job	10	No past loans	0
10	1,1	0,83	21	Job available	7	Breaches	0
Amid Crisis							
1	1,30	0,70	37	No job	15	Repaid in time	1
2	1,32	0,65	27	Job available	8	No past loans	1
3	1,31	0,68	31	Job available	16	Repaid in time	1
4	1,30	0,60	38	Job available	18	No past loans	1
5	1,33	0,64	42	Job available	20	No past loans	1
6	1,25	0,71	34	Job available	7	No past loans	0

7	1,18	0,75	22	Job available	5	No past loans	0
8	1,25	0,70	58	No job	31	Breaches	0
9	1, 28	0,72	28	No job	8	No past loans	0
10	1,25	0,75	45	Job available	28	Breaches	0

* y is 0, if terms and conditions of a loan agreement between a borrower and the bank have been implemented in full; and y is 1, terms and conditions of a loan agreement have not been implemented in full or partially

Source: Prepared by authors

Built terms (under ordinary circumstances and amid crisis) for quantitative variables (K1, K2, K3, K4, K5, K6) of a model are shown in Table 2.

Table 2

Terms (Linguistic Assessment) for Indicators K1, K2, K3, K4, K5, K6

Term	Qualitative and Quantitative Indicators					
	K1	K2	K3	K4	K5	K6
Under Ordinary Circumstances						
Term1 (H) low	[0.90,1.0]	[1.0,0.90]	[18, 25)	No job	[0, 5)	Outstanding loan in the past
Term 2 (C) medium	[1.1,1.25)	[0.90,0.80]	[25, 50)	-	[5, 10)	No loans in the past
Term 3 (B) High	≥ 1.25	[0.80,0.70]	≥ 50	Job available	≥ 10	Timely loan repayment in the past
Amid Crisis						
Term1 (H) low	[1.1,1.25)	[0.90,0.80]	[18, 30]	No job	[0, 10)	Outstanding loan in the past
Term 2 (C) medium	[1.25,1.30)	[0.80,0.70]	[31, 40)	-	[10, 15)	No loans in the past
Term 3 (B) High	$\geq 1,30$	< 70	≥ 40	Job available	≥ 15	Timely loan repayment in the past

Source: Prepared by authors

Let us apply detached terms to real credit records of PJSC CB ZEMELNY KAPITAL (Bank) (see Table 3).

Table 3

The Compact View of the Knowledge Database by Individual Borrower's Credit Risk Assessment

y	№	Qualitative and Quantitative Indicators					
		K1	K2	K3	K4	K5	K6
Under Ordinary Circumstances							
1	1	B	B	B	B	B	C
	2	C	B	C	B	B	B
	3	B	C	B	B	B	C

	4	B	B	C	H	B	B
	5	B	B	C	B	B	C
0	6	C	B	C	B	B	C
	7	C	B	C	B	H	H
	8	C	B	B	B	B	B
	9	H	B	C	H	C	C
	10	C	C	H	B	C	H
Amid Crisis							
y	1	B	B	C	H	C	B
	2	B	B	H	B	H	C
	3	B	B	C	B	B	B
	4	B	B	C	B	B	C
	5	B	B	B	B	B	C
0	6	C	C	C	B	H	C
	7	H	C	H	B	H	C
	8	C	B	B	H	B	H
	9	C	C	H	H	H	C
	10	C	C	B	B	B	H

Source: Prepared by authors

From Table 3 it is obvious that the value of individual borrower's credit risk is minimal if the ratio of net income of an individual borrower to consumer loan payments is "high" (the ratio value under ordinary circumstances equals to or exceeds 1.25, and to 1.30 amid crisis), and a borrower did not take any loans in the past or repaid previous loans timely and in full. The level of individual credit risk increases significantly when the ratio of loan repayment in the past is "low" (previously, an individual repaid loans in violation of the agreement), and K1 indicator is "medium" (its parameters are within the range of 1.1 to 1.25 under ordinary circumstances, and 1.25, 1.30 amid crisis) or "low" (its value is within the range of 0.90 to 1.0 under ordinary circumstances, and of 1.25 to 1.30 amid crisis).

