Research on Regulation of Personal Financial Data Sharing in Open Banking

Yingsi Chen [a*]

[a] School of Law, Anhui University of Finance and Economics, Anhui, China.

Author's contribution

The sole author designed, analyzed, interpreted and prepared the manuscript.

Mini-review Article

ABSTRACT

Open banking is a platform-based and ecological business model based on data sharing, which has the characteristics of "disruptive innovation". The value of data is mainly reflected in the fusion and mining on the basis of sharing, and the essence of open banking is data sharing. As a new key production factor driving the development of financial industry in the era of digital finance, personal data still has many challenges in the practice of open banking, such as data leakage risk, data sharing authorization risk, correlation risk of data sharing with third-party institutions, and lack of supervision risk. Based on the word frequency statistics and comparative analysis with non-bank financial institutions, the empirical study shows that China's banking industry has significantly increased the construction of open banking since 2018, among which banks with poor profitability and high risk level regard open banking as an important direction of transformation and upgrading. However, open banking also brings new risks such as data leakage and network security and the empirical results also confirm that open banking construction significantly improves the probability of bank violations. Combining with the existing three types of compulsion, such as Self-regulatory, Self-regulatory I and boost the regulatory, this paper argues that it is suitable for our country to adopt the boost regulatory mode.

_____

Corresponding author: Email: yingsichen119@gmail.com;

1. INTRODUCTION

Reviewing the development process of the banking industry, the development and reform of the banking industry can be roughly divided into three main stages: The first stage, business promotion and scale expansion with physical network services as the center of business expansion; In the second stage, with the development and maturity of the Internet, the banking industry began to establish channels, find solutions and seek solutions by itself, and develop online banking and mobile terminal banking to replace some branches and outlets to enhance and improve user experience; The third stage is based on the rapid development of financial technology and the continuous emergence of innovative products, the banking industry began to enter the open banking stage characterized by "openness, integration and sharing" [1]. In 2004, PayPal launched and issued the PayPal application programming Interface, which was the initial attempt of open bank construction. In 2011, Credit Agricoles began to provide SDK and application service, and the data opening based on SDK and API application program interface attracted the attention of the industry [2].

At present, the academic community has not reached an authoritative consensus on the concept of open banking. Some scholars believe that open banking is a platform cooperation paradigm, which enhances customer experience by using open application programming interface (API) technology to realize data sharing between banks and third-party institutions. Some scholars believe that open banking is a user-centered and scenario-based financial service platform. Open banking integrates and integrates internal and external resources through API or SDK, and supports big data and other technologies to make banks more convenient, intelligent and open [3].

A more commonly recognized definition comes from Gartner. "Open banking is not a traditional bank, but a business paradigm in which banks share data and algorithms with third-party institutions through the financial ecosystem to provide better services for financial consumers and third-party institutions. It enables banks to create more value than traditional banking business on the basis of fintech to enhance their competitiveness [4].

Personal financial data is an extension of personal data in the financial field, and some scholars call it personal data of financial institutions. According to the existing laws and regulations on the definition of personal financial data, the core concept is "financial institution". Financial institutions are the actual controllers and processors of personal financial data. This is one of the important characteristics that distinguish personal financial data from ordinary personal data. In addition, due to the financial attributes of personal financial data, it also has the characteristics of high value, high sensitivity, high publicity and complexity. However, with the development of fintech and big data technology, more and more personal data have begun to be transformed into personal financial data. There are two reasons: first, with the development of digital finance, the scope of data that can be identified, integrated and processed by financial institutions is gradually expanding; Second, due to the great value that financial data analysis can bring, driven by interests, financial institutions have an expanded demand for collecting personal data. Many data that are not in the scope of data collected by traditional financial institutions are also included in the scope of collection by financial institutions and become personal financial data. However, not all the data processed by financial institutions are personal financial data, and there are also general financial data. The difference between the two lies in "individual", the former is the financial data generated by the activities of individuals. The difference in legal attributes between the two is that personal financial data have both property rights and personality rights, while general financial data only have property rights and no personality rights. The difference between the two in the value goal of protection is that the legal protection of personal financial data focuses on safeguarding the rights and interests of individuals, while the legal protection of general financial data is mainly safeguarding the data rights and interests of financial institutions.

