An empirical study of China's financial institutions holding non-financial listed companies' shares on company innovation – a moderated mediating effect

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Abstract

The economy of China is gradually transforming from high-speed development to high-quality development. The innovation in companies is conducive to companies' sustainable development, but innovation is often accompanied by risks and instability that needs the support of a large amount of capital. Financial institutions holding non-financial companies' shares are favourable in alleviating the financial constraints of companies and they are of great significance in promotion of technological innovation and industrial technological upgradation of non-financial companies. The data for this study is selected from China's a-share non-financial listed companies from 2013 to 2020 as research samples and data is empirically tested to show the effects of the industry-finance combination on non-financial companies and their technological innovation by creating the multiple regression equation. The test results showed that financial institutions holding non-financial companies' shares significantly promoted the investment in the innovation of technology in non-financial companies. Through stepwise regression and other methods, it is concluded that financing constraints had a mediating effect on financial institutions holding entity companies' shares and company innovation. Financial institutions holding non-financial companies' shares could promote technological innovation of companies by easing financial constraints, and the monetary policy as they had a moderating effect on this mediation. In addition, this paper conducted the sub-industries' test on financial institutions holding non-financial companies' shares and non-financial companies' technological innovation through cluster analysis. Moreover, it examined the impact of property rights nature according to the basic national conditions of China. This study offers a new method for the innovation of companies in China and it provides a prerequisite for the high-quality economic development and industrial upgrading of China.

1. Introduction

The existing research shows that the companies' technological innovation ability is the micro-basis in high-quality development of the macroeconomy. The improvement of companies' technological innovation ability is conducive in improving production technology, re-shaping production process, and increasing production efficiency, which enhances competitiveness of companies in market to promote the sustainable economic development (Hsiao, 2014; Romer, 1990; Tongbin & Tiemei, 2012; Yu, Fan, & Zhong, 2016). In the dual pressures of the current economic downturn and overcapacity, the upgrading of industrial technology and the

transformation of successful economy, the implementation of innovative strategies and the cultivation and creation of new economic growth are the keys to China's qualitative economic development.

Innovative activities are long-term and uncertain that's why investors are unable to monopolize the benefits of new technological knowledge and they are subjected t to severe financial constraints (Hall, 2002). Technological innovation requires continuous investment of substantial capital. The innovation's risk is another obstacle for companies to engage in research and development activities (Weimin, Qingquan, & Shanshan, 2009; Weimin & Hongxing, 2011). Therefore, the difficulty of external finances is one of the difficulties that restrict the innovation of companies in China.

The role of financial institutions in company's technological innovation has always been a significant issue that requires great concern in both theoretical and practical circles. However, the pattern of the financial system of banks formed for a long time determines that bank credit remains the principal source of China's corporate financing. As a high leverage bank, its risk preference makes it difficult for bank debt financing to become the major source of innovative investment funds for companies. In these years, as the virtual and real economies have been continuously combined, mutual equity participation between financial institutions and non-financial companies has become an important mode of industry-finance combination. Therefore, the financial institutions holding non-financial companies' shares ("financial +non-financial companies") are a very important mode of industry-finance combination.

If the financial constraint caused by information asymmetry is an important constraint for the technological and innovative behaviour of companies, Industry finance combination is a major mode of industry for ordinary investors, who hold non-financial companies' shares. On the one hand, they can make full use of the natural convenience in which financial institutions are master. They make financial capital, which provides timely support to non-financial companies and effectively ease the financial problem in the innovative investment of non-financial companies. On the other hand, it can mitigate the risk of information asymmetry existing in innovative investment through a pre-set risk, benefit sharing mechanism and a continuous monitoring mechanism for company's technological innovation investment, which helps to ensure the sustainability of company's innovation investment and reduces the risk. Thus, it becomes an important way to break through long-term innovation constraints due to companies' insufficient investment and then improve the innovation motivation of companies. Therefore, this paper chooses financial institutions holding non-financial listed companies' shares as the object of study to research the influences of financial institutions holding entity companies' shares on listed companies' innovation behaviours and the mechanism. Therefore, this paper will take the premium development of the macroeconomy in China as a background study From technological innovation's aspect of financing constraints, it will focus on the exploration of specific mechanism of the industry's finance combination mode. Financial institutions holding non-financial companies' shares, affecting the technological innovation activities of companies. The mechanism test showed that this kind of promotion effects through financing constraints' alleviation. The study theoretically clarified the specific mechanism that financial institutions holding non-financial companies' shares promoted company's innovative investment., Practically, it is helpful for future researchers as they can further guide about financial capital which supports the development of non-financial companies and optimize their resources' allocation to advance the sustained growth of the macroeconomy. Therefore, it has great significance in theory and practice.

