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Analysis of the Impact of Financial Technology on Capital Allocation Efficiency—Empirical Evidence from Chinese A-Share Listed Companies

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Abstract: Improving the efficiency of corporate capital allocation is the microfoundation for promoting high-quality economic development. Starting from the Cobb-Douglas production function, this paper constructs a theoretical model of the impact of finance technology on capital allocation efficiency. Based on this, an empirical test of the impact and mechanism of financial technology on capital allocation efficiency is conducted using data from Chinese A-share listed companies from 2008 to 2023. The research indicates that: (I) The improvement of financial technology levels could significantly reduce the deviation of capital allocation from the ideal state and improve capital allocation efficiency; (II) Financial technology could enhance corporate governance levels, thereby improving the efficiency of corporate capital allocation; (III) The enhancement of financial technology levels could restrain excessive investment and underinvestment behaviors in enterprises, promoting the improvement of capital allocation efficiency; (IV) The higher the level of financial technology is, the more significant effect on improving capital allocation efficiency would be.

Keywords: financial technology; capital allocation efficiency; development of the real economy

1. Introduction

With the arrival of the digital economy era, fully utilizing the function of financial technology in optimizing resource allocation is not only an important measure for China to comprehensively deepen reform and promote Chinese-style modernization, but also a key point for breaking the bottlenecks in factor flow and unblocking the economic cycle. In 2016, the Financial Stability Board (FSB) defined "financial technology" as "technology-driven financial innovation that could create new business models, applications, processes or products, thus having a significant impact on financial markets, financial institutions and the provision of financial services". (Financial Stability Board (FSB): "A Descriptive and Analytical Framework for Fintech", March 2016). On this basis, the People's Bank of China pointed out that "financial technology is technology-driven financial innovation, aiming to use modern scientific and technological achievements to transform or innovate financial products, business models, business processes, etc." and emphasized the important role of financial technology in enhancing the service of financial institutions to the real economy in the "Development Plan for Financial Technology (2022–2025)". Generally speaking, the essence of financial technology lies in innovation. According to the theory of "creative destruction" by the famous economist Joseph Schumpeter, the development of financial technology would promote economic structural transformation and achieve economic growth. As the

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micro-carrier of the development of the real economy, would enterprises be affected by the level of financial technology? Would the improvement of financial technology levels help enterprises optimize resource allocation and improve the efficiency of capital allocation? What is its mechanism of action? Answering this question has important theoretical significance for further enhancing the ability of financial institutions to serve the real economy; at the same time, it has important practical significance for enterprises to improve the efficiency of capital allocation, optimize resource allocation, and promote the process of high-quality economic development.

Based on this, this paper starts from a micro perspective, taking Chinese A-share listed companies from 2008 to 2023 as the research sample, systematically analyzes the theoretical analysis of the impact of financial technology on capital allocation efficiency, and empirically tests the impact and mechanism of financial technology on capital allocation efficiency through the construction of a econometric model.

The rest of this paper is structured as follows: The second part reviews the relevant literature, clarifying the innovation points of this study; the third part constructs a theoretical analysis framework of the impact of financial technology on capital allocation efficiency; the fourth part constructs an econometric model to empirically test the impact of financial technology on capital allocation efficiency; the fifth part further explores the mechanism of action and heterogeneity of the impact of financial technology on capital allocation efficiency; the sixth part is the conclusion and enlightenment.

2. Literature Review

Microeconomic theory shows that capital plays an important role in the production behavior of enterprises. Under the socialist market economic system, capital is still the link that drives the optimal allocation of various production factors (Sun Fangcheng, 2023) [1]. Microeconomics believes that under ideal conditions, capital allocation could achieve Pareto optimality in a perfectly competitive market. However, in reality, capital is subject to various factors and there is misallocation. The key to correcting capital misallocation lies in improving the efficiency of capital allocation.

