

The Competition and Cooperation Relationship between Financial Technology and Commercial Banks

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Abstract

Purpose: This paper explored the competition and cooperation relationship between financial technology and commercial banks. The purpose of paper is to provide suggestions for dynamic competition and cooperation between fintech and commercial banks.

Design/methodology/approach: The competitive game analysis of fintech and commercial banks constructs the Hotelling model of differentiated competition between fintech and commercial banks, and uses the two-stage game model to concretely analyze their equilibrium decisions.

Findings: Financial technology companies can provide technical support to commercial banks. Commercial banks can provide funds and customer data for financial technology companies. Appropriate profit distribution ratio is important.

Research limitations/implications: The research method of this article is game theory. The cooperative game is incomplete. The hypothesis of game theory is rational, and it may not be consistent with actual facts. The current cooperation between commercial banks and financial technology companies is immature, so the cooperation model between traditional commercial banks and financial technology companies needs to be explored.

Practical implications: There is a lack of in-depth discussion of the interaction process. Therefore, this paper uses game theory analysis and discussion. Fintech and traditional commercial banks have different competing relationships because of their different dominant positions. Provide corresponding reference theory for their dynamic competition and cooperation development.

Originality/value: Fintech companies mainly focus on technology, and banks mainly focus on the diversity of financial services. Fintech companies use advanced technology to simplify financial business processes and improve business efficiency. Therefore, traditional commercial banks need to use financial technology to transform and innovate.

Keywords: Financial technology, commercial banks, Hotelling game model.

Introduction

With the gradual improvement of Internet technology, people are completely inseparable from the Internet in their daily lives. The number of Internet users has reached 854 million in China in 2020(Thomala, 2021). Customers are more willing to handle financial business online. The

Internet has not only been used to transmit information, it can also improve production efficiency, accelerate industrial integration, and reduce production costs (Kombe and Wafula, 2015). "Internet + Finance" is not only the integration of the traditional financial industry and the Internet, but also meets the financial business needs of a large number of customers (Zhang and Sun, 2017). Internet finance has had a great influence and scale effect in China. Internet companies represented by Taobao and JD.com have developed financial services with integrated platforms, and they have gradually occupied a large number of market shares in Internet finance.

Advanced technologies such as the Internet, big data, cloud computing, and blockchain have helped financial technology companies such as Alipay, P2P, and crowdfunding to develop rapidly. The development of fintech companies reached its peak in 2016, which has threatened the development of traditional commercial banks (Románova and Kudinska, 2016). Internet finance has the characteristics of fast payment, high capital allocation efficiency, and low capital matching cost (Frame, Wall and White, 2018). At the same time, it continues to innovate new products and new business models, which has seriously affected the business models and operating profits of commercial banks. Fintech meets 80% of the long-tail market needs, and it has a certain impact on the traditional business of commercial banks. Product differentiation competition has formed duopoly markets of traditional banking model and financial technology model (Thakor, 2020).

The Internet's wealth management channels gradually occupy the traditional financial wealth management market. Alipay's Yu'e Bao function combines technological innovation and financial innovation. The Yu'e Bao Currency Fund went online in 2013. In January 2014, depositors' deposits decreased by RMB 940.2 billion, and the balance of RMB deposits grew slowly in 2014 (Lu, 2018). At the same time, Yu'e Bao deposits reached 589.8 billion yuan in 2014, which reduced the profits of commercial banks (Aveni and Roest, 2017).

Internet finance can improve financial service innovation capabilities, reduce commercial bank operating costs and improve efficiency (Zhilai, 2015). And commercial banks provide financial technology with a large number of customers, data, and financial support (Hou, Gao and Wang, 2016). Although the financial technology model has forced commercial banks to transform and develop, commercial banks are still the core force of the financial market.

Fintech companies mainly focus on technology, and banks mainly focus on the diversity of financial services (Vučinić, 2020). Fintech companies use advanced technology to simplify financial business processes and improve business efficiency (Thakor, 2019). In addition, Internet finance can be used in multiple scenarios to quickly collect and process customer information (Zhang and Sun, 2017). However, the Internet financial business is highly risky and the risk control system is imperfect (Guo and Shen, 2016). Traditional businesses have mature business models and complete risk control systems. Commercial banks are slow to collect and process customer information and lack product innovation. Therefore, traditional commercial banks need to use financial technology to transform and innovate.

Therefore, how traditional commercial banks develop in fierce competition is an important issue. Therefore, in order to promote the sustainable and healthy development of traditional commercial banks, this article conducts in-depth analysis and research on the development strategies of traditional commercial banks and financial technology. Traditional commercial banks are innovating financial product innovation based on their own advantages and user needs. The cooperation between traditional commercial banks and financial technology companies is beneficial to the development of commercial banks.