The development of Internet technology has changed all aspects of production and life, and also brought major changes in the financial field. Digital finance is the product of the combination of Internet technology and financial market. The development of digital finance promotes the value of data to be mined and recognized, and data sharing has become a hot topic. Open banking is the product of the rapid development

of fintech and the increasing value of data. It is based on data sharing between banks and third-party institutions to carry out innovation and development of financial services. At the same time, the research and regulations on the use of personal financial data in open banks are relatively backward in our country, which cannot meet the needs of current development.

Consumer data sharing is the premise and foundation of open banking, and some scholars even believe that its essence is data sharing. As a symbol of the banking industry entering the 4.0 era, it broke the boundaries of banks, non-bank financial institutions and non-financial institutions, subverted the traditional financial service mode, and was called the "Copernican Revolution" in the banking industry. As a new thing, the unknown is greater than the known, the academic discussion of its supervision is still in its infancy, especially the choice of supervision mode. Based on the basic dimensions of promoting data sharing to stimulate the advantages of open banking and preventing and regulating the risks derived from it, this paper examines the challenges faced by traditional supervision, compares the three existing supervision modes to meet the challenges, explores the supervision mode that meets the needs of open banking data sharing and the reality of China, and tries to propose the improvement of supervision system under this mode.

2. TYPES OF OPEN BANKING AND TYPES OF PERSONAL FINANCIAL DATA SHARING RISKS

2.1 Types of Open Banking

Data sharing is a core feature of open banking. The main value of open banking is to further enhance the value of data through data circulation, transmission and sharing. With the rapid development of computer network technology and artificial intelligence technology, financial business gradually develops towards the direction of data centralization and business digitalization, and the magnitude of customer, transaction, management and behavioral data has significantly increased. There is a large space for banks to use data assets, and the economic value contained in financial data needs to be further explored. It can be predicted that in the era of big data, data sharing is an inevitable trend of the digital development of the financial industry. In addition, data sharing can effectively reduce the cost of financial services, and provide consumers with more accurate and personalized services while promoting the coordinated development of the financial industry.

Open banking builds a new "finance-technology" network platform based on information network system. As a collection of commercial banks, fintech enterprises, financial customers and many other subjects, this network platform provides a basic framework of technology and business model, laying a foundation for data sharing. By constructing a new "finance-technology" network ecology, open banking expands the boundary of traditional banking, shapes a new business scene, and speeds up the acquisition of external traffic resources and customer data value by banking and other forms of business. Network platforms use cloud computing, big data, Internet of Things and other emerging technologies to provide open financial services, build a symbiotic financial ecosystem, effectively form a collaborative operation situation of multiple businesses, and finally realize the integrated development of finance and science and technology industries.

2.1.1 Open banking driven by regulation

Open banking in Europe is mostly regulation-driven and develops as the regulatory framework is established and improved. Taking the UK as an example, it is a pioneering force in the development of open banking in Europe and even the world. In 2014, the Competition and Markets Authority of the UK conducted a survey on the banked market. The survey showed that several major banks in the UK formed a monopoly in the market based on their huge data base, and the market competitiveness was insufficient and the cost of banking services was too high, which was not conducive to the long-term healthy development of the banking industry. In order to solve the above problems, one of the measures proposed by the British government is "open banking". In 2015, led by the British Treasury, the British government established a special working group on open banking, which was responsible for conducting research and experiments on the framework, standards, implementation plans and other aspects of open banking. In August 2016, the UK's nine banks were required by the Competition Commission to allow licensed companies to share data. Subsequently, the nine banks reached a consensus to jointly fund the open banking plan, which was officially put into

practice in 2018. The practice of open banking in the UK is jointly managed by the Financial Conduct Authority of the UK, the Treasury and other government departments, and relevant businesses are changed under the guidance of the government according to different market conditions. For example, the government issued the latest standards for open banking services in response to COVID-19 during the epidemic and banks put them into practice. As of August 2021, there were 151 institutions on the UK Open Banking whitelist, mainly commercial banks and third-party institutions, and the number is continuing to rise [5].