Moreover, in times of crisis, when assets value begins to depreciate, the ratio of loan debt to the market or appraised value of a credit facility (K2 indicator) is of special importance. It is desirable that the K2 indicator is lower than 0.7 in times of financial instability.

The above indicators assist in assigning a certain ranking (class) to an individual borrower, which determines the maximum amount of P2P loan and the interest rate. Characteristics of classes of individual borrowers are given in Table 4.

Table 4

Characteristics of Classes of Individual Borrowers under P2P Lending

Class of an Individual Borrower	Characteristics	Credit Risk Level	Interest Rate Level
1 (high)	The financial status is high: qualitative and quantitative indicators that characterize the current solvency of an individual borrower and his/her financial capacity to fulfil the loan obligations are not lower than their optimal values or exceed these optimal values. A borrower has a job and “good” credit records on the date of application submitted for P2P loan.	Low	Below the average market bank level
2 (medium)	The financial status is good: qualitative and quantitative indicators that characterize the current solvency of an individual borrower and his/her financial capacity to fulfil the loan obligations correspond to the optimal values, but there are some negative trends: changing the job with worsening conditions, growth of liabilities of an individual borrower. A borrower has a job and “good” credit records (or did not take loans in the past) on the date of application submitted for P2P loan.	Medium	At the level of the middle market bank or higher level
3 (low)	The financial status is satisfactory: qualitative and quantitative indicators that characterize the current solvency of an individual borrower and his/her financial capacity to fulfil the loan obligations do not always correspond to the optimal values. A borrower has a job and did not take loans in the past on the date of application submitted for P2P loan.	High	Significantly higher than the average market bank level
4 (critical)	The financial status is poor: qualitative and quantitative indicators that characterize the current solvency of an individual borrower and his/her financial capacity to fulfil the loan obligations are significantly below the optimal values. A borrower is unemployed and has “bad” credit records on the date of application submitted for P2P loan.	Maximum	Denial of granting a loan

Source: Prepared by authors

As Table 4 shows, individual borrowers, who have the higher probability of default according to the results of scoring assessment are assigned with higher interest rates, and in some cases it is advisable to deny P2P loan at all (for example, in case of borrowers of Class 4, who have the highest level of individual credit risk).

We would like to note that the probability of default of an individual borrower increases significantly amid crisis through significant change of environmental factors. In this connection, we recommend to consider the state of the environment in the process of decision-making on P2P lending (the probability of default of an

individual borrower under ordinary circumstances and amid crisis is shown in Table 5).

Table 5

Probability of Default of an Individual Borrower under Ordinary Circumstances and amid Crisis

Class of an Individual Borrower	Probability of Default	
	Under Ordinary Circumstances	Amid Crisis
1	0.10 – 0.30	0.15 – 0.35
2	0.31 – 0.60	0.36 – 0.70
3	0.60 – 0.99	0.71 – 0.99
4	1.0	1.0

Source: Prepared by authors

The investor's risk could be reduced by means of insurance companies, which in case of problems with the solvency of a borrower will repay deposits together with interest (an investor will not even notice the delay in P2P loan). But deposit insurance, in turn, increases the cost of P2P loan that can also affect an investor's decision regarding allocation of financial resources.

Thus, P2P lending is a new financial instrument in the lending market that does not require involving any intermediaries (banks) and is carried out by using the Internet. The advantages of P2P lending are as follows: savings on transaction costs and variable nature of determining the loan cost and its maximum amount. The main disadvantages of P2P lending include the high probability of a deposit default (especially amid crisis).

Conclusions

1. Due to the high volatility of financial markets, the assessment of credit risk in P2P lending is a relevant issue for both domestic and foreign financial institutions.
2. The suggested technique of assessment of individual credit risk of an individual borrower is based on neural technology. It is recommended to use certain quantitative and qualitative indicators for credit scoring.
3. Depending on the level of individual credit risk of an individual borrower, a class of a debtor, which in turn affects the amount of the P2P loan and the interest rate, is determined.

4. The probability of default of an individual borrower increases amid crisis significantly. It is recommended to consider the impact of environmental factors in the P2P lending decision-making process.

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