



Empirical Research on Innovation of Internet Financial Regulatory System Based on Big Data Technology

Yingyun Zhang^(✉) and Cheng Huang

Business School, Hohai University, Moling Street, Nanjing, China
1967133736@qq.com

Abstract. Big data technology has great application value in Internet finance, which can well solve the problem of supervision failure caused by the rapid development of Internet finance in China. Based on the panel data of 31 provinces and cities in China from 2013 to 2019, this paper constructed a panel regression model. After analyzing the impact of financial regulation on the development of Internet finance, it further discussed the framework and loopholes of the existing financial regulation system, finally puts forward some innovative ideas combined with the application mode of big data technology, such as building big data supervision mode with interconnection and information sharing, establishing multi-level intelligent supervision system of big data and comprehensive and safe credit investigation system of big data and so on, so as to promote the coordinated development of Internet finance and supervision system in China.

Keywords: Big Data Technology · Internet Finance · Panel Data Regression Model · Big Data Innovation Supervision · Big Data Intelligent Supervision

1 Introduction

With the advent of the era of big data, Internet finance with information technology as the core driving force has achieved rapid development in just a few years, providing a huge boost to China's economic development. However, while affirms that the traditional financial industry has successfully achieved informatization innovation breakthrough with the help of the Internet and big data technology, we cannot ignore the industry risks and regulatory loopholes caused by the rapid development of Internet finance, as well as the serious consequences that may be brought by the excessive accumulation of these problems. The emergence of Internet, big data, artificial intelligence and other technologies provides a broad space for the development of Internet finance, but also provides information and technical support for the innovation and improvement of Internet finance regulatory system. Only by realizing the coordinated progress of Internet finance and regulatory system can we better achieve the grand goal of high-quality development of China's economy!

2 Literature Review

2.1 Research on the Development Status of Internet Finance

Internet finance, in a nutshell, is a new financial model generated by the combination of Internet and financial industry. The exploration and research of Internet finance in foreign countries precedes that in China, and most of them focus on financial models such as third-party payment, P2P lending and crowdfunding. They believed that P2P borrowing mode could reduce the cost of both sides of the transaction, but due to the market failure of both sides of the transaction, borrowers would face the risk of adverse selection, which is much higher than the risk of traditional lending [1]. Furthermore, The emergence of Internet financial crowd-funding mode enriches the traditional investment and financing channels and can effectively alleviate the problem of financing constraints [7].

In China, the concept of “Internet finance” was first put forward by Ping Xie and Chuanwei Zou. They believe that Internet finance mode is a third financial financing mode based on modern information technology, which is different from indirect financing of commercial banks and direct financing of capital market [5]. Then, After research, Chinese scholars concluded that the mode of Internet finance could be divided into third-party payment, intelligent financial management, crowd funding, P2P lending and electronic money, etc., and put forward forward-looking suggestions on strengthening the risk control of Internet finance industry while paying attention to the development of Internet finance [3]. Furthermore, Yonghong Du believes that the deep integration of finance and big data will solve problems such as financial credit evaluation, risk prevention and control, and information security [10]. Yuhu Li argues that the development and improvement of big data and other information technologies will further drive the further innovation of Internet finance such as Internet securities and Internet insurance [11]. Rongda Chen, by analyzing the development stages and modes of Internet finance, predicted that China’s Internet finance would face three major challenges: preventing systemic risks, government regulation and industry self-discipline, and estimating the behavior evolution rules of participants [6].