2.1.2 Market spontaneous open banking

The degree of marketization in the financial field of the United States leads the world, and its financial development level and fintech level are also among the top in the world. The development of open banking in the United States is spontaneously promoted by the market. In 2016, Citibank set up a global API developer Center, officially starting the practice of open banking. Developers can call some API interfaces through the center to realize data sharing. [6] J.P. Morgan Access, the bank's global online banking platform, has also opened APIs to provide end-to-end integration. Subsequently, on the basis of the market's first response, the Federal Financial Consumer Protection Bureau, the financial regulatory authority of the United States, issued nine financial data sharing guidelines in 2017 to provide practical guidance and theoretical support for the development of financial data. [7] Accordingly, as the mainstay of the development of open banking in the United States, the United States has formed middle-level enterprises with data circulation and technology support, actively providing support for the establishment of links between banks and third-party institutions, promoting the vigorous development of third-party institutions such as e-commerce and fintech, and promoting the innovation of financial products and services.

2.2 Risks of Personal Financial Data Sharing

2.2.1 Risk of data breach

According to Cybersecurity Ventures, global losses due to cybersecurity incidents such as data breaches will reach $6 trillion by 2021. At present, the legal system of data sharing in our country is still not perfect, which brings great security risks to data sharing. In the process of open banking data sharing, real-time data and core data are involved, and core data such as customers' personal property information, personal identity information and personal biological information may be leaked [8]. The existence of open banking mode will objectively lengthen the chain of data storage, transmission and use. If there are weak links in supervision and compliance or design defects in this process, it is highly likely to be attacked by malicious attacks, leading to data leakage. In addition, with the increase of data dimension and volume, as well as the progress of processing technology, data processing and transmission standards that were considered safe and reliable in the past may become unreliable, and desensitization data may be reverse restored, causing data security risks [9].

2.2.2 Risk of unauthorized or beyond authorized data sharing

The premise of data sharing is the control of data, and its essence is the expansion of the scope of data controllers. This process involves the circulation of data property and the process of repeated collection and utilization of personal information. Once there is a lack of norms, data sharing may get out of control, leading to the abuse of personal information. Data use is out of the control of consumers and goes against their original intention. Personal financial data sharing is the secondary use of personal data, and the secondary use should conform to the purpose and scope authorized by consumers at the time of initial data collection. However, in practice, the usual trick of financial institutions is to obtain the authorization of users by means of "generalized authorization" and "overlord clause", so that financial institutions have more room for interpretation when sharing personal data, making consumers lose the right of self-control over personal data.

2.2.3 Correlation risk of sharing data with third party institutions

First, the new "finance-technology" network platform constructed by open banks involves many subjects, and there is the possibility of being shared again by the shared, so its boundary is relatively vague. Some banks will even relax risk control for third-party subscribers in order to expand their business scale. The risks here include technical risks, data compliance

risks, financial risks, business risks and many other types. These risks are highly contagious in an open banking system. Second, there are great differences between commercial banks and third-party institutions in their attitude towards risk and their ability to deal with it. Banks focus on risk management, while technology enterprises pay more attention to customer experience. Many third-party institutions have shortcomings in technology level, network security protection level and data sharing ability. [10] In open banking, third-party institutions often become the source of risks, and a large number of banks' transaction interfaces are associated with third-party institutions. Once the system of the third-party institution is breached, it will bring great data loss to the bank. Third, in open banking, the relevant risk exposure increases, the links become more and the chain is extended. Among them, how to allocate and clarify the risk management obligations of each subject becomes more difficult. When customers' information rights and interests are infringed, how to determine the responsible person and effectively protect their rights will also become very difficult.

2.3 Open Banking Development Trend Analysis and Operational Risk Analysis

2.3.1 Development trend analysis

With the rapid development of information and communication technology (ICT), a series of new economic formats represented by digital economy have been born. Among them, facing the impact of the wave of digital economy, the traditional economic and financial industry is facing great challenges and transformation pressure, and open banking has become a self-innovation of the banking industry to cope with the wave of digital economy. In order to better understand the development trend of China's open banking in recent years, this paper first takes China's listed banks as samples and constructs relevant indicators of open banking. [11].

Considering that the core of open banking is to realize data sharing through API, and data processing should be the key technology involved in open banking, this paper only selects the word frequency related to big data (and big data and cloud computing) in the annual reports of listed banks in China and performs logarithmic processing on them as the measurement index

Digital1 (and *Digital2*) of the development degree of open banking.

