

The Crowdfunding: Financial Flows and Risks

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Abstract. The article analyzes the financial flows of crowdfunding implemented in various types of crowdfunding platforms. There is a positive effect of crowdfunding on the Russian economy. We consider crowdfunding platforms that invest by providing loans, by purchasing equity securities, and by acquiring utilitarian digital rights. We discuss and systematize the risks inherent in all types of crowdfunding platforms, including the risks of bankruptcy, fraud or unfair practices, the risks of disclosure of information that is presented by the platform in a limited amount, cross-border risk, the risk of illegal use of the platform by users, the liquidity risk associated with the difficulty of implementing purchased investments, and other types of risks. We propose machine learning algorithms for analyzing crowdfunding financial flows based on neural networks, decision trees that sequentially divide projects placed on the crowdfunding platform into clusters based on a key characteristic, a naive Bayesian classifier, and other predictive models for predicting project success. A comparative analysis of the discussed algorithms is carried out. The article analyzes the international experience in the supervision of crowdfunding by regulators. An example is the Italian regulatory body Consob, which oversees the activities of crowdfunding platforms and monitors compliance with securities-related regulations. The use of machine learning tools for the development of crowdfunding platforms and risk-based preventive supervision of crowdfunding is discussed.

Keywords: Crowdfunding, Crowdfunding Platforms, Machine Learning.

1 Introduction

The mechanism for attracting borrowed funds to finance a project or the activities of a commercial or non-profit organization through the use of Internet platforms is called crowdfunding. Crowdfunding is a collaboration of people who voluntarily pool their money or other resources through the Internet together to support the efforts of other people or organizations [1]. The investment platforms on which this kind of association is conducted (usually sites) are called the crowdfunding platforms.

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Crowdfunding promotes the growth of startups, as well as the promotion of projects of individuals, small and medium-sized enterprises with lower costs [2]. Thanks to the introduction of new technologies for distributing databases and expanding the boundaries of collective project financing, crowdfunding is actively developing, as evidenced by the competition between the largest financial companies in the Russian financial services market [3], as well as the growth of the global crowdfunding market. This market is expected to reach \$ 5.8 billion by the end of 2020 [4].

We also note the positive effect of crowdfunding on the Russian economy due to its orientation on small and medium businesses, which need financial injections to develop activities, reduce transaction costs, increase the efficiency of the investment process, and attract more non-professional investors [4]. Crowdfunding platforms increase the number of jobs, tax revenues and promote high-tech and innovative companies.

On August 2, 2019, Federal law No. 259-FZ "On attracting investment using investment platforms and on amendments to certain legislative acts of the Russian Federation" (hereinafter – Law No. 259-FZ) was adopted [5]. Law No. 259-ФЗ regulates the relations that arise in connection with investing and attracting investments using investment platforms (crowdfunding platforms). These platforms are defined as information systems used to conclude investment agreements using information technologies and technical means, access to which is provided by the operator of the investment platform. An investment platform operator is a business entity that engages in the organization of investment attraction and is included by the Bank of Russia in the register of investment platform operators (hereinafter referred to as the operator).

2 Types of the Crowdfunding Platforms

At the same time, based on Article 5 of Law No. 259-FZ, investing using crowdfunding platforms can be carried out in the following ways:

1) by providing the loans (hereinafter referred to as the crowdfunding platform of the first type, CP1)

2) by acquiring equity securities placed using the investment platform, except for securities intended for qualified securities investors (hereinafter referred to as the second type crowdfunding platform, CP2);

3) by acquiring utilitarian digital rights (hereinafter referred to as the third type crowdfunding platform, CP3).

CP1 is an Internet service (usually a website) where the investors and the borrowers register. The competitive advantage of CP1 operator is the assistance to the investor in the formation of a portfolio, aimed at ensuring that a significant number of reliable borrowers account for a small number of unknown borrowers, some of whom will default, and the other part will become a regular customer of the operator for a loan through the platform. The operator expands the circle of its clients, borrowers with a positive credit history, as well as the circle of investors by spreading information about the platform's services that allow you to earn real money.