Literature Review

The differences between financial technology and commercial banks

Internet finance uses search engines, big data, social networks and cloud computing technology to provide financial services, which greatly reduces the information asymmetry of the Internet financial market (Vučinić, 2020). Internet finance has effectively alleviated the problem of information asymmetry in financing. Although traditional financial companies have used big data services such as online banking. However, compared with Internet finance, traditional financial institutions have insufficient information collection and processing capabilities (Zhilai, 2015).

Information technologies such as big data and cloud computing can significantly reduce the cost of searching and matching financial transactions (Frame, Wall and White, 2018). In addition, Internet financial transactions are mainly online, and it only needs to pay fixed costs. Therefore, Internet finance can significantly reduce transaction costs. Traditional commercial banks need professional technology to reduce transaction costs, professional investigation and financial analysis to solve the problem of information asymmetry and diversify risks (Polyakova *et al.*, 2019). Internet finance and traditional finance have different payment methods. Traditional finance is a physical channel of payment, and Internet finance is the unification of a centralized payment system and personal mobile payment. Traditional financial institutions process information manually, which may cause information asymmetry and static information. Internet finance processes information and assesses risks through the Internet, it uses big data to match suitable currency investors and currency demanders (Piao and Lin, 2020). Internet search technology standardizes processing requirements, and it forms a dynamic sequence of financial market information in continuous time, and it provides dynamic pricing or dynamic probability of default risk for capital demanders, which has low cost. (Salampasis and Mention, 2018). Internet finance can directly match fund supply and demand online.

The impact of financial technology on commercial banks

Some researchers believed that financial technology increased the risks of commercial banks. Although traditional commercial online banks use financial technology to obtain more financial resources, commercial banks will face greater market risks (Xu and Cheng, 2017). Internet finance takes up a large amount of online customer resources, which reduces the original customer resources of traditional banks and improves operations risk (Hou, Gao and Wang, 2016). In addition, Internet finance promotes the marketization of interest rates, which increases the risk of bankruptcy and non-performing assets of commercial banks (Betz and Khalil, 2011).

Financial technology has mainly affected the liability business, asset business and intermediary business of commercial banks. Commercial banks can only develop loans and investment businesses when they obtain funds through deposit business. Therefore, expanding the deposit business of commercial banks can expand the scale of bank loans and investment (Polyakova *et al.*, 2019). Third-party payment, P2P and Internet financial management have severely affected the deposit business of commercial banks. The interest rate of bank deposits is relatively low compared with Internet financial management, so more customers are more willing to choose Internet financial wealth management products (Saksonova and Kuzmina-Merlino, 2017). With the rapid development of financial technology, more funds are absorbed by different channels. Traditional commercial bank deposits and wealth management products are threatened.

Asset business is the use of funds by banks to create profits. The bank loan process is complicated and the loan requirements are high, and traditional commercial banks cannot meet the loan needs of SMEs due to information asymmetry (Kammoun, Loukil and Loukil, 2020).

In addition, traditional commercial banks do not provide personalized services for many small and medium-sized enterprises. Internet finance makes up for the shortcomings of banks. It focuses on the needs of small and medium-sized enterprises and provides convenient and low-cost loan services for small and medium-sized enterprises and individuals (Agarwal *et al.*, 2020).

The intermediary business of China's commercial banks is mainly non-interest income business, which faces the competition of Internet financial business. Customers can use mobile phone software to complete transfers and payments. A large number of customers do not need to handle financial services through the bank, which leads to a decline in the income of the banking business (Wang, Liu and Luo, 2021). In addition, some Internet wealth management products have the characteristics of high return rates and fast withdrawals, which have attracted many individuals and investors in the market, and commercial banks have lost many customers. In addition, traditional financial institutions mainly serve high-income customers, ignoring the financial needs of low-income customers (Zhilai, 2015). In addition, commercial banks have low product yields and slow withdrawals, which reduces the income of intermediary services (Guo and Shen, 2016).

Fintech promotes the development of commercial banks

Financial model innovation also uses big data to develop and apply. A lot of resources and technology have been invested in research and development of financial technology services (Salampasis and Mention, 2018). Compared with financial technology, traditional commercial banks have poor ability to build models using emerging technologies (Guo and Shen, 2016). But commercial banks have very rich application scenarios, and they can optimize rich financial products and services. Third, the openness of financial data helps financial services. Fintech services not only share technology and financial services, but also actively cooperate with external institutions to increase their profits (Mărăcine, Voican and Scarlat, 2020).

Fintech can reduce the operating risks of traditional commercial banks (Molnár, 2018). Traditional commercial banks use the credit review system developed by big data technology to evaluate the credit of customers, which can solve the problem of information asymmetry between borrowers and lenders (Chen, 2016). In addition, researchers have found that innovation in payment methods can reduce the risk of non-performing loans in the banking industry (Agarwal *et al.*, 2020). Researchers have found financial technology can reduce the management fees and capital costs of commercial banks (Schueffel, 2016).