This study's academic value and theoretical contribution are mainly embodied in three aspects as below:

Firstly, based on technological innovation's perspective, it expands and enriches research on the microeconomic effects of the industry-finance combination of financial institutions holding non-financial companies. The available literature emphasises on the search of companies holding financial institutions' shares and innovation (Wan, Liao, & Hu, 2015; Wei'an & Chao, 2014). There is a little literature to study financial institutions holding non-financial companies' shares and company innovation. This study performs the sub-industries test on financial institutions holding non-financial companies' shares and innovation via cluster analysis and searches the relationship between them under different property rights nature.

Secondly, this paper also studies the function mechanism between financial institutions holding non-financial companies' shares and innovation and finds the mediating effect of financing constraints on them. This helps to expand and enrich the determinants of company's technologically innovative behaviour from the aspect of financing constraints. Thirdly, the macro variable - monetary policy is taken as a moderating variable in this paper. This paper not only studies the moderating effect of monetary policy on financial institutions holding non-financial companies' shares and innovation but also concludes that in the year of monetary policy tightening, financial institutions holding non-financial companies' shares has a stronger role in promoting company innovation, which is basically consistent with the reality. Moreover, this paper innovatively studies monetary policy which moderates the mediating effect of financing constraints on the relationship between industry-finance combination and innovation.

2. Theoretical Analysis and Research Hypothesis

The industry-finance combination is a vital process in the development of companies. It expands, and achieve "diversification" and "globalization" through industry-finance combination. How to achieve industry-

finance combination's high-quality and sustainable development has been widely concerned by theoretical and practical circles. Studies on the industry-finance combination can be traced back to Marx and Engels' discussion on the relationship between industrial capital and financial capital (Piketty, 2014; Zhang & Zhang, 2015).

However, financial institutions holding companies' shares not only can increase the risk-bearing capacity of companies but it can also help companies to ease financing constraints, and this affects the innovative ability of companies. If finance returns to its original nature, the sustainable development of the economy should have a strong industrial sector as support. The relationship between the industry sector and the financial sector is harmonious and symbiotic, in a wide sense of the word, the industry-finance combination refers to the combination of industrial capital and financial capital. It is a system arrangement with mutual penetration, cross, and fusion of industrial capital and financial capital (Hong, Guisheng, & Yuanyue, 2018; Wei'an & Chao, 2014). According to two scholars' data test of the micro-finance industry and non-financial companies in Guangdong Province, it was found that equity investment formed in the capital market had the strongest supporting effect on technological innovation of companies, compared with the bank capital (Ying, Jianghuai, & Chunchao, 2009). To sum up, financial institutions holding non-financial companies' shares not only had financing convenience but also had important impacts on non-financial companies' technological innovation behaviours. The hypothesis is proposed according to the above analysis.

H1: A significant positive relationship exists between the industry-finance combination and company innovation.

Due to the large investment amount, high risk, and long cycle of innovation, company faces with great risk of uncertainty. Thus, companies are not willing to invest in innovation projects. Through equity participation in financial institutions, non-financial companies can ease their financing constraints, and further it alleviates the underinvestment of the companies or reduce the cash flow sensitivity of the companies' innovation (Wan et al., 2015; Wei'an & Chao, 2014). Similar to non-financial companies holding financial institutions' shares, financial institutions directly holding non-financial companies' shares can fully exploit financial capital's scale and effectively ease non-financial companies' financing constraints when engaging in company's technological investment and innovation. (Zheng, Mangmang, & Fang, 2019). The study of scholars showed that the industry-finance combination model could effectively ease the financing constraints of non-financial companies (Wei'an & Chao, 2014). The deficiency was that it was easy to affect over-investment of non-financial companies, which indirectly supported the capital supply function of the industry-finance combination model. To sum up, the industry-finance combination can relieve companies' financing constraints and advance the companies' innovation investment. Thus, the hypothesis of this paper is raised.

