The Influence of Internet Finance on the Performance of Commercial Banks: The Intermediary Effect of Interest Rate Marketization

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Abstract. Based on the panel data of 42 commercial banks in China, this paper analyzes the influence of Internet finance on the performance of commercial banks through the fixed effect model, and explores its transmission path. It is found that Internet finance has a significant negative effect on bank performance, and interest rate marketization plays an intermediary role in it. The mechanism research shows that the negative effects of Internet finance on the performance of commercial banks are mainly realized through the marketization of interest rates promoted by it, and the negative effects of Internet finance on the performance of commercial banks are greater than the positive technology spillover effect and competition effect. This paper sheds light on the government's formulates of relevant policies for commercial banks and commercial banks to develop and improve themselves.

Keywords: Internet finance; bank performance; interest rate marketization; intermediary effect

1 Introduction

Internet finance began in the 1990s and developed in developed countries. On October 18 th, 1995, the world's first online bank was established in Atlanta, USA, and the development of Internet finance gradually improved. The development of Internet finance in China is much later than that in developed countries. In June 2013, Alipay and Tianhong Fund jointly launched Yu'E Bao Monetary Fund, which is considered the beginning of Internet finance in China. Since then, more online payment platforms have emerged, and Internet finance has set off a new wave in China's financial industry. Xie and Zou (2011) investigated the payment method, information processing and resource allocation of Internet finance, and considered that Internet finance mode could promote economic growth by improving the efficiency of resource allocation and reducing transaction costs, which would bring huge social benefits[1].

Indirect financing from commercial banks and direct financing from the capital market are the two major ways of financing. However, the Internet financial mode, which was pointed out by Xie and Zou (2011) is the third financial financing mode different from these two financing modes. Compared with the traditional financing mode, the Internet finance mode can seize the market share of traditional commercial banks from the aspects of wealth management, financial intermediation, and payment and settlement by combining Internet technology with the traditional financial business mode, thus impacting the traditional financing mode (Cheng & Yang,

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2016)[2]. In response to the impact of Internet finance, commercial banks began to participate in the competition of Internet finance, actively seeking transformation and development, including constructing e-commerce platforms, cooperating with third-party payment, or building mobile security terminals (Li & Wang, 2021)[3].

China's interest rate marketization began in 1996, and the general idea of reform is "foreign currency first, local currency later; loan first, deposit later; long-term first, short-term later; large sum first, small sum later". The marketization of bank deposits and loan interest rates are two main aspects of interest rate marketization. Before the marketization of interest rates, the central bank's deposit and loan interest rates were strictly controlled. Commercial banks can adjust interest rates according to their own and customers' conditions, but the interest rates must be within the upper and lower limits set by the central bank. After nearly 30 years of interest rate marketization reform, the loan interest rate has been fully liberalized and the deposit interest rate range has gradually expanded. Under the marketization of interest rate, the interest rate is determined by the relationship between capital supply and demand, and financial resources are effectively allocated according to market supply and demand, which is conducive to the formation of a standardized market environment.

Based on the above background, this paper first theoretically analyzes the promotion of Internet finance to interest rate marketization, the influence of Internet finance on bank performance, and the intermediary effect of interest rate marketization, and further investigates the relationship among them through empirical analysis. After the robustness test, the present study finally provides a summary and suggestions for the results. At present, there are many studies on the influence of Internet finance on bank performance, but few studies have analyzed the intermediary role of interest rate marketization. Therefore, this paper adds new literature to this branch, which not only improves the theory of Internet finance but also provides help and reference for government departments to strengthen and improve the Internet finance management of banks and broaden their own development path.

2 The Influence Mechanism and Related Research

2.1 The promotion of Internet finance to the marketization of interest rates

Since the rise of Internet finance and interest rate marketization in China is different from that in Europe and the United States, this paper discusses the promotion of Internet finance to interest rate marketization in China, and the relevant literature is also from China scholars.

Mobile payment is a payment method under the Internet financial mode. With the rise of mobile payment, online financial products came into being and appeared. Online wealth management products are a combination of monetary funds and mobile payment. Because monetary fund does not belong to the banking system and does not need to pay deposit reserve, online wealth management products have a higher yield than a bank deposit, which are attractive to customers. However, most money funds follow T+1 trading rules, and some wealth management products (such as Yu' E Bao) can even be used at any time, so they have high liquidity and low risk. Internet financial products based on mobile payment force commercial banks to raise deposit interest rates due to their high returns and low risks, which promotes the marketization process of bank deposit interest rates.