Considering that the concept of open banking in China was only put forward in 2012, this paper chooses the samples from 2013 to 2020 for analysis. It is worth noting that in 2018, as China's banking industry began to pay large-scale attention to and layout open banking, China's banking industry greatly improved its digital performance related to open banking, and the growth rate was significantly higher than that of non-banking finance. Based on this, this paper further constructs the following empirical model:

$$\mathbf{Digital_{it}} = \mathbf{\beta_0} + \mathbf{\beta_1 Bank_i} \times \mathbf{Post_i} + \mathbf{\beta_2 ROA_{it}} + \mathbf{\beta_3 Equity_{it}} + \mathbf{\beta_4 Size} + \mathbf{\mu_i} + \mathbf{v_t} + \mathbf{\epsilon_{it}} \quad (1)$$

Among them, the explained variable is the digital performance related to open banking, including the word frequency *Digital1* related to big data in the annual report and the word frequency *digital2* related to big data and cloud computing. The explanatory variable is the interaction term *Bank×Post*, and *Bank* represents the dummy variable of whether it is a bank or not, which is 1 for bank samples and 0 for non-bank financial samples; *Post* indicates whether it is a dummy variable for the year 2018 and after, with 0 for the samples before 2018 and 1 for the samples after 2018. Control variables include profitability (*ROA*, return on total assets), leverage level (*Equity*, the ratio of equity to total assets), *Size* (Size, the logarithm of assets in total assets), and *year* and *individual fixed effects*. The primary terms *Bank* and *Post* of the explanatory variables *Bank×Post* are also absorbed by individual fixed effects and year fixed effects, respectively.

Table 1 reports the empirical test results of Model (1), from which it can be seen that the coefficient of explanatory variable *Bank×Post* is significantly positive at the level of 1%. This means that compared with non-banking finance, the digital performance of China's banking industry related to open banking has improved significantly since 2018. In economic sense, compared with non-banking finance, the digitalization performance of open banking in China's banking industry *Digital1* and *Digital2* has increased by 78%(=e0.575-1) and 87%(=e0.628-1) on average since 2018.

2.3.2 The multi-interest pattern of personal financial data

In general, operational risks are difficult to identify accurately ex ante. Therefore, this paper

uses ex-post identified violations as a measure of operational risk. On this basis, a two-stage regression model of instrumental variables is constructed for test. In the first stage, Model (1) is still used, and the interaction term Bank×Post is the instrumental variable of Digital. In the second stage, the impact of open banking on bank operating risk is tested through the following model:

$$Misconduct_{it} = \beta_0 + \beta_1 Digital_{it} + \beta_2 ROA_{it} + \beta_3 Equity_{it} + \beta_4 Size + \mu_i + v_t + \epsilon_{it} \quad (2)$$

Among them, the explained variable is whether there is a violation or not. The explanatory variables are the digitalization performance related to open banking, including *Digital1* based on the word frequency related to big data and *Digital2* based on the word frequency related to big data and cloud computing. The design of control variables is completely consistent with Model (1). Instrumental variable regression can not only avoid endogeneity problems such as missing variables and reverse causality, but also better clarify the potential impact of the rapid development of open banking on bank violation risk.

Table 1. The development trend of open banking

	(1)	(2)
	Digital 1	**Digital 2**
Bank×Post	0.575***	0.628***
	(0.129)	(0.136)
ROA	0.565*	0.520
	(0.309)	(0.337)
Equity	0.0445	−0.106
	(0.284)	(0.308)
Size	0.0722	0.0890
	(0.0554)	(0.0574)
Year/Firm FE	Yes	Yes
R²	0.737	0.730
Obs	710	710

*The standard error of enterprise clustering is in parentheses, and***, ** and * indicate significance at the levels of 1%, 5% and 10%, respectively*

Table 2 reports the empirical results based on the above instrumental variable regression model, from which it can be seen that the coefficients of explanatory variables *Digital1* and *Digital2* are significantly positive. This means that compared with non-banking finance, the digital transformation related to open banking significantly increases the probability of bank

violations, thus indicating that open banking does exacerbate bank operational risks.