H2: Financing constraints have a mediating effect on industry-finance combination and company innovation.

Monetary policy depends on monetary channels and credit channels to influence economic activities. Credit channels play a decisive role in monetary policy's transmission. When the credit market is not completely replaced by other markets, monetary policy can exert the financial accelerator effect through credit channels (Bernanke & Gertler, 1995) which is manifested in the fact that changes in monetary policy will increase the volatility of economic consequences and speed up the change of company investment scale and output. Under the loose monetary policy, although the prices of financial assets are too high or even bubble frequently, companies are more willing to use more funds for investment activities rather than holding cash (Weixing, Xiaoran, Pan, & Tingting, 2019). Meanwhile, driven by strong speculative motives, company managers are more likely to ignore huge risks brought by asset bubbles and invest more funds in finance, real estate, and other fields to obtain higher returns. This kind of excess return will reduce companies' initiative to undertake innovation and drive companies to seize funds that should be invested in innovation activities, which results in that companies' innovation activities cannot obtain the expected results due to the lack of continuous financial support. On the contrary, under the tight monetary policy, companies will hold more cash in their hands to maintain liquidity and ease external financing pressure (Weixing et al., 2019). At this time, problems of adverse selection and moral hazards in the credit market are more prominent. In order to reduce the risk that creditors will not be able to recover their debts in full when they fall due, they strictly supervise the capital utilization of companies, which holds down the speculation of "money begets money" of companies. The financing convenience brought by the industry-finance combination is more important during the period of tight monetary policy. According to the above analysis, a hypothesis is presented as below:

H3: Monetary policy moderates the mediating effect of financing constraints on the relationship between industry-finance combination and innovation.

3. Research Design

3.1. Data Source

This study took China's A-shares non-financial listed companies as objects. It chooses the time from 2013 to 2020 as the study sample period. This timeline was chosen as the interval for measurement since the quality of innovation and other indicators before 2013 was inferior and incomplete. And the study's industry classification was derived from the classification of the China Securities Regulatory Commission in 2012. For ensuring sample data accuracy and validity, this paper eliminated sample companies with the Special Treatment (ST) mark and missing main data, and delete the maximum 1% and the minimum 1% of the data to avoid the

impact of extreme values The sample data and information were all derived from the China Stock Market & Accounting Research (CSMAR) database, which was analysed and processed by Stata 15.0 statistical software.

3.2. Variable Interpretation
(1) The Explained Variable

The explained variable is innovation input. Some scholars pointed out that the comparability of technological innovation results was poor due to the great influence of exogenous factors and less control of management. Thus, the ratio of Research and Development (R&D) input and operation income was used in this paper to judge the technological investment of companies, which is marked as INPUT (Zheng et al., 2019).

(2) The Explanatory Variable

The explanatory variable is the industry-finance combination. It reflects natural changes of non-financial listed companies' shareholders, which is manifested by the corporate equity' increasing proportion held by financial institutions. According to Chinas Coding Standards of Financial Institutions, the sum (FE) of entity companies' shares held by financial institutions is used to measure the degree of listed companies and their industry-finance combination (Chao, 2016; Jinduo & Xi, 2022; Songkai, 2020).

(3) The Mediating Variable

The mediating variables are the financing constraints. Many methods are used to measure financing constraints including Kaplan-Zingales (KZ) Index, Whited Wu (WW) Index, etc. But these methods will face endogenous interference. To avoid endogeneity and other problems, this paper refers to the methods of some scholars (Weiwei & Minjia, 2022) and used the SA index to assess financing constraints. When the SA Index has greater absolute value, the degree of financing constraint will be higher.

The SA index formula is: $| -0.737 \times Size + 0.043 \times Size^2 - 0.04 \times Age |$

Here, the SA index is calculated by first processing of the company's inflation-adjustment and total assets in Yuan into millions of Yuan. The Size mentioned at the above formula means the logarithm of the actual total assets of the company (Unit: Million Chinese Yuan), and the Age means the fixed number of the years a company has been listed.

(4) The Moderating Variable

The moderating variable is monetary policy. For the degree of monetary policy tightening (MP), according to the research of scholars (Sukun & Ling, 2021) it is divided in this paper through broad money supply M2's growth rate subtracts Gross domestic product (GDP)'s growth rate and then subtracts Consumer Price Index (CPI)'S growth rate.