From the perspective of the connotation of capital allocation efficiency, some scholars believe that capital allocation includes the whole process of capital input to output, and the level of capital allocation efficiency lies in the input-output ratio (Guo Jitao, 2023 [2]; Cai Zhen, 2023 [3]), which is a broad concept. There are also some scholars who believe that the capital allocation process only targets the capital input link, which is essentially the effectiveness of investment decisions, that is, whether capital could be allocated from low-return departments to high-return departments (Chen Taoqin, 2023 [4]; Hao Ying, 2022 [5]), which is the narrow concept of capital allocation efficiency. Correspondingly, the academic community has also produced different measurement methods of capital allocation efficiency. From the broad concept, scholars such as Li Qinyang (2023) [6] and Qin Jiaqi (2015) [7] use input-output efficiency as the capital allocation efficiency of enterprises; Cai Zhen (2023) [3] and Qi Huaijin (2019) [8] consider the cost of corporate financing, and measure the capital allocation efficiency of enterprises by the ratio of enterprise investment return to capital cost rate. From the narrow concept, scholars mostly use the non-efficiency investment model of Richardson (2006) [9] to measure the deviation between the actual investment level and the ideal state of enterprise investment behavior through model fitting, which is used as the measurement index of enterprise capital allocation efficiency.

As a derivative product of the combination of traditional finance and modern technology, financial technology plays an important role in the operation of enterprises. Most studies show that the progress of financial technology could improve the way of information production and dissemination (Daud et al., 2022) [10], reduce the cost of obtaining information, and effectively alleviate the problem of information asymmetry (Zhou et al., 2024) [11]. Moreover, financial technology could broaden financing channels, reduce borrowing costs (Jagtiani and Lemieux, 2019 [12]), alleviate financing constraints, and improve enterprise competitiveness (Yuan et al., 2024 [13]; Tang et al., 2023 [14]). In terms of the relationship between financial technology and capital allocation efficiency, there is no consensus in the academic community yet. Representative research results include: Lan (2024) [15] conducted research from the perspective of Chinese prefecture-level cities and found that there is an inverted “U” shape between the level of financial technology and capital misallocation. The degree of capital misallocation would first increase and then decrease with the improvement of the level of

financial technology development, accompanied by siphon effect and spatial spillover effect with different levels of financial technology development. Song Min (2021) [16] found through research that small and medium-sized enterprises and weak competitive markets benefit more from the development of financial technology. In this regard, Xie et al. (2022) [17] speculated that financial technology would allocate capital to low-efficiency departments. Based on the data of Chinese enterprises, they found that the development of financial technology would reduce the available capital of high-efficiency companies, and explained it as the impact of loan market competition and the inclusiveness of financial technology, which is contrary to the above research conclusions.

In summary, the relevant research on capital allocation efficiency in the academic community is relatively mature at present, but the relationship between financial technology and capital allocation efficiency still needs to be further clarified. Therefore, this paper would enrich the relevant literature from the following aspects: (1) Construct a theoretical framework of the impact of financial technology on capital allocation efficiency, and explain the relationship between the two from the perspective of mathematics and economics; (2) Starting from the micro perspective, take Chinese A-share listed companies as the research sample, measure the capital allocation efficiency of enterprises, construct an econometric model, and deeply analyze the impact effect and mechanism of financial technology on capital allocation efficiency from the overall perspective and the heterogeneity perspective, providing empirical support for improving the efficiency of enterprise capital allocation.

3. Theoretical Analysis of the Impact of Financial Technology on Capital Allocation Efficiency

(I) Defining the Connotation of Capital Allocation Efficiency

Microeconomic theory indicates that under perfect competition market conditions, resource allocation could reach a Pareto optimal state and achieve optimal resource allocation. However, perfect competition is only an ideal state of economic operation. In the actual process of economic operation, various economic factors interfere, causing the market to always be in an imperfectly competitive state, which leads to the deviation of the resource allocation state from the Pareto optimal state. Capital, as a key resource in the economic operation process, would also deviate from the optimal allocation state when it is in an imperfectly competitive market state. Based on this, this paper defines the efficiency of capital allocation as the deviation between the actual allocation state of capital and its optimal allocation state, and the process of improving the efficiency of capital allocation is the process of reducing the deviation between capital allocation and the ideal state.

(II) Theoretical Foundation of the Impact of Financial Technology Innovation on Capital Allocation Efficiency

The theoretical impact of financial technology on capital allocation efficiency could be proven by the following mathematical relationship. Assume that enterprises produce with Cobb-Douglas production function, denoted as model (1):

$$Y = A \cdot K^{\alpha} \cdot L^{\beta} \tag{1}$$

In model (1), Y represents the output level of the enterprise, A represents the level of technology, K and L represent capital and labor input, and α and β represent the output elasticity of capital and labor, respectively.