In addition, some researchers believe that financial technology can promote the transformation and upgrading of traditional banks, and enhance the profitability and innovation capabilities of traditional commercial banks (Thakor, 2019). Internet finance has innovated business models, which has promoted the traditional commercial banking industry to explore new service methods. Researchers have found that Internet finance has promoted the competition of financial institutions, and traditional commercial banks have to strengthen cooperation with Internet companies to reform inefficient financial services (Zhang and Sun, 2017). In addition, the researchers found that although Internet finance reduces the profitability of commercial banks, it optimizes the profit structure of commercial banks and promotes the diversification of commercial banking business (Abdillah, 2019).

Advanced financial technology has improved the business methods of commercial banks and increased the operating efficiency of the banking industry (Thakor, 2019). The researcher analysed the total factor productivity of 36 Chinese commercial banks and found that Internet finance has significantly improved the total factor productivity of commercial banks, and banks of different sizes are affected differently (Thakor, 2020). In addition, researchers believe that

Internet finance will not replace traditional banks, it can promote banking innovation and improve the efficiency of the banking financial system(Chen, 2018).

Methods

Game Theory Analysis of Financial Technology and Commercial Banks Dominated by Competition

(1) Problem Description

Many researchers use the Hotelling model to focus on the competition among enterprises on product quality, price, and service. It is suitable for describing the process of game competition between different enterprises. At the same time, the competitive market between the financial technology model and the traditional banking model is dynamic, and the market positions of financial technology and commercial banks are different at different stages. Therefore, this article adopts a two-stage game model analysis to provide a corresponding theoretical basis for their development.

(2) Model Assumes

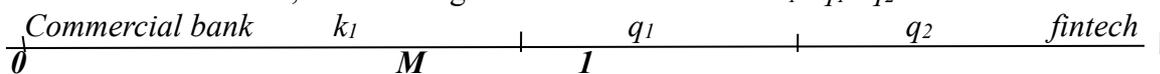
Assuming that the market is ideal, the market capacity is 1.

There are a commercial bank and a financial technology company. They provide customers with corresponding financial services, such as deposit and loan services, payment and settlement services. There are alternatives between businesses, but they have differentiated competition in terms of capital cost, service efficiency, and risk management. Set the price, cost, market share, and profit of products provided by commercial banks and financial technology companies to customers as $p_i, c_i, q_i, \pi_i (i = 1, 2)$. Assume that the unit cost of the product provided by the commercial bank is c_1 , the unit cost of financial technology products is $c_2 = 0$.

Assuming that the total demand of customers is 1, the value of commercial banks and financial technology companies providing products are U_1 and U_2 respectively. In addition, the total utility of commercial banks and financial technology companies in serving customer "M" with specific preferences is U_0 . Customers who choose commercial bank products or financial technology enterprise products have utility losses, which are recorded as q_1x_1 and q_2x_2 respectively. x_1 and x_2 are the unit utility losses of commercial banks and financial technology companies' products.

(3) Model design

When Internet finance companies entered the market for the first time, the policy, customer resources, and risk management of traditional banks dominated the market. Therefore, the market share of traditional banks is $k_1 (0 < k_1 < 1)$. Fintech companies enter the market late, so their market share is 0. Customers who choose commercial banks can obtain additional utility, which is U_α . $U_\alpha = \alpha k_1 (0 < \alpha < 1)$, α is the external advantage coefficient. Assume that the commercial bank provides unit product cost $C_1 = \lambda U_\alpha = \lambda \alpha k_1 (0 < \lambda < 1)$. λ is the service cost coefficient. Therefore, the first stage of the market share is $k_1 + q_1 + q_2 = 1$.



Therefore, the net utility obtained by customers who prefer M when purchasing products from financial technology and commercial banks is expressed as:

$$\begin{cases} U_1 = U_0 + U_\alpha - p_1 - q_1 x_1 \\ U_2 = U_0 - p_2 - q_2 x_2 \end{cases} \quad (3.1)$$

When customers buy their products and get the same net benefit, there is no difference between the products:

$$\begin{cases} U_1=U_2. \\ q_1= \{x_2+(\alpha-x_2)k_1-p_1+p_2\} / (x_1+x_2) \\ q_2= \{x_1-(\alpha-x_1)k_1-p_1+p_2\} / (x_1+x_2) \end{cases} \quad (3.2)$$

Therefore, customers located in the market $(0, k_1+q_1)$ will choose the products and services of commercial banks, and customers located in the market $(1-q_2, 1)$ will choose the products or services of fintech enterprises.