The years of 2013, 2014, 2015, and 2020 are defined as the years of monetary policy easing with an MP value of 1. The remaining four years are defined as the years of monetary policy tightening with an MP value of 0.

(5) Control Variables

For analysing the industry-finance combination's impact on company innovation investment more comprehensively, it is necessary to control other factors that may affect company's innovative investment. This paper streamlined previous research literature and referred to some scholars' research (Wang, Li, & Tang, 2016) related to asset-liability ratio DEBT, operating activities' cash flow CF, operating profit margin FM, equity concentration EC, and company scale SIZE as control variables, which affect companies' innovation input to minimize the error of missing variables.

See Table 1 for specific information on each variable.

3.3. Model Building
(1) Multiple Regression

In this paper, the following Equation were built to conduct regression analysis on company innovation investment:

$$RD = \alpha_0 + \alpha_1 FE + \sum Controls + + \sum Industry + \sum Year + \varepsilon \quad (1)$$

Where Controls represents all the above-mentioned control variables, α_1 is the regression coefficient and ε is the error term. If α_1 is significant, it proves that the independent variable is significantly correlated with the dependent variable, then hypothesis 1 was valid.

Table 1. Definition and explanation of variables.

Variable property	Variable name	Code	Variable definition
Dependent variable	Innovation input	INPUT	The ratio of R&D investment and operation income to judge the technological innovation
Independent variable	Combination of industry and finance	FE	Sum of the proportion of non-financial companies shares held by financial institutions
Mediating variable	SA index	SA	The formula of SA index is: $\lvert -0.737 \times \text{size} + 0.043 \times \text{size } 2 - 0.04 \times \text{age} \rvert$
Moderating variable	Monetary policy	MP	If M2's growth rate minus GDP's growth rate minus the median of CPI' growth rate is greater than the median, the value is 1; otherwise, the value is 0
Control variables	Asset–liability ratio	DEBT	Total liabilities/Total assets
	Cash flow from operating activities	CF	Net cash flow/Total assets
	Operating profit margin	FM	Net profit/Total asset balance
	Equity concentration ratio	EC	The proportion of shareholding of top ten shareholders
	Company size	SIZE	The logarithm of total company assets

(2) Mediating Effect

The stepwise regression method was used to verify hypothesis 2. According to the research of scholars (Shi & Li, 2020) firstly, Equation 2's coefficient α_1, Equation 3's coefficient β_1, and Equation 4's coefficient γ_2 were verified in turn. If all three coefficients were significant, the mediating effect of financing constraints wassignificant, then hypothesis 2 was valid. Otherwise, the bootstrap method was used for further verification; Then, Equation 4's coefficient γ_1 was verified. If it was significant, it indicated that industry-finance combination's direct effect on company innovation investment was also significant; otherwise, only the mediating effect was valid; Finally, the symbols of γ_1 and $\beta_1\gamma_2$ were compared. If they had the same sign then it was considered that the financing constraint played a role of partial mediating effect. At this time, the proportion of mediating effect was $\beta_1 \gamma_2 / \alpha_1$. If they had different signs, it was considered as a masking effect. At this time, the proportion of mediating effect was $\lvert \beta_1 \gamma_2 / \alpha_1 \rvert$.

$$RD = \alpha_0 + \alpha_1 FE + \sum Controls + + \sum Industry + \sum Year + \varepsilon \tag{2}$$

$$SA = \beta_0 + \beta_1 FE + \sum Controls + \sum Industry + \sum Year + \varepsilon \tag{3}$$

$$RD = \gamma_0 + \gamma_1 FE + \gamma_2 SA + \sum Controls + \sum Industry + \sum Year + \varepsilon \tag{4}$$

(3) Moderating Effect

Here, MP represents the monetary policy and it is a moderating variable. FE×MP represents the interaction term of industry-finance combination and monetary policy. The test method of scholars (Zhonglin & Baojuan, 2014) was used to verify whether the coefficient in Equations 5, 6, and 7 were significant and if so, there was a moderated mediating effect,then hypothesis 3 was valid.

$$RD = a_0 + a_1 FE + a_2 MP + a_3 FE \times MP + \sum Controls + \sum Industry + \sum Year + \varepsilon \tag{5}$$

$$SA = b_0 + b_1 FE + b_2 MP + b_3 FE \times MP + \sum Controls + \sum Industry + \sum Year + \varepsilon \tag{6}$$

$$RD = c_1 + c_1 FE + c_2 SA + c_3 MP + c_4 FE \times MP + \sum Controls + \sum Industry + \sum Year + \varepsilon \tag{7}$$