The efficiency of capital allocation could be defined as the equilibrium distribution of marginal output of capital among different enterprises. Financial technology innovation may cause capital to flow from enterprises with low marginal output to enterprises with high marginal output.

According to model (1), the marginal output of capital could be obtained, denoted as model (2):

$$MPK = \alpha \cdot AK^{\alpha - 1} \cdot L^{\beta} \tag{2}$$

Financial technology innovation may affect the level of technology (A). Therefore, the factor of financial technology F is introduced into model (1), and the output level of the enterprise could be obtained as model (3):

$$Y = \left(A + \gamma \cdot F \right) \cdot K^{\alpha} \cdot L^{\beta} \tag{3}$$

In model (2), γ represents the marginal impact of financial technology on the level of technology. Based on model (3), the marginal output of capital could be further obtained, denoted as model (4):

$$MPK = \alpha \cdot (A + \gamma \cdot F) K^{\alpha - 1} \cdot L^{\beta} \tag{4}$$

This establishes that the level of financial technology would impact the efficiency of capital allocation in enterprises. From the perspective of microeconomic theory, the essence of financial technology lies in technological progress driving financial innovation. With the arrival of the digital economy and digital civilization era, innovation is the endogenous driving force of economic growth, and an important means for enterprises to optimize resource allocation. Specifically, the theoretical mechanism of the impact of the level of financial technology on the efficiency of capital allocation in enterprises lies in: (1) the improvement of the level of financial technology could drive financial innovation, create financial supply, provide enterprises with more space and more convenient channels for financing, improve the liquidity of capital, optimize capital allocation, and promote enterprises to improve the efficiency of capital allocation (Li Wenfang and Hu Qiuyang, 2024 [18]; Liu Huihao et al., 2024 [19]); (2) the improvement of the level of financial technology could promote the continuous development and improvement of the capital market, promote the orderly flow of capital among enterprises, and thus improve the efficiency of capital allocation in enterprises (Yang Dong, 2018 [20]; Hu Yunfei, 2024 [21]). Furthermore, as financial technology continues to develop, the institutional system of the Chinese capital market would also become increasingly complete. On the one hand, a sound capital market would force enterprises to constantly improve their corporate governance mechanisms; on the other hand, enterprises would also continuously improve their corporate governance level and competitiveness in pursuit of profit maximization. Based on this, this paper proposes a theoretical hypothesis, that is, "the improvement of the level of financial technology promotes the improvement of the level of enterprise governance, and thus improves the efficiency of capital allocation."

4. Research Design

Theoretical analysis shows that the improvement of the level of financial technology innovation could effectively improve the efficiency of capital allocation in enterprises. To more accurately identify this relationship, this section uses an econometric model to empirically test this logical relationship.

(I) Model Construction

According to the research content, this paper constructs the following econometric model to analyze the impact of financial technology innovation on the efficiency of capital allocation:

$$Einv_{i,t} = \alpha_0 + \alpha_1 FinTech_{i,t} + \sum_j \delta_j Controls_{j,i,t} + \eta_{ind} + \eta_{year} + \varepsilon_{i,t} \tag{5}$$

In model (5), *Einv* represents the efficiency of enterprise capital allocation, *FinTech* represents the financial technology index; *Controls* are control variables, η_{ind} and η_{year} represent fixed industry and time fixed effects, respectively, and $\varepsilon_{i,t}$ is the random error term, where *i* refers to the enterprises involved in this study that are listed on the Chinese A-share market, and t = 2008, 2009, ..., 2023.

1. Explained Variable: Enterprise Capital Allocation Efficiency (*Einv*). This paper refers to the methods of scholars such as Richardson (2006) [9], Liu Guang (2023) [22], and Zhang Anjun (2022) [23], and uses an improved expected investment model to measure the difference between actual capital expenditure and optimal investment expenditure as a proxy variable for measuring enterprise capital allocation efficiency. The measurement formula is denoted as model (6):

$$\begin{aligned} Invest_{i,t} = {} & \beta_1 + \beta_1 Growth_{i,t-1} + \beta_2 Size_{i,t-1} + \beta_3 Lev_{i,t-1} + \beta_1 Cash_{i,t-1} + \beta_5 Age_{i,t-1} \\ & + \beta_6 Returng_{i,t-1} + \beta_7 Invest_{i,t-1} + \eta_{ind} + \eta_{year} + \varepsilon_{i,t} \end{aligned} \tag{6}$$