Table 2. The impact of open banking on bank irregularities

	(1)	(2)
	IV=Bank × Post	
	Misconduct	
Digital1	0.246*	
	(0.135)	
Digital2		0.225*
		(0.123)
Year/Firm FE	Yes	Yes
Obs	710	710

*The standard error of enterprise clustering is in parentheses, and***, ** and * indicate significance at the levels of 1%, 5% and 10%, respectively*

2.4 The Generating Logic of Personal Financial Data Sharing Risks

2.4.1 The multi-interest pattern of personal financial data

The value and benefits of personal financial data are diverse. The personal data processing of financial institutions involves multiple interest subjects and diversified interests, forming a complex interest pattern. The conflict between the personal rights and property rights of financial consumers and the property rights and interests of financial institutions, the conflict between the property rights and interests of financial institutions and the public rights and interests of personal financial data, and the conflict between the personal rights and interests of financial consumers are the most fundamental reasons for the risk of personal financial data sharing [12]. Personal data protection initially comes from the personal dignity and freedom interests of data subjects. With the improvement of data value, the property attributes of personal data bring specific commercial benefits to financial institutions. Financial institutions invest a lot of human, material and financial resources to collect, analyze and process personal data, so that the value of data can be fully mined. The value of these data condenses the undifferentiated labor of financial institutions, so they enjoy the property interests of personal data [13]. It will not only affect the research and development of financial products and the provision of financial services, but also affect the welfare of all social members. In the fields of anti-money laundering, anti-terrorist financing and credit investigation, personal data also

carries the mission of safeguarding social and public interests. Therefore, the construction of the legal system of personal financial data sharing should consider the realization of multiple interests and values.

2.4.2 The imbalance of power among financial institutions' personal data stakeholders

In the process of personal data processing of financial institutions, financial consumers, financial institutions and financial regulatory authorities are involved, and the power among interest subjects is seriously unbalanced. Among them, financial consumers are in an absolute weak position, and financial institutions and regulatory authorities also present serious data asymmetry problems in data processing.

Financial consumers are in an absolute weak position in the personal data processing relationship. In the financial transaction relationship, financial institutions play a dominant role. The integration of finance and technology makes financial products more and more technical and professional, and financial institutions have a large number of professional and technical personnel, coupled with their own increasingly perfect structural system and operational functions, they occupy a dominant position in financial transactions. When receiving financial services, financial consumers must agree to and accept the content of the standard contract provided by financial institutions, otherwise they cannot accept financial services, which virtually undermines the right of self-determination of financial consumers. Secondly, there is information asymmetry between financial consumers and financial institutions. The personal data provided by financial consumers is completely controlled by financial institutions. Financial consumers essentially lose control of their personal data, and there is no way to know how financial institutions handle their personal data and whether it is beyond the scope of authorization [14]. It is often only after a personal data breach leads to serious consequences that financial consumers become aware of the problem.

The problems of technology asymmetry and information asymmetry between financial institutions and financial regulators. On the one hand, the development of data technology in

financial institutions is ahead of the financial regulatory authorities. Personal data can create huge wealth. In order to improve competitiveness, financial institutions have mastered massive personal data of financial consumers and invested a lot of human, material and financial resources to improve data technology. In terms of financial data technology, financial institutions have the advantages of talent, capital and data accumulation, while financial regulators are at an obvious disadvantage [15]. On the other hand, the asymmetry of technology intensifies the information asymmetry between the two sides. Faced with the rapidly changing personal data processing of financial institutions, it is necessary to improve the big data technology of financial supervision departments, otherwise, the information asymmetry between supervision departments and financial institutions will become more and more serious.

2.4.3 The spread of financial institutions personal data processing

The development of data processing technology not only enables the financial industry, but also generates new financial risks. The real-time and high-speed processing of data intensifies the diffusion effect of financial market risks. The spreading risk of personal data processing in financial institutions is mainly manifested as the instantaneous data processing, the concealment of processing risk and the systematization of risk transmission. The incompleteness of technology causes risks in financial data security. Hackers will use network security vulnerabilities to carry out network attacks, or implant Trojan virus, send spam and other threats to network security [16]. Financial data processing depends not only on hardware, but also on algorithm. Algorithm is the key to realize automatic data processing. However, the black-box operation of algorithm leads to the lack of transparency of the whole data processing process, which seriously violates the right to know of financial consumers. The immediacy and transmission effect of data processing will lead to systemic financial risks. High-speed and real-time data processing can complete hundreds of millions of calculations in an instant and spread rapidly on the network [17]. On the positive side, it can greatly improve the efficiency of data processing while reducing costs, and on the negative side, the results of data processing will quickly produce a chain reaction of transmission, resulting in real-time risks.