2.2 Research on Innovation of Internet Financial Regulatory System

The development of Internet finance has brought huge economic benefits, but also brought a series of problems in risk control and supervision. Abroad due to the study of the Internet financial ahead of our country and has a relatively perfect credit system, so the study of the Internet financial regulatory system is relatively mature. Xiuhong Fan found that China should establish an Internet finance industry association to moderately supervise Internet finance and pay attention to guidance and risk prevention by studying financial supervision modes in the United States and the United Kingdom [8]. In terms of China’s domestic financial supervision system, Yan Tong also believes that the development of Internet finance in China does not match the existing supervision system. Regulatory legislation should be further improved to enhance regulatory capacity [9]. In addition, In improving China’s Internet financial supervision system, Peiyu He believes that the top-level design of big data strategy should be strengthened and establish the

joint supervision mode of Internet finance, which is also the idea of applying big data technology to the financial supervision system earlier proposed by Chinese scholars [4]. Hong Lan, combined with the development of big data technology, proposed the use of big data to achieve collaborative supervision, the introduction of artificial intelligence supervision, the establishment of a sound big data credit investigation system and other Internet financial innovation supervision measures [2].

Based on the research of domestic and foreign scholars on the development and supervision system of Internet finance, it is found that foreign countries have much more mature experience in dealing with the risk control and supervision of Internet finance than China. The researches of Chinese scholars on Internet finance mainly focus on the business mode, development issues, regulatory measures and legislation, while the researches on the application and innovation of big data technology in the supervision system of Internet finance are slightly insufficient. Now the era of informatization and data has arrived, This paper uses panel regression model to analyze the influence of existing financial supervision system on the development of Internet finance, then puts forward innovative ideas of applying big data technology to the supervision mode of Internet finance and other suggestions and measures, so as to promote the coordinated and synchronous development of China's Internet finance and supervision system and provide new vitality for China's economic development.

3 Research Design

3.1 Research Hypothesis

China's current Internet finance industry is mainly supervised and managed by the People's Bank of China, China Banking and Insurance Regulatory Commission, China Securities Regulatory Commission, Cyberspace Administration, the Ministry of Industry and Information Technology, the Ministry of Justice and other departments. In July 2015, People's Bank of China and other ten ministries jointly issued *the guidance on promoting the healthy development of Internet finance* for the first time, defined what Internet finance is, and divided it into Internet payment, online lending, equity crowdfunding, Internet fund sales, Internet insurance, Internet trust and other major Internet financial forms. The guidance clear the specific business boundary, and the Internet finance has been formally subsumed into the regulatory framework ever after. However, since 2015, various kinds of Internet financial risk events occur in China gave rise to widespread social concern. Subsequently, the regulators began to develop a series of correction, rectification and preventive policies, provide operational guidance for Internet financial enterprises, increase legal punishment mechanisms, make future planning of China's Internet financial industry development. Since the operation of China's Internet finance supervision work, P2P online lending mode has been fully transformed, third-party payment mode and Internet insurance mode may face a tendency of merger and reorganization due to the significant decelerate of license granting.

Internet finance must be in a proper regulatory environment to develop healthily. In recent years, although various regulatory bodies have issued a series of policies to control the risks of Internet financial activities, due to the rapid development of Internet finance, the industry has gradually emerged some problems, such as frequent information leakage

events, weak risk control ability of financial platforms, and high crime rate of Internet finance. Then, can the existing financial supervision system play a regulatory role in the development of Internet finance and promote its healthy development? How strong is its influence on the development of Internet finance? Does the existing regulatory system need improvement and innovation? For these problems, this paper makes the following two hypotheses based on the existing regulatory framework of Internet finance:

Hypothesis 1: The existing regulatory system has been unable to meet the regulatory needs of the development of Internet finance.

Hypothesis 2: The regulatory system needs further improvement and innovation to promote the development of Internet finance.

3.2 Model Building

In order to verify the above assumptions, this paper constructed a panel data regression model for empirical analysis and conducted logarithmic processing on the data, the specific model is as follows:

$$\ln INF_{it} = \beta_0 + \beta_1 \ln FR_{it} + \beta_2 \ln TL_{it} + \beta_3 \ln EL_{it} + \beta_4 \ln CL_{it} + \varepsilon_{it} \quad (1)$$

Among them, i represents province, t represents year, INF represents development level of Internet finance, FR represents regional financial supervision intensity, TL represents technology level, EL represents economic development level, CL represents credit level, and ε_{it} is a random error term.