In model (6), *Invest* represents the ratio of a company's new investment expenditure to total assets, where new investment expenditure = total investment – maintenance investment = cash paid for the purchase, construction, or other long-term assets + net cash paid for the acquisition of subsidiaries and other business units – net cash received from the disposal of fixed assets, intangible assets, and other long-term assets – net cash received from the disposal of subsidiaries and other business units–(depreciation of fixed assets + amortization of intangible assets + amortization of long-term deferred expenses). *Growth* represents the growth opportunities

of the company, measured by the Tobin's Q value. Size represents the scale of the enterprise, measured by the logarithm of total assets. *Lev* represents the financial leverage of the enterprise, measured by the debt-to-assets ratio. *Cash* represents the scale of cash flow, measured by the ratio of cash flow to total assets. *Age* represents the years of listing, measured by the logarithm of "current year−year of listing + 1". *Returng* represents the stock return rate, measured by "(current market value of stocks−previous market value of stocks) / previous market value of stocks". η_{ind} and η_{year} represent fixed industry and time effects, respectively, and $\varepsilon_{i,t}$ is the random error term.

The residuals from an OLS regression of model (6) are taken, and the absolute value of the residuals represents the deviation of the actual capital expenditure of the enterprise from the ideal state. A larger deviation indicates lower capital allocation efficiency, while a smaller deviation indicates higher capital allocation efficiency. This paper uses this as a proxy variable for measuring enterprise capital allocation efficiency.

2. Core Explanatory Variable: Financial Technology Level (*FinTech*). This paper refers to the methods of scholars such as Song Min (2021) [16], Tang Song (2022) [24], and Tan Changchun (2023) [25], and selects the cumulative number of financial technology companies in the city where the company's headquarters is located as a proxy variable for measuring the level of financial technology. To prevent significant right-skewness in the data, it is logged after adding 1. The number of financial technology companies is sourced from the China Research Data Platform (CNRDS).

3. Control Variables: (1) Book-to-Market Ratio (*BM*), measured by the ratio of book value to market value; (2) Business Growth (*Growth*), measured by the Tobin's Q value;(3) Earnings Per Share (*Eps*), measured by the ratio of net profit after tax to the total number of shares;(4) Firm Age (*FirmAge*), measured by the logarithm of the company's age plus one;(5) Tangibility Ratio (*Tangibility*), measured by the ratio of tangible assets to total assets;(6) Stock Return Rate (*Returng*), measured by "(current market value of stocks−previous market value of stocks) / previous market value of stocks".

This paper selects Chinese A-share listed companies from 2008 to 2023. To ensure the scientificity and credibility of the research conclusions, the paper excludes financial listed companies, ST and PT listed companies, companies listed on both B-shares and H-shares, and companies with serious data missing or outliers during the specific research process. Meanwhile, to reduce estimation bias caused by extreme values in the empirical research process, the paper performs a winsorization at 1% and 99% for each variable. Unless otherwise specified, the variables involved in this paper are from the CSMAR database. The descriptive statistical analysis of the variables is shown in Table 1.

Table 1. Descriptive Statistics of Variables.

Variables	Observations	Mean	Standard Deviation	Minimum	Maximum
einv	28,830	0.0319	0.0349	0.000254	0.226
FinTech	28,830	3.953	2.473	0	8.422
BM	28,830	0.622	0.261	0.0724	1.316
Growth	28,830	2.079	1.400	0.760	13.80
Eps	28,830	0.463	0.737	−2.362	5.854
FirmAge	28,830	2.950	0.313	1.609	3.689
Tangibilit	28,830	0.927	0.0856	0.452	1
Returng	28,830	0.188	0.492	−0.686	3.887

(II) Benchmark Regression Results

This paper uses panel data from Chinese A-share listed companies from 2008 to 2023 as the sample to estimate model (5) and test the impact of financial technology on capital allocation efficiency. From a theoretical perspective, mixed OLS, fixed effect models, and random effect models are commonly used for estimating panel models. However, in practical applications, the mixed OLS model is often biased due to omitted variable issues,

and the random effect model is often difficult to implement in practice due to overly stringent assumptions. Therefore, most scholars choose to use the fixed effect model to estimate panel data models. Additionally, the results of the Hausman test strongly reject the use of the random effect model. Based on this, the estimation results of model (1) are presented in Table 2.