Cloud computing technology in Internet finance can ensure that the fund supplier can obtain the risk pricing or dynamic default probability information of the fund demander at a very low cost so that in financial transactions, the fund supplier can master the information base of the fund demander. In the Internet finance model, the supply and demand sides of funds can contact and trade online without going through financial institutions, that is, Internet finance has the characteristics of disintermediation (Xie and Zou, 2011). The advantages of the Internet in information processing and resource allocation enable both parties to coordinate the loan interest rate and complete the transaction conveniently and quickly at a very low cost. This has provided great help to small and medium-sized enterprises whose loans in commercial banks have been restricted or even refused, and promoted the process of lowering interest rates by commercial banks, canceling the lower limit control of loan interest rates by the central bank, and promoting the marketization of loan interest rates.

Internet finance is similar to inclusive finance. According to statistics, more than 400 million people in China are using Yu'E bao. The majority of small and medium-sized enterprises are also more likely to obtain loans under the development of Internet finance. As an important part of China's financial reform, interest rate marketization is one of the ways to realize inclusive finance. The important reason for the reform is to enable most people or groups, especially low-income people, and small and micro enterprises that had difficulty in obtaining financial services before, to join the new financial system (Lu, 2017)[4].

Internet finance has the characteristics of low payment cost, low information cost, and disintermediation, which has a positive role in promoting the marketization of bank deposit interest rates and loan interest rates. Therefore, this paper puts forward the following hypothesis:

H1: Internet finance plays a positive role in promoting interest rate marketization.

2.2 The impact of Internet finance on bank performance

Many Chinese and foreign researchers have conducted relevant research on the impact of Internet finance on bank performance. From the research results, Internet finance has both positive and negative externalities on bank performance. Ignacio and María (2007) empirically studied the influence of Internet payment channels on bank performance based on 72 commercial banks and concluded that opening Internet payment channels gradually reduced management costs, thus improving the profitability of banks[5]. Ovidiu, Seyed and Alina (2015) used DEA and PCA methods to calculate bank performance and grouped 24 banks. The study found that very few banks can use Internet banking services to improve their performance[6]. Chinese scholars' related research mainly appeared after 2015. Shen and Liu (2017) examined the relationship between Internet finance, the performance of commercial banks and market forces, and concluded that the development of Internet finance had a significant negative impact on the performance level of commercial banks, and market forces played a positive regulatory effect in it[7]. Liu Lei et al. (2022) used the comprehensive indicators of bank performance obtained by principal component analysis to empirically study the influence of Internet finance on bank performance, and the regression results showed that Internet finance had a significant positive impact on the comprehensive performance of banks[8]. Hu (2017) analyzed the influence of Internet finance on the innovation performance of city commercial banks from the perspective of city commercial banks. The research concluded that the influence of Internet finance on the innovation performance of city commercial banks showed an inverted "U" trend[9].

Internet finance has a negative impact on the assets, liabilities and intermediary business of banks. As the three businesses are the main profit sources of banks, Internet finance has negative externalities on bank performance. As far as asset business is concerned, the asset business of banks mainly includes loan business, investment business and bill discount. With the development of Internet finance, the emergence of various online lending platforms is bound to have a diversion effect, especially for ordinary consumers and small and medium-sized enterprises, which has a certain negative impact on the bank loan business. In terms of liability business, the deposit business is the main business, and Internet financial products with Yu'E Bao as a typical example have a higher yield than bank demand deposits without weakening liquidity, which makes users choose to deposit in these products instead, weakening the bank's credit creation ability. Combining assets and liabilities, Internet finance reduces bank spreads and negatively affects interest income. The intermediary business of a bank refers to the business that does not constitute on-balance-sheet assets and on-balance-sheet liabilities of the bank, but forms non-interest income of the bank, including settlement, consulting, leasing, and agency business. In terms of intermediary business, banks are negatively affected by third-party payment. With respect to payment and settlement fees, the traditional way for commercial banks to obtain fees mainly comes from POS machines, which will charge users 1%-2% fees when transferring money through POS machines. In the Internet financial model, the way to complete the transfer or transaction is to use a third party to pay, and the handling fee is only about 0.4% of the transaction amount, which greatly reduces the rate (Sun, 2022)[10]. Concerning consignment funds and insurance, the rise of third-party payment platforms has led to a significant reduction in the proportion of commission income that commercial banks can obtain, which is only 3.5% of the transaction amount (Liu et al., 2022).