3.3 Index Selection

3.3.1 Explained Variable

Internet Finance Development Level (INF): At present, the most authoritative index to measure the development level of Internet finance in China is the Internet Finance Development Index released by Peking University. However, as the data of this indicator is only updated to 2015, it cannot be used for quantitative analysis. Therefore, this paper takes the third-party Internet payment scale data, which accounts for a large proportion of Internet finance and has relatively standardized statistics, as an indicator to measure the development level of Internet finance.

3.3.2 Explanatory Variable

Financial Supervision Intensity (FR): This paper adopts the ratio of regional financial supervision expenditure to the added value of the financial industry as an indicator of regional financial supervision intensity.

Table 1. Descriptive statistical results of variables

Variables	Obs	Mean	S.D.	Max	Min
lnINF _{it}	217	28.093	1.405	30.495	25.159
lnFR _{it}	217	11.106	1.293	14.292	6.551
lnTL _{it}	217	9.599	1.537	12.470	4.152
lnEL _{it}	217	10.825	0.419	12.011	10.035
lnCL _{it}	217	10.123	0.871	11.997	6.981

3.3.3 Control Variables

In order to improve the reliability of the model estimation results, other major factors affecting the development of Internet finance are considered in this paper, mainly including: ① **Technology level (TL)**: The innovation of Internet finance is influenced by big data and Internet technology. In this paper, the application number of invention patent, utility model patent and appearance patent are selected, and the index obtained by weighting the application number of these three patents is used to represent the technical level (the weight ratio of the three patents is 0.5:0.3:0.2). ② **Economic development level (EL)**: per capital GDP of each region is used to represent. ③ **Credit level (CL)**: it is expressed by the loan balance of financial institutions in each region.

3.4 Data Sources

Considering that 2013 is the first year of The development of Internet finance in China and the availability of sample data, this paper selects the panel data of 31 provinces and cities in China from 2013 to 2019. Among them, the development level data of Internet finance are mainly collated according to the data provided by iResearch, a relatively recognized authoritative institution at present. The data of explanatory variables and control variables are mainly from the National Bureau of Statistics, CSMAR and *China Financial Yearbook*. The descriptive statistical analysis of each variable is shown in Table 1.

4 Analysis of Empirical Results

In the regression analysis of panel data, panel unit root test for each variable is carried out first (since this method has been relatively mature and is the basic step of panel model estimation, it will not be described in this paper). In terms of model selection, there are mixed regression model, fixed effect model and random effect model. In this paper, Stata16.0 was used to conduct F test on panel data, and the result was $F(4,182) = 499.88$, P value = 0.000 < 0.05. Therefore, the null hypothesis should be rejected and the fixed-effect model should be selected. In addition, the modified Hausman test results show that the P value is 0.000, which also rejects the null hypothesis, indicating that the random effects model should be rejected and the fixed effects model should be selected. Based on this, this paper chooses the individual fixed effect model for regression analysis, and the regression results are shown in Table 2.

Table 2. Results of regression estimation

Variables	Models	
	(1)	(2)
lnFR _{it}	0.380*** (3.280)	0.059 (1.620)
lnTL _{it}		0.181*** (4.280)
lnEL _{it}		2.621*** (4.530)
lnCL _{it}		3.202*** (9.010)
constant	23.869*** (18.500)	-35.085*** (-11.390)
Control variables	NO	YES
R ²	0.055	0.917
Individual fixation effect	YES	YES
N	217	217

Note: the values in brackets are the t values of the estimated coefficients. *, ** and *** mean significant at the statistical level of 10%, 5% and 1% respectively.

Model (1) only considers the impact of financial supervision intensity on the development of Internet finance without controlling variables. It can be seen from the estimation results that the variable coefficient of financial supervision intensity is positive and significant at the level of 1%. However, under this condition, the goodness of fit of this equation is only 0.055, indicating that this equation cannot well explain the development of Internet finance, nor can it indicate that the intensity of financial supervision can meet the regulatory needs of the development of Internet finance in China and promote its development.