CP2, like CP1, is an Internet service (usually a website) where investors and issuers are registered. However, in this case, to increase its competitiveness, the operator of the platform where the securities are placed will strive to create a market in which liquid securities are traded, i.e. the operator will try to formulate certain conditions for the circulation of securities, which will be characterized by a quick exit from the investment at any time.

CP3 is an online service (usually a site) where investors and manufacturers of goods, services, and intellectual products are registered. As a rule, this is a pre-order for small consignments of consumer goods. Due to the small volumes of attracting financing, demand is initiated by the consumer of the product. For operators, additional benefits are possible from the organization of a secondary market within the platform.

3 The Crowdfunding Risks and common features for successful projects

Despite the variety of different types of crowdfunding platforms, we can distinguish their common risks [6].

1. The risk of bankruptcy, fraud or unfair practices associated with the activities of the crowdfunding platform. According to an analysis of fraud cases conducted by Ezubao in 2016, 900,000 mainly retail investors were affected by illegal actions on the part of crowdfunding platforms for 18 months, with losses amounting to about us \$ 7.6 billion [7].

2. The risk associated with public offerings and unlicensed activities. Since the range of services offered by crowdfunding platforms is very diverse, the services provided may fall under the scope of regulated activities. In this case, certain regulations and licensing must be applied to their activities.

3. The risks of the information disclosing that are presented by the platform in a limited volume or there are no detailed descriptions of certain services, projects, etc., which will result in an incorrect decision. However, the disclosure of data that is not detailed or standardized does not necessarily lead to distortion of information in general.

4. Cross- border risk, which is realized, for example, if the platform carries out international operations and it is not established what legislation the investor should follow in case of unforeseen situations (non- payments, bankruptcy).

5. The risk of the platform illegal use by the clients. If the users do not pass due verification from the crowdfunding platform operator, illegal actions on their part may be a source of risk for investors.

6. The risk of insolvency of the borrower who cannot pay the loan on time. This risk is typical for startups, since these innovative projects may have remote investment horizons.

7. The liquidity risk associated with the difficulty of selling the purchased investment.

Despite a large number of risks inherent in crowdfunding platforms, the number of successfully completed projects is growing. Overall, 56% of completed projects (that is, completed, not canceled or suspended) were successful [8]. The following characteristics are common to successfully completed projects:

- Successful projects tend to have smaller (and therefore more realistic) goals: the average amount that successful projects achieve is about half that of failed projects.
- Large differences in the average amount of contributions for each project. The average amount announced for a successful project is significantly higher than the average amount requested. This allows us to conclude that projects that achieve their goal, as a rule, further receive even more funding and become "overfinanced".
- There is a significant difference between unsuccessful and successful companies in terms of announced amount and number of sponsors versus the target amount. The "crowd effect" probably works: as soon as potential sponsors see that the project looks successful, they are much more likely to participate and fund it.
- For successful projects, the campaign duration is shorter, but the launch of the company itself takes longer (measured from the moment the project was first created on the site).

4 The Crowdfunding Platforms Stages

As a rule, the scheme of crowdfunding platforms includes several stages [9].

- Stage 1. The registration of the organization.
- Stage 2. The choice of the form (site).
- Stage 3. The company description.
- Stage 4. The determination of the required amount.
- Stage 5. The choice of bonuses and the size of the donations.
- Stage 6. Setting the deadlines and collecting funds.
- Stage 7. The platform commission.

5 The Crowdfunding Financial Flows and Project Success Analysis

To analyze the financial flows, we consider stage 6 "Setting the deadlines and collecting funds". The information on fundraising by the crowdfunding platform will be used as input data for the financial flow analysis. Just before use, the input data must be converted to the appropriate format. This requires the necessary number of iterations of cleaning the input data: removing duplicates and irrelevant rows.