The profit functions of financial technology and commercial banks are respectively:

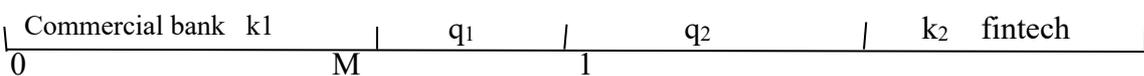
$$\begin{cases} \pi_1=(p_1-c_1)(k_1+q_1)=(p_1-\lambda\alpha k_1) \{k_1+ \{x_2+(\alpha-x_2)k_1-p_1+p_2\} / (x_1+x_2) \} \\ \pi_2=p_2q_2=p_2 \{ \{x_1-(\alpha-x_1)k_1-p_1+p_2\} / (x_1+x_2) \} \end{cases} \quad (3.3)$$

When the profits of traditional commercial banks and fintech company are maximized, the equilibrium market price, equilibrium market share and equilibrium profit can be obtained in the competitive game.

Commercial Bank	Fintech Company
$p_1^* = \{x_1+2x_2+(x_1+\alpha+2\lambda\alpha)k_1\} / 3$	$p_2^* = \{2x_1+x_2+(\lambda\alpha-x_1-\alpha)k_1\} / 3$
$q_1^* = \{2x_2+x_1+(\alpha-2x_1-3x_2-\lambda\alpha)k_1\} / 3(x_1+x_2)$	$q_2^* = \{2x_1+x_2+(\lambda\alpha-\alpha-x_1)k_1\} / 3(x_1+x_2)$
$\pi_1^* = \{2x_2+x_1+(\alpha+x_1-\beta\alpha)k_1\}^2 / 9(x_1+x_2)$	$\pi_2^* = \{2x_1+x_2+(\lambda\alpha-\alpha-x_1)k_1\}^2 / 9(x_1+x_2)$

The second stage is market stability game

With the rapid popularization of big data and cloud computing technology, internet finance has innovated a large number of financial applications, which have had an impact on the business model of commercial banks and occupied a part of the market share. Assuming that the market share obtained by internet finance is k_2 ($0 < k_2 < k_1$), and $k_1+q_1+q_2+k_2=1$. Fintech uses technology to reduce transaction costs and improve service efficiency. So, the fintech company increased the customer utility and set it to U_β . In addition, assuming that there is a positive linear relationship between utility and acquired inherent market share, so $U_\beta=\beta k_2$. β is the innovation coefficient of internet finance. Assume the unit cost of Internet finance is $c_2=\theta$ ($0 < \theta < 1$). θ is the constraint cost coefficient.



Therefore, the net utility obtained by customers who prefer M when purchasing products from financial technology and commercial banks is expressed as:

$$\begin{cases} U_1=U_0+U_\alpha-p_1-q_1x_1 \\ U_2=U_0+U_\beta-p_2-q_2x_2. \end{cases} \quad (3.4)$$

When customers buy their products and get the same net benefit, there is no difference between the products:

$$\begin{cases} U_1=U_2. \\ q_1= \{x_2+(\alpha-x_2)k_1-k_2(\beta+x_2)-p_1+p_2\} / (x_1+x_2) \\ q_2= \{x_1-(\alpha+x_1)k_1+k_2(\beta-x_2)+p_1+p_2\} / (x_1+x_2) \end{cases} \quad (3.5)$$

Therefore, customers located in the market $(0, k_1+q_1)$ will choose the products and services of commercial banks, and customers located in the market $(1-q_2-k_2, 1)$ will choose the products or services of fintech enterprises.

The profit functions of financial technology and commercial banks are respectively:

$$\begin{cases} \pi_1 = (p_1 - c_1)(k_1 + q_1) = (p_1 - \lambda \alpha k_1) \{k_1 + \{x_2 + (\alpha - x_2)k_1 - k_2(\beta + x_2) - p_1 + p_2\} / (x_1 + x_2)\} \\ \pi_2 = (p_2 - c_2)(k_2 + q_2) = (p_2 - \theta) \llbracket \{x_1 - (\alpha - x_1)k_1 + (\beta + x_2) + p_1 - p_2\} / (x_1 + x_2) \rrbracket \end{cases} \quad (3.6)$$

When the profits of traditional commercial banks and fintech company are maximized, the equilibrium market price, equilibrium market share and equilibrium profit can be obtained in the competitive game.

Commercial Bank	Fintech Company
$p_1^* = \{x_1 + 2x_2 + (x_1 + \alpha + 2\lambda\alpha)k_1 - k_2(\beta + x_2 - \theta)\} / 3$	$p_2^* = \{2x_1 + x_2 + (\lambda\alpha - x_1 - \alpha)k_1 + k_2(\beta + x_2 + 2\theta)\} / 3$
$q_1^* = \{2x_2 + x_1 + (\alpha - 2x_1 - 3x_2 - \lambda\alpha)k_1 - k_2(\beta + x_2 - \theta)\} / 3(x_1 + x_2)$	$q_2^* = \{2x_1 + x_2 + (\lambda\alpha - \alpha - x_1)k_1 - k_2(3x_1 + 2x_2 - \beta + \theta)\} / 3(x_1 + x_2)$
$\pi_1^* = \{2x_2 + x_1 + (\alpha + x_1 - \beta\alpha)k_1 - k_2(\beta + x_2 - \theta)\}^2 / 9(x_1 + x_2)$	$\pi_2^* = \{2x_1 + x_2 + (\lambda\alpha - \alpha - x_1)k_1 + k_2(\beta + x_2 + \theta)\}^2 / 9(x_1 + x_2)$