Model (2) considers the impact of technology level, economic development level and credit level on the development of Internet finance. It can be seen from the regression results that the goodness of fit of this model is 0.917, which can well explain the influencing factors of the development of Internet finance. At the same time, although the variable coefficient of financial supervision intensity is positive, it is not significant at the level of 10%, which indicates that the existing Internet financial supervision has no regulatory effect on Internet finance and promotes its healthy development. Hypothesis 1 is verified. In addition, the estimated coefficients of technology level, economic development level and credit level are positive and significant at 1% level. This indicates that the technological level, economic development level and credit level are all conducive to the development of Internet finance in China, and further indicates that the existing financial supervision system must be innovated to play a regulatory role in Internet finance again. Hypothesis 2 is verified.

In general, the regression estimation results of the two models are relatively credible, and China's existing regulatory system has been unable to meet the development needs of Internet finance. In the process of the China regulatory system governance of various problems in recent years, we can find that the existing regulatory system has the following deficiencies. On the one hand, there is a lack of contact between regulatory subjects and a low degree of data sharing. Although different regulatory bodies have their own access to data, they do not share data through cooperation. The occlusion of information between regulatory bodies not only increases the consumption of regulatory funds, but also increases the regulatory time and delays the progress of problem handling and resolution. On the other hand, regulation lags behind. In 2007, online lending platforms appeared in China, but it was not until 2015 that relevant departments issued control policies targeted at P2P lending. The eight-year regulatory vacancy directly led to the brutal development of P2P platforms, increased the difficulty of follow-up governance as well as the consumption of social resources. It is the failure to timely detect the risk factors in the Internet financial market that seriously delayed the regulatory speed. Financial supervision system must be innovated in order to adapt to the development speed of Internet finance and promote its healthy development. Then how to innovate the existing supervision system? Big data technology would be a good choice.

5 Analysis of the Innovation of Internet Financial Regulatory System Promoted by Big Data Technology

Big data technology application mode, simply can be divided into four levels: the first level is big data collection, which mainly refers to the collection of structured and unstructured massive data from big data infrastructure, intelligent terminals, APPS and other aspects. Currently, Sqoop and ETL technologies are popular. The second layer is big data processing, that is to clean, extract, classify and integrate the collected massive data, so as to improve the quality and value of data. The third layer is the storage of big data, which is to store processed data into a database for future use. Currently, Hadoop HDFS, Tachyon and KFS are commonly used. The fourth layer is the analysis and application of big data, mainly using visual analysis, data mining algorithm, predictive analysis, semantic engine, data quality management and other methods to extract and analyze the data in the database, to make inductive reasoning and help the management to make reasonable and correct decisions. These four levels constitute the core technology of big data operation, and are also the basis for the extended application of big data technology in various industries. The innovative ideas of Internet financial supervision system proposed in this paper based on big data technology are also inseparable from these four levels, which can be summarized as the following three points.

5.1 Build a Big Data Supervision Model Featuring Connectivity and Information Sharing

Internet finance mainly uses Internet platforms and applications to conduct online transactions. Transaction subjects cover multiple fields and industries, and the content and forms are complex and diverse, which leads to a significant increase in the difficulty of