4. Empirical Research and Results Analysis

4.1. Descriptive Statistics and Correlation Analysis

See Table 2 for relevant statistical data on each indicator. Company's innovation and investment's average value was 1.2349, the maximum value was 4.3353, and the minimum value was -4.6052, which presented those great differences in development that existed among different industries. Meanwhile, the maximum value of the industry-finance combination was 147.3585, the minimum value was only 0, and the average value was 5.6947. There was a significant difference in development among various industries, so it had good research value.

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Table 2. Descriptive statistics.

Variable	N	Min.	Max.	Mean	Sd.
INPUT	4270	-4.605	4.335	1.235	0.986
FE	4270	0	147.359	5.695	8.322
SA	4270	2.666	5.053	3.777	0.229
MP	4270	0	1	0.407	0.491
SIZE	4270	19.560	26.751	22.159	1.204
CF	4270	-0.258	0.533	0.051	0.066
DEBT	4270	0.009	1.352	0.391	0.191
FM	4270	-0.847	0.494	0.043	0.063
EC	4270	9.150	101.160	57.553	14.241

This paper conducted correlation analysis to verify whether there was multicollinearity among the indicators. As shown in Table 3, the major variables in this paper were all significant, which was basically consistent with the assumptions in this paper. Of course, the specific impact mechanism among the variables required further regression analysis. Secondly, the correlation coefficient among major variables were less than 0.7, which indicated that no multicollinearity problem existed among these major variables.

Table 3. Correlation analysis.

Variable	FE	INPUT	MP	SA
FE	1.000			
INPUT	0.012***	1.000		
MP	-0.094***	-0.009**	1.000	
SA	-0.060***	-0.121***	-0.287***	1.000

Note: ***, **respectively indicates it is significant at level 1%, 5%. T statistic in brackets.

4.2. Regression Results Analysis of Industry-finance Combination in Company's Innovation Input

Table 4 tested the core hypothesis of this paper, that was, the industry-finance combination could promote companies' innovation input to some extent. The test results show that the industry-finance combination had an obvious positive impact on innovative input. There was a strong correlation between the two. The coefficient was 0.008 and it was distinctly positive at the level of 1%. Hypothesis 1 held. It was proved that the industry-finance combination could effectively increase the company's anti-risk ability. Thus, the company's long-term development was considered, and it played a better role in advancing innovative input. The constant term was distinctly positive at level 1%. The results basically met expectations.

Table 4. Benchmark regression analysis of industry-finance combination to company innovation input.

Variables	INPUT
FE	0.008***
	(4.58)
SIZE	-0.151***
	(-9.04)
CF	-0.948***
	(-3.54)
DEBT	-1.489***
	(-13.85)
FM	-0.911***
	(-3.12)
EC	-0.003***
	(-3.07)
_cons	5.312***
	(15.54)
Industry	Control
Year	Control
R-squared	0.276
N	4270

Note: ***respectively indicates it is significant at level 1%. T statistic in brackets.

4.3. Regression Analysis of Mediating Effect

The results are as shown in Table 5, Formula (2) first verified the industry-finance combination promoted companies' innovation input. Industry-finance combination's regression coefficient was 0.008. It was distinct at level 1%. This indicated that the industry-finance combination was significantly and positively correlated with

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companies' innovative input. And the industry-finance combination would promote innovation input. In formula (3) with financing constraints as the explained variable, the industry-finance combination's regression coefficient was still distinct at level 1%, indicating that the industry-finance combination had a significant negative correlation with financing constraints. Finally, the industry-finance combination's coefficient and financing constraint's coefficient in formula (4) was 0. 006 and -0.414 respectively, and both passed the significance test. The empirical results were in line with hypothesis 2. The industry-finance combination would promote companies' innovation investment and enhance companies' innovation input by easing the financing constraints.

Table 5. Industry-finance combination, financing constraints, and innovation input.