The positive externalities of Internet finance to banks mainly come from the competition effect and technology spillover effect. Under the influence of Internet finance, the interest income of banks has decreased. Besides, with the competitive effect caused by the entry of Internet financial institutions, banks will seek financial innovation and adjust their profit structure under pressure in order to adapt to the development of financial markets. Blockchain, big data, cloud computing and other technologies in Internet finance can improve the business efficiency of banks and help them achieve the purpose of improving performance. For example, through the blockchain, the customer's historical credit status can be traced, and based on this, the customer's economic ability is rated, and then the exclusive contract is designated for the customer. Big data is helpful in understanding the customer's demand for products more comprehensively and profoundly, so as to design products according to the demand. The advanced quality assurance technology and security maintenance measures of cloud computing platforms can help commercial banks maintain data security (Li, 2021)[11]. In this paper, we hypothesize that the negative impact of Internet finance on commercial banking business is greater than the positive competition effect and technology spillover effect, namely:

H2: Internet finance has a negative impact on the performance of commercial banks.

2.3 The intermediary effect of interest rate liberalization

The negative effect of interest rate marketization on commercial banks is mainly reflected in the reduction of interest income of commercial banks. However, similar to Internet finance, interest rate marketization will also prompt banks to adjust their business structure, reduce the interest income ratio, actively innovate in intermediary business and try to improve their overall

performance. Ren and Zhao (2017) conducted an empirical study on the relationship between the proportion of non-interest income, interest rate marketization and the performance of commercial banks, and found that there was a significant positive correlation between interest rate marketization and the performance of commercial banks[12]. Tang et al. (2019) analyzed the operating performance of rural commercial banks, and showed that interest rate marketization had a negative effect on the operating performance of rural commercial banks[13]. This paper hypothesizes that interest rate liberalization has a negative effect on bank performance, and puts forward the following hypothesis:

H3: The marketization of interest rates has a negative impact on the performance of commercial banks.

Internet finance has an impact on the performance of commercial banks in terms of assets, liabilities and intermediate business, and the interest rate marketization reform promoted by Internet finance mainly affects the performance of commercial banks in terms of deposits and loans in banking business. Therefore, it can be considered that interest rate marketization plays an indirect role in the transmission mechanism of Internet finance on the performance of commercial banks, so we have:

H4: The marketization of interest rate plays a partial intermediary role in the influence of Internet finance on the performance of commercial banks.

The relationship among Internet finance, Commercial bank performance and the interest rate marketization is shown in Fig.1.

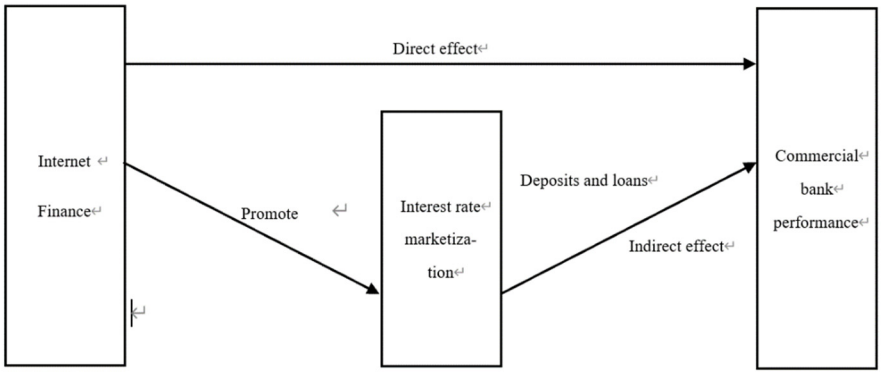

Fig. 1. Internet Finance, Interest Rate Marketization and Performance Transmission Mechanism of Commercial Banks

3 Variable Selection and Research Design

3.1 Research samples and data source

This paper selects 42 Chinese commercial banks as research samples, including 6 large state-controlled commercial banks, 8 national joint-stock commercial banks and 28 city commercial banks and rural commercial banks. The source of sample data is WIND database and Digital

Finance Research Center of Peking University, and the time interval is from 2011 to 2020. In this empirical study, the two sorts of statistical software used are Excel and Stata15.1.