Table 1 The second stage of the market competition

(4) Market equilibrium analysis

Commercial banks and financial technology in the first stage of the equilibrium mainly analyze the influence of the external advantage coefficient “ α ” and the service cost coefficient “ λ ” on the equilibrium price, equilibrium market share, and equilibrium profit. Therefore, the equilibrium prices, equilibrium market shares, and equilibrium profits of commercial banks and financial technology have their first derivatives with respect to the external advantage coefficient “ α ”.

$$dp_1^*/d\alpha > 0, dq_1^*/d\alpha > 0, d\pi_1^*/d\alpha > 0. dp_2^*/d\alpha > 0, dq_2^*/d\alpha > 0, d\pi_2^*/d\alpha > 0.$$

Therefore, as the market external coefficient of commercial banks increases, the equilibrium prices, market shares, and profits of commercial banks show an upward trend. In contrast, the equilibrium price, market share, and profit of financial technology companies are showing a downward trend.

At the same time, the equilibrium prices, equilibrium market shares, and equilibrium profits of commercial banks and financial technology seek first-order derivatives of the service cost coefficient “ λ ”.

$$dp_1^*/d\lambda > 0, dq_1^*/d\lambda < 0, d\pi_1^*/d\lambda < 0. dp_2^*/d\lambda > 0, dq_2^*/d\lambda > 0, d\pi_2^*/d\lambda > 0.$$

Therefore, when the service cost coefficient increases, the equilibrium price of commercial banks rises, but the equilibrium market share and equilibrium profits decline. The equilibrium price, equilibrium market share, and equilibrium profit of financial technology companies have all increased, which shows that financial technology companies need relatively low market prices to obtain a certain market share.

The equilibrium result of the game is that financial technology companies have seized a certain market share in the first stage. The equilibrium state of the second stage mainly analyzes the influence of the innovation advantage coefficient “ β ” and the restriction coefficient “ θ ” on the

equilibrium price, equilibrium market share and equilibrium profit. Therefore, the equilibrium price, equilibrium market share, and equilibrium profit of commercial banks and financial technology have their first derivatives with respect to the external advantage coefficient “ β ”.
 $dp_1^*/d\beta < 0, dq_1^*/d\beta < 0, d\pi_1^*/d\beta < 0. dp_2^*/d\beta > 0, dq_2^*/d\beta > 0, d\pi_2^*/d\beta > 0.$

It shows that the innovative technology of financial technology enterprises positively affects their equilibrium prices, equilibrium market shares and equilibrium profits, while it has a negative influence on the equilibrium prices, equilibrium market shares and equilibrium profits of commercial banks. Therefore, the equilibrium prices, equilibrium market shares, and equilibrium profits of commercial banks and financial technology have their first derivatives with respect to the limiting coefficient “ θ ”.

$dp_1^*/d\theta > 0, dq_1^*/d\theta > 0, d\pi_1^*/d\theta > 0. dp_2^*/d\theta < 0, dq_2^*/d\theta > 0, d\pi_2^*/d\theta > 0.$

Therefore, when the restriction coefficient of commercial banks on fintech companies increases, the equilibrium price, equilibrium market share, and equilibrium profits of commercial banks will rise, while the equilibrium price of fintech companies rises, but the equilibrium market share and equilibrium profits will fall.

A Game Theory Analysis of Financial Technology and Commercial Banks Dominated by Cooperation

(1) Problem Description

This section mainly analyzes the equilibrium of cooperation between Internet finance and commercial banks by constructing a Stackelberg game model. This section finds the best profit distribution ratio in the cooperation model of commercial banks and financial technology.

(2) Model Assumes

Commercial banks provide funds and customer resources, Internet finance provide service platforms. Assuming R_1 is the cost of borrowing funds of Internet finance. Suppose the price of the cooperative product is P , the market size is Q , and the demand function is:

$$Q = a - bP \quad (a > 0, b > 0). \quad (3.7)$$

The profits realized by financial technology are distributed to commercial banks in a certain proportion e ($0 \leq e \leq 1$).