Variables	Input	SA	INPUT
FE	0.008***	–0.002***	0.006***
	(4.58)	(–4.3)	(3.58)
SA			–0.414***
			(–5.87)
CF	–0.948***	0.211***	–0.691***
	(–3.54)	(3.21)	(–2.61)
DEBT	–1.502***	0.102***	–1.460***
	(–13.85)	(3.83)	(–13.6)
FM	–0.911***	0.147**	–0.957***
	(–3.12)	(2.06)	(–3.31)
EC	–0.003***	–0.003***	–0.004***
	(–3.07)	(–11.56)	(–4.28)
SIZE	–0.151***	0.006	–0.140***
	(–9.04)	(1.49)	(–8.51)
_cons	5.312***	3.782***	6.793***
	(15.54)	(44.96)	(15.76)
Industry	Control	Control	Control
Year	Control	Control	Control
R-squared	0.269	0.154	0.277
N	4270	4270	4270

Note: ***, ** respectively indicates it is significant at level 1%, 5%. T statistic in brackets.

Table 6. Moderating effect of monetary policy.

Variables	Input	SA	INPUT
FE	0.012***	–0.003***	0.011***
	(4.64)	(–4.19)	(4.16)
MP	–0.031	–0.146***	–0.103**
	(–0.8)	(–15.66)	(–2.55)
FE×MP	–0.008**	0.003***	–0.007**
	(–2.28)	(3.48)	(–1.88)
SA			–0.493***
			(–6.72)
SIZE	–0.153***	–0.003	–0.154***
	(–9.11)	(–0.85)	(–9.27)
CF	–0.781***	0.187***	–0.688***
	(–2.94)	(2.97)	(–2.61)
DEBT	–1.480***	0.118***	–1.422***
	(–13.75)	(4.61)	(–13.25)
FM	–1.033***	0.166**	–0.951***
	(–3.56)	(2.41)	(–3.29)
EC	–0.003***	–0.003***	0.599***
	(–3.15)	(–11.26)	(19.51)
_cons	5.456***	4.030***	–0.005***
	(15.7)	(48.81)	(–4.41)
Industry	Control	Control	Control
Year	Control	Control	Control
R-squared	0.272	0.130	0.183
N	4270	4270	4270

Note: ***, ** respectively indicates it is significant at level 1%, 5%.
T statistic in brackets.

4.4. Regression Analysis of Moderating Effect

The following Table 6 reported the moderating effect of monetary policy (MP)' mediating effect on R&D investment. Firstly, Equation 5's verification results showed that the interaction term's coefficient (FE×MP) between the industry-finance combination and monetary policy is -0.008, which was significant at level 1%. It indicated that the industry-finance combination's direct effect on innovative output that was regulated by monetary policy, i.e., the promotion effect of the industry-finance combination on innovation would be

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strengthened under the tight monetary policy. From the results of Equations 6 and 7, it could be seen that the coefficients of FE, SA, and (FE×MP) were all significant. Therefore, MP had a moderating effect on mediating effect's first half and second half. Therefore, hypothesis 3 was valid. That was, in the year of monetary tightening, the more capital the companies needed, the stronger the promotion effect of the industry-finance combination on innovation would have, which was more conducive in easing companies' financing constraints. The promotion effect of monetary policy on the mediating mechanism between the combination of industry and finance-constraints-innovation is stronger

5. Heterogeneity Test and Robustness Test
5.1. Heterogeneity Test
(1) Sub-Industries Research

Based on the latest Chinas industry classification in 2012 and the nature of companies, companies were classified into 3 types by using cluster analysis, namely, Abor-intensive, capital-intensive, and technology-intensive companies.

$$The\ proportion\ of\ Fixed\ Assets\ =\ Net\ Fixed\ Assets\ /\ Total\ Assets \qquad (1)$$

$$R\&D\ Expenditure\ Proportion\ =\ R\&D\ Expenditure\ /\ Salary\ Payable \qquad (2)$$

Formula 1 mainly measured fixed assets' importance. When the ratio was greater, the capital in the company was more important. Formula 2 used the R&D expenditure ratio to employee payroll payable to measure, if the ratio was greater than 1, it was technology-intensive, or otherwise, it was labour-intensive. The classification results from cluster analysis are seen in Table 7.

Table 7. Industry classification by factor intensity.