Consider predictive models for analyzing project success. In this context, the success of a project hosted on a crowdfunding platform means the achievement of $\frac{3}{4}$ the declared required amount for the implementation of the project. To solve the problem

of determining the success of a hosted project, we can use machine learning models (hereinafter referred to as ML).

5.1 The Discriminant Analysis

The discriminant analysis [10] involves the use of linear functions ($s_n(x)$) to determine the probability of project success:

$$s_n(x) = q_0^n + q_1^n x_1 + \dots + q_p^n x_p,$$

where x_1, \dots, x_p is the set of features; q_0, \dots, q_p are the regression parameters, and n is the corresponding set.

Since only 2 conditions for the success and failure of the project are specified in the initial condition, the final function will be presented in the form of linear regression.

5.2 The Logistic Regression

Logistic regression [11]: it is assumed that the probability of an event occurring $y=1$ (the project is successful) is equal to

$$P\{y = 1|X\} = f(z)$$

$$z = Q^T X = q_0 + q_1 x_1 + \dots + q_p x_p,$$

where X is the vector-column of independent variables x_1, \dots, x_p ;

Q is the vector-column of regression parameters q_0, \dots, q_p ;

$f(z) = \frac{1}{1+e^{-z}}$ - the logistic function.

The probability of an event occurring when a project placed on the crowdfunding platform does not reach the required amount (the project is unsuccessful) is determined as follows:

$$P\{y = 0|X\} = 1 - f(z) = 1 - f(Q^T X)$$

The logistic regression function is written as follows:

$$\log \frac{P\{y = 1|X\}}{P\{y = 0|X\}} = \frac{f(z)}{1 - f(z)} = q_0 + q_1 x_1 + \dots + q_p x_p = s(x)$$

To find the parameters q_0, \dots, q_p , it is necessary to use the maximum likelihood method to select parameters that maximize the value of the likelihood function on the compiled training sample of the set of pairs $(X_i, Y_i), i = 1, \dots, n$. Also, to find the

parameters, it is possible to use the Newton-Raphson method [12] or gradient descent [13].

5.3 The Neural Network

The neural network method [14] is a multi-parameter nonlinear optimization problem for finding the values of the coefficients of connections between neurons. Each neuron consists of three main components: synapses or multipliers, an adder, and a non-linear converter. The multipliers transmit a signal increased by a weight coefficient that determines the level of relationship, then the adder combines the signals, after which the final conversion of the generalized pool of signals is performed based on some neuron activation function.

$$S = \sum_{r=1}^p q_r x_r + b, Y = F(S).$$

Here S is the result of the summation, q_r is the weight of the r -th multiplier, x_r – input signal, b is the offset value, Y is the output signal, p is number of neuron inputs, F is the activation function.

Neural networks applied to a set of incomplete source data, which is especially true for crowdfunding platforms in the case of partial disclosure of information. Also, neural networks can quickly adapt to external conditions, which again is a significant advantage in the case the startups' placement on crowdfunding platforms.

5.4 The Decision Trees

The decision trees [14] consistently divide hosted projects into clusters based on a key characteristic. In the first step, the division is made according to the most significant criteria, for example, the declared amount for collecting investors' funds. This method allows you to easily interpret the results and quickly process large data sets. However, in some cases, the values of clusters for splitting are not clearly defined.

5.5 The Naive Bayesian Classifier

The naive Bayesian classifier [15] looks like a graph divided into two parts: one of the parts is the vertex of the project success cluster L , and the other is the vertices of independent variables x_1, \dots, x_p , which are directed by arrows from the cluster vertex. Classifier training is determined by the estimation of conditional probabilities $P(X|L)$, and classification on l clusters is performed using the Bayes formula:

$$P(L = l|X = x) = \frac{P(L = l) \prod_{r=1}^p P(X_r = x_r|L = l)}{\sum_{l'} P(L = l') \prod_{r=1}^p P(X_r = x_r|L = l')}$$

A naïve Bayesian classifier avoids the complexity of the model and combines the patterns obtained from the data. The disadvantage of this method is the possibility of losing significant patterns when converting the source data.