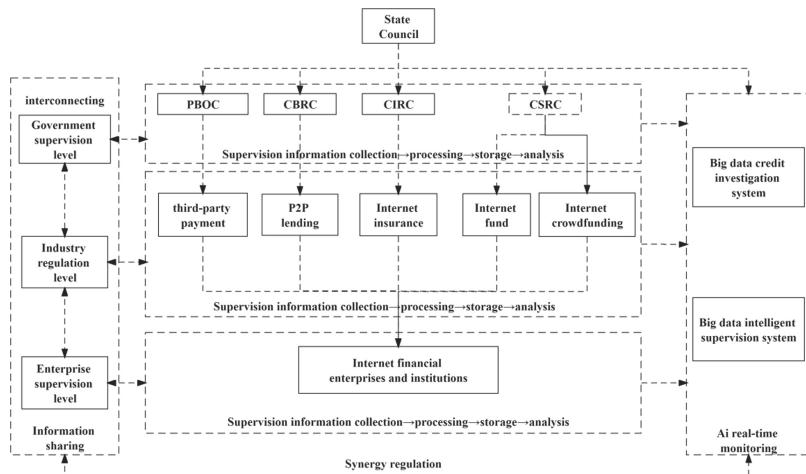


Fig. 1. Internet finance big data regulatory system concept diagram

supervision, traditional supervision methods can no longer meet the regulatory needs of Internet finance. Therefore, for the supervision of Internet finance, we should give full play to the online and off-site supervision role of big data technology, and build a big data supervision mode of interconnection and information sharing. According to China's current Internet financial regulatory system, we can divide Internet financial regulatory bodies into government regulatory bodies, industry regulatory bodies and enterprise regulatory bodies. Each regulatory body should first define its own regulatory responsibilities and regulatory scope, and shall collect, process, store and analyze the Internet financial regulatory information at its own level in accordance with the application mode of big data technology, and identify the risks and loopholes that may arise from Internet financial business and take corresponding measures in a timely manner. Finally, all regulatory bodies should maintain data and information exchange at all times, achieve interconnection and information sharing among government, industry and enterprises, ensure timeliness and accuracy of all layers' access to regulatory information, and establish a unified and interconnected big data supervision model, so as to achieve penetrating supervision of Internet finance. The specific process is shown in Fig. 1.

5.2 Build a Multi-level Intelligent Supervision System for Big Data

Under the current regulatory framework of Internet finance in China, the regulatory bodies are not strong in information collection, processing and analysis. Therefore, some financial risks are often discovered late or supervision fails, which may even lead to serious consequences. For such problems, the emergence of big data artificial intelligence technology will be a good solution. Regulatory bodies at all levels should fully recognize the importance of artificial intelligence and apply it to the interconnected and information-sharing big data supervision mode to realize the combination of artificial supervision and intelligent supervision means. Therefore, government departments should develop an authoritative and unified intelligent big data supervision system, which

can simultaneously assist the government, industry and enterprises to collect and process Internet financial supervision information and improve their information mining ability and efficiency. In addition, the system should also make real-time analysis of the regulatory information collected by various regulatory layers, give timely warning of possible risks and loopholes and feed back to various regulatory bodies, so as to realize the coordinated supervision of big data regulatory mode and intelligent regulatory system. The specific process is also shown in Fig. 1.

5.3 Establish a Comprehensive and Secure Big Data Credit Investigation System

Western developed countries have more mature experience in dealing with Internet financial supervision than China. The key reason is that they have a sound credit system as a support, which improves the efficiency of Internet financial supervision. On the contrary, although China's current Internet finance is booming, the construction of credit investigation system is relatively backward. The new forms and transactions of Internet financial services have generated a large amount of user information and credit data, but they are dispersed in the government and Internet financial enterprises, the sharing, unification and protection of user credit data at all levels are not realized, thus it is very easy to cause user information leakage and other security problems. Therefore, the government should encourage regulatory bodies at all levels to share user credit data, coordinate the interests of financial institutions, and use big data technology to establish a comprehensive and safe big data credit investigation system, so as to provide strong support for the successful construction of the big data supervision system of Internet finance.

6 Conclusion

In the era of big data and information, the development of Internet finance is like a moving train. Although the speed is extremely fast, it must travel on the track of supervision to reach the final destination. We should realize that big data technology provides a broad space for the innovation and development of Internet finance, and also provides information and technical support for the innovation and improvement of Internet finance regulatory system. A perfect and unified financial regulatory system will not curb the innovation of Internet finance, but provide sufficient soil for the growth of financial innovation while ensuring the stable development of Internet finance. China should attach importance to the innovative application of big data technology in the Internet financial supervision system, improve the legislation of big data supervision as soon as possible, create an interconnected and information-sharing Internet financial big data supervision model, realize the collaborative supervision with artificial intelligence, and provide guarantee for the healthy growth of China's Internet finance!

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