3. REGULATORY CHALLENGES AND REGULATORY MODEL CHOICES FOR OPEN BANKING PERSONAL FINANCIAL DATA SHARING

3.1 Regulatory Challenges of Open Banking Personal Financial Data Sharing

3.1.1 The inadaptability of regulatory supply

First of all, the sectoral legislative supply and the supervision object of the cross-sectoral dislocation. Open bank data sharing is neither a matter of pure financial law nor a matter of pure data law. However, in the sectoral legislative system, regulatory agencies often dominate the legislative process, and the interests of their own departments are embedded in the relevant system design, forming mutually separated legal silos, which are difficult to interweave into a tight legal network, leaving a large number of legal loopholes, providing space for regulatory evasion and arbitrage, and the risk spillover effect cannot be effectively regulated. Secondly, there is a mismatch between the remedial legislative thinking and the disruptive innovation of open banking. The deepening of legislators' understanding of new things is a gradual process, and it is not easy to change the cognitive inertia. This determines that law is a compromise product of conservatism and innovation. Legislation is often manifested as a repair on the basis of old law, which is difficult to break through the original framework. This is effective when the adjustment object changes little, but it cannot effectively deal with the fundamental change of the adjustment object. Finally, the pace of regulatory legislation and practice development is "disconnected." [18] Regulatory legislation often acts as an afterthought, designed to respond to previous crises rather than the next, and is always a step behind market developments.

3.1.2 A clash of regulatory thinking

The controlling thinking of traditional supervision is based on the traditional function positioning of market failure, which makes regulators stubbornly focus on risk prevention and disposal, and mostly adopt the "command-control" mode to reduce the negative externalities of economic behavior [19]. There is a double conflict between this thinking and open banking data sharing. On the one hand, the regulatory function is positioned unilaterally and only intervenes when there is externality risk due to market failure. However, open banking will reshape the traditional value distribution pattern, greatly improve consumer welfare, promote financial innovation and market competition. On the other hand, over-reliance on specific rules facilitates regulatory evasion. This thinking is mainly manifested as mandatory or prohibitive norms in legislation, which must be clear and specific, which gives the behavior expectation determined by the regulated. However, open banking is a continuous process of financial innovation.

3.2 Open Banking Personal Financial Data Sharing Supervision Modes

3.2.1 Compulsory supervision mode

Regulators pass legislation to force banks to share customer data with third parties, establish or designate specialized agencies to supervise data sharing, and implement centralized audit and certification for third-party access. It is mandatory to provide the consumer banking data held by the bank to a third party in accordance with the instructions of the consumer, which is its statutory regulatory obligation and shall not be refused without reason; Regulators play a leading role in the risk regulation of data sharing, especially the third party can participate in data sharing only if it has obtained regulatory certification identity. Specifically, this model has the following characteristics: first, supervision and legislation precede. The "mandatory power" of regulators to require banks to provide data to third parties at the behest of consumers must have a legal basis, which requires prior legislation to authorize it. Second, the structure of regulatory power allocation is relatively clear. This model has obvious constructive characteristics, that is, to reshape the interest pattern of all participants in data sharing with the external force of regulation. The consistency of regulatory positions and clear boundaries of authority and effective regulatory coordination are the key to unleash this external force and prevent the exercise of power chaos [20]. The third is to build a regulatory led third-party access certification mechanism. Sharing customer data between banks and third parties is fundamental to open banking, but forced sharing without security is irrational. Banks assume this obligation only if they know to whom it is appropriate and safe to share, and the authoritative certification of third parties by supervisors can effectively reduce the cost of bilateral audit and regulatory compliance. Fourth,

we should attach importance to the unification of technical standards. In the case of different data formats and different API design parameters, forcing data sharing will undoubtedly shift the coordination cost to all participants, which will greatly weaken the enthusiasm of participants. [21] Now that regulators are going to force banks to share data with third parties, they should provide uniform technical standards on how to do so. The elements of the model support each other: legislation containing a mandatory data-sharing obligation is the foundation; The allocation of supervision rights with clear division of labor and coordination is the guarantee; The third-party access certification led by supervision and unified technical standards not only guarantee the security of data sharing, but also support the "public goods" of sharing, which can reduce the cost of data sharing among participants and improve the efficiency of data sharing. The model originated in the European Union and the United Kingdom, followed by Australia and followed by Brazil, Mexico and other countries.