Comparing and analyzing the listed methods for analyzing crowdfunding financial flows, we note that each method has its advantages and disadvantages. Combinations of existing machine learning classification models can be used to compensate for the inherent disadvantages of these methods. An integrated approach also improves the accuracy of forecasting.

6 The Regulatory Oversight of Crowdfunding Platforms

Given the variety the crowdfunding forms and the risks involved, it is important to exercise regulatory oversight of crowdfunding platforms.

According to the statement of the world Association of national securities regulatory commissions IOSCO [18], at least at the moment, there is no General international approach to the supervision of crowdfunding. According to IOSCO, most crowdfunding regulatory regimes have been put in place recently, which means that creating a common international approach may be premature. However, IOSCO aims to raise awareness of some of the main risks associated with crowdfunding. These are the risk of default and serious failure of startups, platform failure, fraud and money laundering, lack of liquidity, and information asymmetry. According to IOSCO, measures taken so far to mitigate these risks include:

- Configure login, registration, or licensing requirements for funding portals;
- Establishing the requirements for disclosure of information for issuers and funding portals;
- Restriction of services that can be provided by crowdfunding platforms;
- Investor training requirements and / or statements signed by investors confirming their understanding of the risks;
- Limit the amount of investment made by an individual in each offer and within a certain time frame;
- A requirement to appoint a third-party custodian to hold the investor's assets.

In 2019, the EU agreed on rules for the development of European crowdfunding platforms [19]. A single set of criteria will be applied to all European crowdfunding service providers (ECSP) up to offers of at least 5,000,000 euros (from 1,000,000 euros proposed by the Commission), calculated over 12 months for each project owner. For small companies or startups to use the crowdfunding option, the scope of the legislation included shares of some private limited liability companies that can be freely transferred in the capital markets. The legislation will be accompanied by additional guarantees and explanations on how investors should be informed about the consequences of their choice.

Full disclosure and transparency are required to protect investors. Investors will be provided with a key investment information sheet (KIIS) compiled by the project owner for each crowdfunding offer or at the platform level. Crowdfunding service

providers will need to provide clients with clear information about the financial risks and costs they may incur, including insolvency risks and project selection criteria. Also, novice investors will be offered more detailed advice and recommendations, including the possibility of incurring losses and a warning if their investment exceeds 1000 euros or 5% of their net investment value. Regarding authorization and supervision, the negotiators agreed that a potential ECSP would need to request permission from the national competent authority (NCA) of the member state in which they are established. Through the notification procedure, an ECSP member state will also be able to provide its services abroad. Supervision will also be carried out by the NCA in conjunction with the European Securities and markets authority (ESMA), which facilitates and coordinates cooperation between member countries.

So far, the rules for the development of European crowdfunding platforms do not fully apply in the EU. Regulatory measures vary depending on jurisdictions and may be determined in some cases by the current legislation on securities transactions, in others by the official regulatory system.

As a rule, regulatory measures vary depending on jurisdictions and can be determined in some cases by the current legislation on securities transactions, in others - by the official regulation system. At the same time, the common goal of most regulators is to achieve a balance between the reliability of capital formation of enterprises and borrowing projects and the risks of investors.

The supervisory measures are different in each jurisdiction. For example, in Italy, crowdfunding platforms are supervised by the securities compliance Authority (Consob) [6]. The supervision is continuous, carried out on an ongoing basis, and on-site inspections are carried out. Consob may request the necessary information and implement punitive measures - fines, administrative measures up to the prohibition of crowdfunding activities.