3.2 Selection of variables

3.2.1 Explained variables

The explained variable is bank performance. At present, return on total assets (ROA), rate of return on common stockholders' equity(ROE) and balance of bank assets (ZC) are used as indicators to measure bank performance, among which ROA is the most common. Therefore, in this paper, ROA is selected as a substitute variable of bank performance in the regression model, and ROE is selected for robustness test.

3.2.2 Explanatory variables

The explanatory variable in this study is Internet finance index (IF). According to references, the measurement methods of Internet finance index include text mining (Shen & Guo, 2015)[14], the scale of third-party payment (Liu & Wang, 2021), the inclusive index of digital finance in Peking University (Jaco, 2020)[15], and the natural logarithm of the sum of the transaction scales of crowdfunding, P2P and third-party payment (Zhang etal., 2022)[16]. Considering that the word segments selected by text mining method are subjective, and the P2P and crowdfunding models are gradually weakening, this paper chooses the sum of the scale of third-party Internet payment and third-party mobile payment as the measurement index of Internet finance index, and selects Peking University Digital Finance Inclusive Index to verify the robustness of the model.

3.2.3 Intermediate variables

The methods to measure interest rate marketization in previous literature include introducing time variables to divide China's interest rate marketization into several time periods. If it enters a certain time period, the time variable is 1, and if it has not entered, it is 0 (Jin & Wu, 2016)[17]. The interest rate marketization index is obtained by scoring different indicators and simple arithmetic averages (Huang, 2015)[18]; The interest rate marketization index is obtained by the analytic hierarchy process (AHP) (Wan & Peng, 2014)[19]. In view of the fact that the variables of 0 and 1 are not precise enough, and it is too rough to take the arithmetic average directly, this paper uses the analytic hierarchy process to get the interest rate marketization index (IMI).

3.2.4 Control variables

According to the previous literature, this paper selects control variables from macro and micro levels of banks. Macro-level control variables are real Gross Domestic Product growth rate (GDP), while micro-level control variables include bank revenue growth rate (RGR), equity multiplier (EM), bad loan ratio (BLR) and loan-to-deposit ratio (LDR). The variables and descriptions used in this paper are shown in Table 1.

Table 1. Variable Definition

Variable type	Variable name	Variable symbol	Definition and explanation
Explained variable	Return on total assets	ROA	Net profit/total assets

Explanatory variable	Internet finance index	IF	The sum of the scale of third-party Internet payment and third-party mobile payment
Intermediate variable	Interest rate marketization index	IMI	Obtained by analytic hierarchy process
Control variable	Bank revenue growth rate	RGR	(Current operating income-previous operating income)/previous operating income
	Equity multiplier	EM	Owner's equity/total assets
	Bad loan ratio	BLR	Non-performing loans/total loans
	loan deposit ratio	LDR	Total loans/deposits
	Domestic Product growth rate	GDP	(current GDP- previous GDP)/ previous GDP
Robustness test	Rate of Return on Common Stockholders' Equity	ROE	Net profit/owner's equity
	Digital inclusive finance total index	IF1	Four Different Indicators in Peking University Digital inclusive finance Index
	Coverage of digital finance	IF2	
	Depth of use of digital finance	IF3	
	Digitalization of inclusive finance	IF4	

3.3 Model construction

In this paper, the panel individual fixed effect model is used for regression analysis. Firstly, the present study explores the role of Internet finance in promoting interest rate marketization, and establishes the following model:

$$IMI_t = \alpha_0 + \alpha_1 IF_t + \alpha_2 X_{it} + \lambda_i + \varepsilon_{it} \quad (1)$$

In model (1), IMI_t and IF_t represent the Internet finance and interest rate marketization index in year t, respectively. X_{it} is a series of control variables, λ_t is the individual effect of commercial banks, and ε_{it} is a random interference term.