The funds provided by commercial banks for financial technology companies mainly come from customer deposits. Assuming that the deposit interest rate is R_2 , the deposit interest that needs to be paid to customers is R_2Q . The unit marginal cost of products and services provided by financial technology companies is C_1 , and the initial investment is C_0 . Therefore, the profit functions of financial technology and commercial banks are respectively:

$$\begin{cases} \pi_1 = (1-e)(P - R_1 - C_1)Q - C_0 \\ \pi_2 = e(P - R_1 - C_1)Q + (R_1 - R_2)Q \end{cases} \quad (3.8)$$

(3) Model design

Total profit is

$$\pi = (P - R_2 - C_1)Q - C_0. \quad (3.9)$$

Combining equations (3.7) and (3.9), it can be found that the second derivative of profit to product price P is less than 0, so total profit has a maximum value.

$$\begin{cases} P^* = \lceil a + b(C_1 + R_2) \rceil / 2b \\ Q^* = \lceil a - b(C_1 + R_2) \rceil / 2 \\ \pi^* = \lceil a + b(C_1 + R_2) \rceil^2 / 4b - C_0 \end{cases} \quad (3.10)$$

Therefore, the total profit π has an inverse relationship with commercial bank deposit interest rates R_2 , the unit cost of products C_1 provided by financial technology companies, and the initial investment C_0 .

$$\begin{cases} \max_P \pi_1 \\ \max_{R_1} \pi_2 \end{cases} \quad (3.11)$$

According to (3.8) and assuming $d\pi_1/dp=0$, it can be calculated:

$$P' = \frac{[a+b(R_1+C_1)]}{2b} \quad (3.12)$$

The second derivative of the profit π_1 of a financial technology company with respect to the price P is less than 0. Therefore, when P is equal to P' , its profit is the largest.

$$\begin{cases} \pi_1' = (1+e) \frac{[a-b(R_2+C_1)]^2}{4b(2-e)^2} - C_0 \\ \pi_2' = \frac{[a-b(R_2+C_1)]^2}{4b(2-e)} \\ \pi' = (3-2e) \frac{[a-b(R_2+C_1)]^2}{4b(2-e)^2} - C_0 \end{cases} \quad (3.13)$$

(4) Equilibrium analysis

Calculate the first derivative and second derivative of the distribution ratio e of π_1' and π_2' respectively according to formula (3.13).

$$\begin{cases} d\pi_1'/de < 0, d^2\pi_1'/de^2 < 0 \\ d\pi_2'/de > 0, d^2\pi_2'/de^2 > 0 \end{cases} \quad (3.14)$$

It shows that the financial technology enterprise profit π_1' and the distribution ratio e are opposite, and the commercial bank profit π_2' and the distribution ratio e are positive. When the distribution ratio e is equal to 0, the profit of fintech companies is the largest and the profit of commercial banks is the smallest. On the contrary, when the distribution ratio e is equal to 1, the profit of fintech companies is the smallest and the profit of commercial banks is the largest.

Findings

Fintech and traditional commercial banks have different competing relationships because of their different dominant positions. This paper uses the Hotelling game model to analyse their equilibrium decision-making under competition dominance, cooperation dominance, and competition and cooperation games. Provide corresponding reference theory for their dynamic competition and cooperation development.

It used the two-stage game model to concretely analyse their equilibrium decisions. When competition between them increases, commercial banks will take corresponding restrictive measures to limit the development of financial technology companies in order to maintain their profits. Fintech companies need to use technological innovation to obtain more policy support and reduce restrictions on their business by commercial banks.

The cooperative game analysis of financial technology and commercial banks is based on the Stackelberg game model. On the one hand, financial technology companies can provide technical support to commercial banks. On the other hand, commercial banks can provide funds and customer data for financial technology companies. Appropriate profit distribution ratio is important.

In the first stage of the game, it is more important for financial technology companies to obtain a certain market share than to obtain profits. Because of $dq_2^*/dk_1 < 0$, the market share of fintech companies has an inverse relationship with the inherent market size of commercial banks. The larger the inherent market size of a commercial bank, the more difficult it is for fintech companies to increase their market share. Therefore, financial technology companies have

relatively low service costs compared with commercial banks, and they can set relatively low market prices to obtain customer resources. In addition, fintech companies can also choose to enter a market with a small inherent market size for commercial banks, or enter a market where commercial banks cannot meet the needs of diversified services

Therefore, when the competition between commercial banks and financial technology increases, commercial banks will take corresponding restrictive measures to maintain their profit levels. In addition, financial technology companies need to further innovate technologies to obtain more policy support and reduce restrictions on their business by commercial banks.

The cooperation between the two parties can eliminate the losses caused by interest rate competition, reduce the unit cost of products and services, and reduce the initial investment of financial technology companies to maximize overall profits. From equation (3.8), it can be seen that the profit of financial technology and commercial banks is mainly determined by the borrowing interest rate R_1 and the distribution ratio e . The larger the R_1 and e , the more profit the commercial bank will get, while the less profit the financial technology company will get. When the distribution ratio e is equal to 1, the total profit of financial technology and commercial banks is maximized. Fintech companies have the lowest profits and commercial banks have the highest profits. Commercial banks provide the lowest borrowing interest rate, which is equal to their deposit interest rate. Fintech companies provide the lowest prices for products and services, the market scale reaches the largest. When the fintech and commercial banks cooperate in the initial stage, commercial banks do not need to rely on loans to make more profits, while fintech companies only provide technology platforms to acquire more customers. The main goal of fintech companies is to increase the number of customers. When they obtain a large number of customer resources, they can increase profits through products and services.