The German regulator BaFin is also involved in reviewing the terms of the contract to determine whether permission is required if funding is raised through crowdfunding or crowd investment. According to section 32 (1) of the German banking Act (hereinafter referred to as KWG) [16], anyone who wishes to conduct banking business or provide financial services in Germany on a commercial basis or on a scale that requires a commercial organization must have written permission from BaFin. In principle, a KWG permit is not required for a brokerage loan, although it may be required under section 34c of the German Industrial code [17]. Therefore, BaFin usually does not control credit platforms. However, depending on the contractual relationship, prudential authorization requirements may apply to both users and the platform operator. If they are not met, BaFin may take the measures listed in sections 44c and 37 KWG against operators and users, as well as against the credit platform as a dependent enterprise. These measures include requests for information and submission of documents, inspections, and searches, and, if the business is conducted without the necessary permission, the authority to terminate and close the business.

Depending on the design of the crowdfunding platform, crowdfunding may also be subject To BaFin's prudential authorization requirements. The platform operator can potentially provide financial services that require an authorization, such as investment brokerage, contract brokerage, or business placement following the KWG. However,

this assumes that investments in equity instruments offered through the platform are financial instruments.

Even if the platform operator meets one of the definitions of an activity that requires the authorization mentioned above, the KWG indicates that in some cases it will not need authorization. Authorization is not necessary if the platform operator simply performs investment or contract brokerage operations and does not receive ownership or ownership rights, money, or if the placement business is conducted exclusively for suppliers or issuers. This applies to most of the investments offered today. The authorization requirement may apply if the crowdfunding platform operator accepts money from investors and transfers it to the person offering equity investments and participates in the money transfer business.

BaFin also defines the responsibility of the investors themselves. Crowdfunding can benefit both the recipients and investors. For businesses, this provides an additional opportunity to finance projects and often serves as the first market test. Investors have the opportunity to support specific projects, including those in which private investors were previously unable to participate. Before making an investment decision, investors should carefully weigh the opportunities and risks involved. They should be aware of the fact that most platforms do not require authorization and as such are part of an unregulated capital market. This term refers to a situation in which the Offeror does not require permission from BaFin and must meet only a few legal requirements. By themselves, investments made through an unregulated capital market do not necessarily involve higher risks. However, investors are discovering a market segment that is not regulated by the state. Neither the products, nor the integrity, nor the financial position of the supplier and investors is controlled. Also, there is a lack of ongoing supervision, compliance with financial reporting requirements, and Deposit protection. Unfortunately, this makes it easier for unscrupulous suppliers to place their products on an unregulated capital market. Investors should be aware of this before making investment decisions. They are responsible for choosing products that match their personal risk appetite and investment goals.

In the USA regulation structure for startups and small businesses to raise capital through the placement of securities through crowdfunding came into force on 5 April 2012 based on the Law the Jumpstart Our Business Startups ("Law on vacancies") [20]. 30, 2015 SEC approves final rules, regulation crowdfunding to implement title III of the Jobs Act ("Section III") [21]. Following the approved version, SEC employees conduct periodic research of available information on the impact of the Regulation on capital accumulation and protection of crowdfunding investors. The latest report, which provides a summary of quantitative information available to supervisors, qualitative observations of SEC and FINRA employees, as well as the contribution of practical experience of crowdfunding market participants, was published on June 18, 2019 [22]. The report provides the following conclusions on the US crowdfunding market:

- The market shows growth over time. Most issuers made one placement during this period, and some issuers returned to the crowdfunding market for subsequent offers.

- The typical offer was small and collected less than the 12-month offer limit. The average requested target amount was \$ 25,000, and the average maximum requested amount was \$ 500,000.

During the period under review, relatively few enforcement actions were taken against issuers and intermediaries in the crowdfunding market.

7 Conclusion

It should be noted that the use of machine learning is a tool for improving the quality of risk-based preventive supervision of crowdfunding and accelerating the development of crowdfunding platforms. This will increase the transparency and efficiency of markets, and increase the financial stability of the state.

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