Then, using the method of intermediary effect model, this paper investigates whether interest rate marketization plays an intermediary role in the influence of Internet finance on bank performance.

$$ROA_{it} = \beta_0 + \beta_1 IF_t + \beta_2 X_{it} + \lambda_i + \varepsilon_{it} \quad (2)$$

$$ROA_{it} = \gamma_0 + \gamma_1 IF_t + \gamma_2 IMI_t + \gamma_3 X_{it} + \lambda_i + \varepsilon_{it} \quad (3)$$

Among them, ROA_{it} represents the performance of the Ith bank in t year.

4 Empirical Analysis

4.1 Descriptive statistics

Descriptive statistical results of variables are shown in Table 2. As shown in Table, the return on total assets standard deviation of 42 commercial banks is less than the average, indicating that there is little difference in bank performance. There is a big gap between the maximum values of Internet financial index, which indicates that the level of Internet development is developing rapidly. The interest rate marketization index changed little during the sample period, and the data was relatively stable. The minimum growth rate of operating income is negative, indicating that some banks have negative growth in operating income in a certain year, while the other control variables have also changed greatly. The VIF test of each variable shows that the VIF values of each variable are less than 5, so it can be considered that there is no multicollinearity in the three models.

Table 2. Descriptive Statistics of Variables

Variable	N	Mean	SD	Min	Max
ROA	420	1.008	0.252	0.439	1.780
IF	420	1.020	1.049	0.0230	2.710
IMI	420	0.896	0.111	0.697	1.016
RGR	418	16.03	14.12	-13.67	127.1
EM	420	15	3.724	6.050	46.01
BLR	414	1.296	0.612	0.220	9.560
LDR	420	69.73	13.49	26.43	116.0
GDP	420	6.832	1.777	2.244	9.551

4.2 Regression analysis

As is shown in Table 3., the result of regression model (1) shows that the coefficient of Internet finance index is 0.063, and through the significance test of 1%, it shows that Internet finance has a significant positive role in promoting interest rate marketization, and H1 is verified. Internet finance attracts the masses and small and medium-sized enterprises by launching online wealth management products and different financing methods from bank loans, which makes banks have to adjust the deposit and loan interest rate structure and promote the marketization of deposit and loan interest rates. The marketization of deposit and loan interest rates is the main part of interest rate marketization, so the promotion of Internet finance to interest rate marketization is significant. Regression models (2) and (3) verify the intermediary effect of interest rate liberalization on bank performance in Internet finance, and the results are all significant at the level of 1%. Among them, in the regression model (2), the coefficient of the Internet finance index is -0.146, which indicates that Internet finance has a negative effect on the performance of commercial banks. In the regression model (3), the coefficient of Internet finance index is -0.092, and the coefficient of interest rate marketization index is -0.854, both of which are significant under 1%, indicating that the development of Internet finance and interest rate marketization significantly reduce the performance of commercial banks, and H2 and H3 are established. Note that 0.063×0.854/0.092 is about 58.48%, which shows that interest rate marketization plays a partial intermediary role in the influence of Internet finance on the performance of

commercial banks, and H4 is verified. The influence of Internet finance on commercial banks is largely transmitted through interest rate marketization, which is still an important part of commercial banks' income, so interest rate marketization can explain a considerable part of the impact of Internet finance on commercial banks' performance. For the mediating effect model, Sobel test and Bootstrap test are used. The results show that P>|Z| z | in Sobel test is 4.073×10^{-12}, and the 95% confidence interval in Bootstrap test is [-0.077, -0.019], excluding 0, so the mediating effect can be considered robust.

Table 3. Regression analysis of intermediary effect model

	(1) IMI	(2) ROA	(3) ROA
IF	0.063***	-0.146***	-0.092***
	(17.49)	(-11.52)	(-5.11)
IMI			-0.854***
			(-3.97)
RGR	-0.002***	0.002**	0.001
	(-4.59)	(2.54)	(1.20)
EM	-0.005***	-0.013***	-0.017***
	(-2.77)	(-3.90)	(-5.77)
BLR	0.031	-0.103*	-0.077*
	(1.10)	(-1.79)	(-1.98)
LDR	-0.002***	0.006***	0.004**
	(-4.95)	(3.45)	(2.23)
GDP	-0.013***	0.011***	-0.000
	(-9.29)	(2.77)	(-0.03)
_cons	1.159***	0.955***	1.944***
	(15.00)	(5.81)	(8.71)
N	413	413	413
R2	0.770	0.670	0.721