When the distribution ratio e is equal to 0, the total profit of financial technology and commercial banks is the smallest. Fintech companies have the highest profits and commercial banks have the lowest profits. At the same time, the prices of products and services provided by financial technology companies are the highest, the scale of market demand is the lowest, and the loan interest rate of commercial banks is the highest.

It shows that financial technology companies occupy a dominant position in cooperation with commercial banks. Fintech companies use technology platforms to provide undeveloped services and products of commercial banks, while commercial banks only provide financial support and earn interest income. Financial technology companies can provide technical support to commercial banks; on the other hand, commercial banks can provide financial technology companies with capital and customer support. Long-term cooperation between them requires a suitable profit distribution ratio.

Discussion and Conclusion

Internet finance has seriously affected the development of China's banking industry, and it poses a threat to liability business, asset business and intermediary business. Internet wealth management has attracted a large amount of deposit funds that originally belonged to banks, which has increased the cost of obtaining funds for traditional commercial banks. Internet credit loan business mainly serves long-tail customers ignored by traditional banks, which has an impact on small and medium-sized commercial banks. Internet finance has a fast and efficient payment model, and third-party payment occupies more market share in the payment and settlement business than traditional banks. At the same time, the fund management business of traditional commercial banks also competes with emerging financial models such as Internet wealth management and Internet credit. The intermediary business of the banking industry has been greatly affected. The new Internet finance model has reduced the market

share and profitability of the bank's business operations, and has expanded the bank's business risks.

There are three main reasons why financial technology companies can quickly occupy a certain market in the early stage of development. First, financial technology has effectively expanded the scope of financial services. It breaks through the limitations of time and space, provides more personalized and diversified products and services, and expands the market space. Second, financial technology has improved the efficiency of financial services and effectively reduced business costs and transaction costs. Commercial banks expand the market by setting up fixed business counters, setting up branches, and expanding the scale of employees. Therefore, financial technology companies have obvious advantages in service cost expenditures. Third, fintech companies use lower costs to provide lower product prices. In addition, the products and services of financial technology have few restrictions and high experience. Therefore, fintech companies use lower market prices and relatively higher services to grab market share. Traditional commercial banks need to use Fintech companies to accelerate transformation and innovation. The cooperation between traditional commercial banks and financial technology companies can optimize the financial services of traditional commercial banks. The financial products of financial technology companies are low-cost, convenient and highly competitive. The cooperation between traditional commercial banks and financial technology companies can comprehensively improve management, improve work efficiency, and reduce business costs.

Fintech can expand the scope of financial services of traditional commercial banks. Traditional commercial banks can use platforms and big data technology to quickly discover customer needs and build financial services. At the same time, financial technology can improve the efficiency of resource circulation and increase the frequency of customer service. Commercial banks should use emerging technologies such as big data analysis and mobile internet to attract more customers and provide more financial services.

Fintech companies have accumulated a large number of customers and data resources, and they have huge amounts of data. The cooperation between traditional commercial banks and financial technology companies can quickly obtain a large amount of data resources, which helps traditional commercial banks develop financial products and financial services.

Limitations and Suggestions for Future Research

Most researchers agree that fintech has had an impact on commercial banks, but there is very little research on the dynamic process of competition and cooperation between fintech and commercial banks. Most of the research concluded that the relationship between financial technology and commercial banks are positive or negative. and There is a lack of in-depth discussion of the interaction process. Therefore, it used game theory analysis and discussion. Fintech and traditional commercial banks have different competing relationships because of their different dominant positions. This paper uses the Hotelling game model to analyse their equilibrium decision-making under competition dominance, cooperation dominance, and competition and cooperation games. Provide corresponding reference theory for their dynamic competition and cooperation development. The research method of this article is game theory. The cooperative game is incomplete. The hypothesis of game theory is rational, and it may not be consistent with actual facts.

Fintech has become the main development direction of the traditional banking industry. On the one hand, it may promote the innovation of commercial banks and improve operating efficiency. On the other hand, it may also increase the risks of commercial banks. Traditional commercial banks in China have cooperated with financial technology companies in different fields and methods, which helps commercial banks to improve their competitiveness, find new business models and increase profits. However, the current cooperation between commercial

banks and financial technology companies is immature, so the cooperation model between traditional commercial banks and financial technology companies needs to be explored. The impact of the asset-liability structure of commercial banks and the total factor productivity of financial technology on the operation of commercial banks can be further studied in the future.