Industries	Technology --Intensive	Asset-intensive	Labor- intensive
The codes of sub- industries	N77 C36 M74 I65 C33 C35 C27 C29 C39 C38 C37 C41 C40	G56 D44 A04 B11 D45 B07 C22 C31 G55 C30 R86 C28 C26 C25	A01 A02 A03 A05 B06 B08 B09 C13 C14 C15 C17 C18 C19 C20 C21 C23 C24 C32 C34 D46 E48 E49 E50 F51 F52 G53 G54 G58 G59 I63 I64 K70 L72 M73 M75 N78 P82 R85 R87 S90

The regression results by industry were as follows: the industry-finance combination and company innovation were correlated in any industry. The correlation between the two was stronger for technology-intensive companies with a coefficient of 0.011, which was notable at level 1%. The coefficient of labour-intensive companies was 0.003, which was obvious at the level of 5%. The promotion effect of the industry-finance combination on capital-intensive companies was the weakest coefficient of only 0.001. It was not difficult to understand that the core feature of technological companies was innovation, while financial institutions holding non-financial companies' shares mainly relied on easing the financing constraints of companies, which promoted innovation and increased the companies' competitiveness.

Table 8. Regression results by industry.

Variables	Technology-intensive companies	Capital-intensive companies	Labor-intensive companies
	INPUT	INPUT	INPUT
FE	0.011***	0.001*	0.003**
	(5.28)	(0.32)	(0.7)
CF	-0.984***	1.111*	-0.872
	(-3.37)	(1.72)	(-1.33)
SIZE	-0.048***	-0.166***	-0.208***
	(-2.56)	(-4.34)	(-4.97)
DEBT	-1.640***	-1.213***	-1.027***
	(-13.74)	(-5.31)	(-3.69)
FM	-1.459***	-0.575	0.007
	(-4.6)	(-0.93)	(0.01)
EC	-0.001	-0.003	-0.001
	(-1.32)	(-1.42)	(-0.55)
_cons	3.200***	5.393***	5.848***
	(8.21)	(6.76)	(7.12)
Year	Control	Control	Control
R-squared	0.166	0.171	0.146
N	1947	920	1403

Note: ***, **, and * respectively indicates it is significant at level 1%, 5%, and 10%. T statistic in brackets.

(2) The Public and Private Companies

Based on basic national conditions in China, heterogeneity tests of companies and non-state-owned companies were carried out for the sample. The results were shown in Table 9, that financial institutions holding non-financial companies' shares played a stronger role in advancing state-owned companies' innovation, because the supporting facilities of state-owned companies were more perfect and non-state-owned companies were mostly small and medium-sized companies, which might not be able to properly handle the relationship with finance shareholders.

Table 9. Empirical test of state-owned companies and non-state-owned companies.

Variables	State-owned companies	Non-state-owned companies
	INPUT	INPUT
FE	0.015***	0.001*
	(4.06)	(0.93)
SIZE	-0.145***	-0.077***
	(-4.56)	(-3.81)
CF	2.329***	0.079
	(3.95)	(0.29)
DEBT	-1.197***	-1.586***
	(-5.31)	(-13.75)
FM	0.760	-1.803***
	(0.99)	(-6.36)
EC	0.006***	0.001
	(2.64)	(1.15)
_cons	5.171***	3.786***
	(8.06)	(8.88)
Industry	Control	Control
Year	Control	Control
R-squared	0.237	0.251
N	1564	2706

Note: ***and * respectively indicates it is significant at level 1%and 10%. T statistic in brackets.

5.2. Robustness Test
(1) Endogenous Problems

To solve the endogenous problem caused by a missing variable between financial institutions holding non-financial companies' shares and innovation output, the study referred to some scholars' studies and selected the combination of industry and finance (FE) lag phase I (FE_{i-1}) and lag phase II (FE_{i-2}) as the tool variables and used "tool variable—generalized moment estimation" (IV-GMM) to re-verify the original Equations. As shown in Table 10, the one-stage regression results showed that the tool variables (FE_{i-1} &FE_{i-2}) were positively correlated with the industry-finance combination (FE). The two-stage regression results show that the industry-finance combination (FE) was significantly correlated with innovation (INPUT), which was consistent with the previous results. On this basis, this paper also carried out the under-identification test, over-identification test, and weak tool variable test. The above results indicated that the paper's core hypothesis 1 was still valid after considering endogeneity problems.

Table 10. Test results of considering the endogenous problem.