t statistics in parentheses

* p < 0.1, ** p < 0.05, *** p < 0.01

4.3 Robustness test

In order to verify the reliability of the empirical results, this paper replaces return on total assets with ROE, and the sum of third-party Internet payment and third-party mobile payment with Peking University Digital inclusive finance Index (IF1), digital finance coverage (IF2), digital finance usage depth (IF3) and digital degree of inclusive finance (IF4), respectively, and carries out five groups of robustness tests on the experimental model (1). The regression results are shown in Table 4, and the Internet finance coefficient still passes the significance test of 1%, which shows that Internet finance has a significant negative impact on commercial banks.

Table 4. Regression Analysis of Robustness Test

	(1) ROE	(2) ROA	(3) ROA	(4) ROA	(5) ROA
IF	-2.016***				
	(-11.22)				
IF1		-0.577***			
		(-8.65)			
IF2			-0.610***		
			(-9.13)		
IF3				-0.571***	

				(-9.92)	
IF4					-0.261***
					(-5.03)
RGR	0.029**	-0.000	0.000	-0.001	0.001
	(2.12)	(-0.06)	(0.69)	(-0.81)	(0.90)
EM	0.607***	-0.017***	-0.017***	-0.015***	-0.014***
	(6.84)	(-5.65)	(-5.68)	(-5.09)	(-4.34)
BLR	-1.492	-0.084**	-0.080**	-0.104**	-0.088*
	(-1.45)	(-2.35)	(-2.24)	(-2.33)	(-1.91)
LDR	0.071**	0.002	0.002	0.002	-0.001
	(2.40)	(1.06)	(1.43)	(1.56)	(-0.36)
GDP	0.282***	0.002	-0.002	0.008**	0.029***
	(4.87)	(0.52)	(-0.44)	(2.37)	(5.59)
_cons	2.814	1.626***	1.581***	1.530***	1.398***
	(0.83)	(14.01)	(13.75)	(12.98)	(9.24)
N	413	413	413	413	413
R2	0.792	0.671	0.684	0.657	0.578

t statistics in parentheses

* p < 0.1, ** p < 0.05, *** p < 0.01

5 Conclusion and Suggestions

5.1 Research conclusion

Based on the annual data of China Commercial Bank from 2011 to 2020, this paper investigates the development degree of Internet finance and the marketization degree of interest rate by means of the sum of the scale of third-party Internet payment and third-party mobile payment, and verifies the negative effect of Internet finance on the performance of commercial banks and the intermediary effect of interest rate marketization, and passes the robustness test. The results show that: (1) Internet finance has a significantly positive role in promoting interest rate marketization; (2) Internet finance has a significantly negative impact on the performance of commercial banks; (3) The marketization of interest rate plays a partial intermediary role in the transmission mechanism of Internet finance to the performance of commercial banks. The mechanism analysis shows that: (1) The role of interest rate marketization in Internet finance on the performance of commercial banks is mainly reflected in deposits and loans; (2) The negative effects of Internet finance and interest rate marketization on the performance of commercial banks are greater than the positive technology spillover effects and competition effects.

5.2 Suggestions

From the conclusion of this paper, among the 42 commercial banks in the sample, the influence of Internet finance on the performance of the sample commercial banks is negative, and the sample already includes all large state-controlled commercial banks and most national joint-stock commercial banks. These banks can make full use of the technology spillover effect of Internet finance to improve their performance. Considering that there are still many local commercial banks that are not included in the sample, for these banks, Internet finance may have a

more negative impact on their performance. Based on this, this paper puts forward the following suggestions: first, for government departments, new measures should be established to urge commercial banks to change their profit structure, improve their business models, and encourage banks to rely on Internet financial technology to innovate products and services; second, commercial banks, especially city commercial banks and rural commercial banks, should actively carry out transformation and innovation from intermediary business under the premise of interest rate marketization to narrow the deposit-loan spread, and launch new products and services according to market and customer needs; at the same time, banks can cooperate with Internet companies, make good use of blockchain, big data, cloud computing and other technologies provided by Internet companies to improve payment settlement, fund depository and other systems, and broaden the sales channels of financial products.

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