References

- Abdillah, L. (2019) 'An Overview of Indonesian Fintech Application', in. *The First International Conference on Communication, Information Technology and Youth Study (I-CITYS2019)*, Bayview Hotel Melaka, Melaka (Malacca), Malaysia.
- Agarwal, S. et al. (2020) 'The real impact of FinTech: Evidence from mobile payment technology', Available at SSRN 3556340 [Preprint].
- Aveni, T. and Roest, J. (2017) 'China's Alipay and WeChat Pay'.
- Betz, F. and Khalil, T.M. (2011) 'Technology and financial innovation', *International Journal of Innovation and Technology Management*, 8(01), pp. 1–25.
- Chen, K. (2018) 'Financial innovation and technology firms: a smart new world with machines', in *Banking and finance issues in emerging markets*. Emerald Publishing Limited.
- Chen, L. (2016) 'From fintech to finlife: the case of fintech development in China', *China Economic Journal*, 9(3), pp. 225–239.
- Frame, W.S., Wall, L.D. and White, L.J. (2018) 'Technological change and financial innovation in banking: Some implications for fintech'.
- Guo, P. and Shen, Y. (2016) 'The impact of Internet finance on commercial banks' risk taking: evidence from China', *China Finance and Economic Review*, 4(1), pp. 1–19.
- Hou, X., Gao, Z. and Wang, Q. (2016) 'Internet finance development and banking market discipline: Evidence from China', *Journal of Financial Stability*, 22, pp. 88–100.
- Kammoun, S., Loukil, S. and Loukil, Y.B.R. (2020) 'The Impact of FinTech on economic performance and financial stability in MENA zone', in *Impact of Financial Technology (FinTech) on Islamic Finance and Financial Stability*. IGI Global, pp. 253–277.
- Kombe, S.K. and Wafula, M.K. (2015) 'Effects of internet banking on the financial performance of commercial banks in Kenya a case of Kenya Commercial Bank', *International Journal of Scientific and Research Publications*, 5(5), pp. 1–10.
- Lu, L. (2018) 'Decoding Alipay: mobile payments, a cashless society and regulatory challenges', *Butterworths Journal of International Banking and Financial Law*, pp. 40–43.
- Mărăcine, V., Voican, O. and Scarlat, E. (2020) 'The digital transformation and disruption in business models of the banks under the impact of FinTech and BigTech', in. *Proceedings of the International Conference on Business Excellence*, pp. 294–305.
- Molnár, J. (2018) 'What does financial intermediation theory tell us about fintechns?', *Vezetéstudomány*, 49(5), pp. 38–46.

- Piao, Z. and Lin, Y. (2020) 'Financing innovation and enterprises' efficiency of technological innovation in the internet industry: Evidence from China', *PloS one*, 15(9), p. e0239265.
- Polyakova, T. *et al.* (2019) 'Development of Fintech as a Challenge for Traditional Banking', in *Vision 2025: Education Excellence and Management of Innovations through Sustainable Economic Competitive Advantage*, pp. 11966–11974.
- Romānova, I. and Kudinska, M. (2016) 'Banking and Fintech: a challenge or opportunity?', in *Contemporary issues in finance: Current challenges from across Europe*. Emerald Group Publishing Limited.
- Saksonova, S. and Kuzmina-Merlino, I. (2017) 'Fintech as financial innovation—The possibilities and problems of implementation'.
- Salampasis, D. and Mention, A.-L. (2018) 'FinTech: Harnessing innovation for financial inclusion', in *Handbook of Blockchain, Digital Finance, and Inclusion, Volume 2*. Elsevier, pp. 451–461.
- Schueffel, P. (2016) 'Taming the beast: A scientific definition of fintech', *Journal of Innovation Management*, 4(4), pp. 32–54.
- Thakor, A.V. (2019) 'Fintech and banking', *Available at SSRN 3332550* [Preprint].
- Thakor, A.V. (2020) 'Fintech and banking: What do we know?', *Journal of Financial Intermediation*, 41, p. 100833.
- Thomala, L.L. (2021) 'Number of internet users in China 2008-2020'. Available at: <https://www.statista.com/statistics/265140/number-of-internet-users-in-china/> (Accessed: 3 February 2021).
- Vučinić, M. (2020) 'Fintech and Financial Stability Potential Influence of FinTech on Financial Stability, Risks and Benefits', *Journal of Central Banking Theory and Practice*, 9(2), pp. 43–66.
- Wang, R., Liu, J. and Luo, H. (2021) 'Fintech development and bank risk taking in China', *The European Journal of Finance*, 27(4–5), pp. 397–418.
- Xu, Z. and Cheng, X. (2017) 'The impact of financial intelligence on commercial banking from the perspective of transaction cost'.
- Zhang, J. and Sun, Q. (2017) 'Research on financing cost of small and medium-sized enterprises by internet finance', *Open Journal of Social Sciences*, 5(11), pp. 95–99.
- Zhilai, Z. (2015) 'The influence of Internet finance of commercial banks—based on the perspective of the influence of "Internet+" on the retail industry', *Financ Econ*, 5, pp. 34–43.