3.2.2 Self-regulatory mode

The regulator shall remain neutral in the data sharing between the bank and the third party, and decide whether to share or not independently. The bank shall review the access qualification of the third party by itself, and clarify the method, scope, legal liability and other matters of data sharing through the contractual framework. In this model, regulators show obvious self-restraint: they do not force banks to share data with third parties, but subject them to private-law cooperation agreements; There is no intention to build a centralized third-party access certification mechanism and unified technical standards. On the whole, the self-regulatory model has distinctive market spontaneity and decentralization, and its specific characteristics are as follows: there is no special law for open bank data sharing, and the current legislation does not force banks to share customer data with third parties; In terms of regulatory power allocation, there is no designated agency for centralized supervision of data sharing, but general supervision by institutions responsible for financial consumer protection and data security, often with weak strength. Regulators are not responsible for third-party access certification, but banks themselves review and establish cooperative relations; Without unified technical standards, large banks or technology companies formulate their own data, API and security

standards, and partners need to constantly adjust their own systems and technologies to achieve compatibility and connection with different standards and systems. The United States, which represents the model, has yet to introduce any formal legal document, and the Treasury has stated that it has no intention of introducing a formal institutional framework like that of the United Kingdom. [22] The main reasons are as follows: the competition in the retail banking market is fierce, and there is no significant incentive to promote the competition in the banking market through the open banking model; In practice, screen scraping is popular and not prohibited by law, becoming an important driver of its digital economy. If strict regulations are introduced, it may damage its international competitiveness; The coordination costs of forming a specialized regulatory framework under the two-tier long regime are huge. As one scholar observed, "the United States is probably one of the least likely governments in the world to enact open banking regulations" [23].

3.2.3 Boost the regulatory mode

Nudges are actually a system of choices that change people's choices or their economic incentives and behavior not by coercion but by prophecy. It is different from both liberalism and absolutism, but a kind of "liberal moderate absolutism". Under the Nudge supervision mode of open banking data sharing, although regulators do not force banks to share data with third parties, they take various flexible measures, supportive policies and infrastructure to actively guide and promote data sharing and risk management. On the one hand, regulators enhance the value recognition of banks and consumers on data sharing through default mechanism, persuasion and consultation strategies, and promote their endogenous willingness to share. On the other hand, we should actively build infrastructure, formulate unified technical standards, and issue third-party access certification guidelines with reference significance to provide public support for data sharing. As a middle way between compulsory and self-regulatory mode, its regularity is not as obvious as the former two modes. In general, the characteristics of Nudge supervision mode can be summarized as follows: there are often no new laws, and banks do not undertake the mandatory obligation to break through the existing legal framework in terms of customer data protection, management and sharing; The allocation of regulatory rights basically maintains

the original framework, but strengthens the responsibility of fintech regulators to monitor data sharing risks; Pay more attention to the formulation of technical standards, through consistent data, API and security standards, improve the compatibility of data sharing participants; Although there is no mandatory third-party access certification mechanism, regulators usually issue relevant guidelines; More attention is paid to infrastructure construction to boost data sharing, such as the construction of financial data API registry or data platform. Singapore and China's Hong Kong region are representatives of this regulatory model, and the Monetary Authority of Singapore believes that this more "organic" approach to the transition to open banking will be more successful.

4. CONCLUSION

Open banking is a platform-based and ecological business model, which takes data sharing as the foundation and core and leads the development process of data financialization and financial digitalization. "Bank" will no longer be the traditional institutional name, but a bank-as-a-service (BaaS), which is not only an intermediary of capital and credit, but also plays an increasingly prominent role as a data intermediary. Data sharing not only improves consumer welfare, promotes market competition and financial innovation, but also makes financial risks, data risks, business risks and technical risks interwoven, contagious and resonant. Traditional supervision is facing unprecedented challenges in legislation, thinking and mechanism, especially the disintermediation of banks and the ecosystem of services, which makes it difficult for traditional institutional supervision and macro-prudential supervision to adapt to the new situation. As an emerging business form emerging in recent years, open banking provides an important development direction for the traditional banking industry to cope with the competition of Internet and fintech companies in the era of digital economy. At the same time, in the face of China's economic transformation and high-quality development requirements, open banking has also become a key breakthrough direction of China's banking transformation. Since 2018, China's banking industry has significantly increased the construction of open banks, and banks with poor profitability and high risk level have vigorously strengthened the construction of open banks, in order to help their own transformation and upgrading.