Dependent variable	One-stage regression FE	Two-stage regression INPUT
FE_{i-1}	0.630***	
	(13.08)	
FE_{i-2}	0.059***	
	(1.52)	
FE		0.033***
		(1.98)
Cons	1.332**	7.402***
	(2.45)	(8.62)
Controls	Yes	Yes
N	831	831

Note: ***, ** respectively indicates it is significant at level 1%, 5%. T statistic in brackets.

(2) Variables

Table 11 presents that the patent (Output) as the dependent variable is adopted to replace the innovation and the other variables are unchanged. It also indicates that the industry-finance combination and innovation still have a distinct positive relationship, and it testifies that hypothesis 1 is valid.

Table 11. The empirical test results of substitution variables.

Variables	Output
FE	0.010***
	(2.82)
SIZE	0.609***
	(19.07)
CF	0.507
	(0.99)
DEBT	0.326
	(1.57)
FM	-0.072
	(-0.13)
EC	0.001
	(0.11)
_cons	10.901***
	(16.58)
Industry	Control
Year	Control
R-squared	0.172
N	3250

Note: ***respectively indicates it is significant at level 1%. T statistic in brackets.

(3) Bootstrap

Bootstrap was used to re-examine financing constraints' mediating effect on the industry-finance combination and innovation. The bootstrap method under 95% confidence intervals was also used to re-examine the mediating mechanism of "industry-finance combination - financing constraints - innovation". The sample number was set at 1,000. According to the verification method proposed by scholars (Zhonglin & Baojuan, 2014) when the 95% confidence interval did not include 0, it was determined that a direct effect is existed. As seen in the following Table 12, among the indirect effects and direct effects, the 95% confidence intervals were [0.0003, 0.0015] and [0.0012, 0.0132], and the 95% deviation correction confidence intervals were [0.0003, 0.0015] and [0.0011, 0.0129], and none of the above intervals contained 0. This result proved that the financing constraint had a partial mediating effect between the industry-finance combination and innovation input, which further supported the conclusion of hypothesis 2.

Table 12. Analysis results of bootstrap.

Effect	Observed coef.	Bootstrap std.err.	P [95%Conf.interval]		BC [95%Conf.interval]	
Indirect effect	0.001	0.000	0.000	0.002	0.000	0.002
Direct effect	0.007	0.003	0.001	0.013	0.001	0.012

6. Conclusions and Policy Implications

It is seen that how the virtual economy can effectively coordinate with the non-financial economy in the promotion of competitiveness in non-financial companies are a significant topic in the process of financial reform and economic transformation in China. A lot of studies show that under insufficient development of the diversified financial system in China, industrial integration, as a new form of financial capital support the development of non-financial companies, they not only can bypass the market to transfer financial capital to non-financial companies to save transaction costs but also can reduce the innovation risk of non-financial companies through risk sharing and supervision mechanism. Therefore, this paper selected A-share non-financial listed companies in China from 2013 to 2020 as the samples and focused on how the industry-finance combination could promote technological innovation and its specific mechanism. The monetary policy had an obvious moderating effect on this mediating effect and there were also industry differences between financial institutions holding non-financial companies' shares and innovation.

Based on the special equity capital way of financial institutions holding non-financial companies' shares, this paper explored its impact on company's technological innovation which deepened and expanded the research field of financial development promoting company's technological innovation to provide a theoretical foundation for establishing innovation-driven financial reform direction.

The policy of this paper is reflected in three aspects. Firstly, the mode of industry-finance combination in which non-financial companies and financial shareholders with share their finances with each other is a useful supplement under the imperfect development of the diversified financial system in China. Therefore, the future should support and encourage the industry-finance combination's development from policy perspectives, especially the mode of industry-finance combination in which financial institutions hold shares in non-financial companies in a timely manner. Secondly, how to promote the technological innovation of non-financial companies to achieve high-quality macroeconomic development is the main focus of China's macro-economic policy. This study found that financial institutions holding non-financial companies' shares promote the level of technological innovation from the financing constraints, which provides ideas for China to give full play to the financial system to promote the real economy's high-quality development. Thirdly, in recent years, due to the downward trend of the real economy's rate of return, financial capital has become "virtual" seriously. How to promote financial capital to better serve the real economy is a major issue in China's current economic development. This research finds that the Equation of financial institutions holding non-financial companies' shares has an obvious promotion effect on the real economy's development. It supports the governance "from real to virtual" level nationally.

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