In view of this, various countries have actively explored their regulatory response plans, and initially formed three regulatory modes: coercion, self-discipline and boosting, each with its own advantages and disadvantages. Taking the theory of governance as the analytical framework and based on the reality of China, the Nudge supervision model is more appropriate, which can better take into account the dual goals of promoting data sharing and risk regulation. Different types of commercial banks in China need to define the application strategies of open banking based on their own positioning. First of all, large commercial banks, by virtue of their scale, resources, technology and other advantages, have the ability to realize closed-loop operation in the open banking system, that is, to complete data sharing, technical support and format application at the same time. Secondly, due to the limitations of scale and business scope, it is often difficult for small and medium-sized banks to carry out too much business, so introducing more technology companies and institutions to cooperate may become the optimal development strategy under the open banking format.

ACKNOWLEDGEMENTS

COMPETING INTERESTS

Author has declared that no competing interests exist.

REFERENCES

1. Ye Chunqing. Open Banking—A new direction of bank transformation. Financial Technology Time. 2019;3:88.
2. Li Yan, Cai Kailong. A preliminary study on data sharing in open banking. China Banking. 2019;(7):31-33.

3. Lu Minfeng, Zhang Huan. Open banking: A study of historical status and future trends. Journal of Hunan University of Finance and Economics. 2018;34(6):5-11.

4. Zheng Qingmin, Li Lei. A brief discussion on the opportunities and challenges facing the construction of open banking. Contemporary Finance. 2020;4:34-36,33.

5. Yuan Jin-ming. Research on the data sharing model and supervision of open banks from the perspective of big data. Hainan Finance. 2021;5:46-54.

6. Chai Ruijuan, Tian Aoni. On the risk mitigation and institutional construction of introducing data portability in open banking scenario. Credit Reference. 2022;40(3):17-25.

7. Nicholls C. Open banking and the rise of fintech: innovative finance and function regulation. Banking and Financial Law Review. 2019;1:121-151.

8. Pascalis F. The Journey to Open Finance: Learning from the open banking movement. European Business Law Review. 2022;3:397-420.

9. Palmieri A, Nazera JB. Open banking and competition: An Intricate relationship. EU and Comparative Law Issues and Challenges Series. 2021;5:217-237.

10. Jones CI, Tonetti C. Nonrivalry and the economics of data. American Economic Review. 2020;110(9):2819-2857.

11. Dimachiki ME. More data and more data sharing: Navigating an Open Banking World. Journal of Digital Banking. 2019;3: 206-214.

12. Yang Dong. Supervising and regulating science and technology: Supervisory Challenges and Dimensional Construction of Financial Technology. Social Sciences in China. 2018;5:69-91.

13. Wu Fei, Hu Huizhi, Lin Huiyan, Ren Xiaoyi. Enterprise digital transformation and capital market performance: Empirical evidence from stock liquidity. Journal of Management World. 2021;37(7):130-144.

14. Yan Fan. The data sharing mechanism in financial supervision. Financial Regulation Research. 2020;10:53-68.

15. Yang Dong, Cai Renjie. Open banking: From data Siloed to Data Sharing Society. Financial View. 2021;11:55-57.

16. Blyth Toby. The new consumer data right and the open banking regime. Governance Directions. 2019;71(11):654-658.

17. He Zhiguo, Huang Jing, Zhou Jidong. Open banking: Credit market competition when borrowers own the data. Journal of Financial Economics. 2023;147(2):449-474.

18. Huang Wenchao. Personal financial data protection and governance: A perspective on data property rights of financial organizations. Science Technology and Law. 2023;(3):137-148.

19. Song Yi, Huang Jie. Data Governance System in European Union: The experience and implication. Journal of Modern Information. 2023;43(6):139-148.

20. Zang Guoquan, Xiao Yang. Research on sensitivity identification and privacy measurement of personal financial data. Information Studies: Theory & Application. 2023;2:1-14.

21. Luo Xianzheng. Bank economic forecasting and financial statistics under the background of big data. Industrial Innovation. 2023;7:124-126.

22. Yang Kang, Cheng Yang. Data risks of Fintech and the prevention strategies. Journal of Beijing University of Aeronautics and Astronautics. 2023;36(2):46-58.

23. Purwandari Betty, Indriasari Elisa, Prabowo Harjanto, Gaol Lumban Ford. Digital Banking: Challenges, emerging technology trends, and future research agenda. International Journal of E-Business Research. 2022;18(1):1-20.

Peer-review history:
The peer review history for this paper can be accessed here:
https://www.sdiarticle5.com/review-history/101229