Table 2. Benchmark Regression.

Variables	Model (1)	Model (2)	Model (3)	Model (4)	Model (5)	Model (6)	Model (7)
FinTech	−0.0004 **	−0.0004 **	−0.0004 **	−0.0004 **	−0.0004 ***	−0.0005 ***	−0.0005 ***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
BM		−0.0129 ***	−0.0122 ***	−0.0123 ***	−0.0115 ***	−0.0117 ***	−0.0114 ***
		(0.001)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Growth			0.0001	0.0001	0.0002	0.0002	−0.0003
			(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Eps				0.0011 ***	0.0011 ***	0.0011 ***	0.0008 **
				(0.000)	(0.000)	(0.000)	(0.000)
FirmAge					−0.0065 ***	−0.0060 ***	−0.0055 ***
					(0.001)	(0.001)	(0.001)
Tangibility						−0.0485 ***	−0.0475 ***
						(0.004)	(0.004)
Returng							0.0040 ***
							(0.001)
Constant	0.0426 ***	0.0542 ***	0.0535 ***	0.0531 ***	0.0685 ***	0.1118 ***	0.1113 ***
	(0.002)	(0.002)	(0.003)	(0.003)	(0.004)	(0.005)	(0.005)
Industry FE	YES	YES	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES	YES	YES
Observations	28,830	28,830	28,830	28,830	28,830	28,830	28,830
Number of id	3418	3418	3418	3418	3418	3418	3418
R2_w	0.0222	0.0242	0.0242	0.0255	0.0260	0.0328	0.0340
F test	4.97	115.80	120.48	133.89	168.49	308.59	342.56

Note: ***, **, * denote statistical significance at the 1%, 5%, and 10% levels, respectively. The values in parentheses are the standard errors.

Table 2′s regression results show that in models (1) to (7), the core explanatory variable financial technology (*FinTech*) passes the statistical significance tests at the 5% level, and the coefficients are negative, indicating that the improvement in the level of financial technology could reduce the deviation of capital allocation from the ideal state and enhance the efficiency of capital allocation. Among the control variables, the book-to-market ratio (*BM*), earnings per share (*Eps*), firm age (*FirmAge*), tangible asset ratio (*Tangibility*), and stock return rate (*Returng*) all pass statistical significance tests.

(III) Robustness Test

The benchmark regression results show that the improvement in the level of financial technology could enhance the efficiency of enterprise capital allocation. However, endogeneity issues may lead to estimation bias. First, the increase in the level of financial technology could improve the efficiency of enterprise capital allocation, and the improvement in the efficiency of capital allocation could promote the flow of capital to more efficient sectors, giving enterprises a stronger motivation and ability to develop financial technology. Therefore, there may be a reverse causality problem; second, in the sample processing process, this paper excludes A-share listed companies with severe data missing, which may lead to sample selection bias; third, although fixed effect

models could largely reduce estimation bias due to omitted variables, unobserved variables may still affect the efficiency of enterprise capital allocation.

Considering this, this paper employs instrumental variable methods (IV), propensity score matching methods (PSM), and control function methods (FC) to test the empirical research conclusions, and the results are presented in Table 3.

Table 3. Robustness Test Results.

Variables	(1) IV	(2) PSM	(3) CF
FinTech	−0.001 ***	−0.0004 **	−0.0006 ***
	(0.000)	(0.000)	(0.000)
Constant		0.1110 ***	0.1032 ***
		(0.006)	(0.005)
Controls	YES	YES	YES
Industry FE	YES	YES	YES
Year FE	YES	YES	YES
Observations	24,343	21,787	26,902
Number of id		3385	3418
R2_w	0.047(Adj_r2)	0.0317	0.0302
F test	371.45	289.02	324.10

Note: ***, **, * denote statistical significance at the 1%, 5%, and 10% levels, respectively. The values in parentheses are the standard errors.

In Table 3, Model (1) of the instrumental variable method is based on the research of Liu Guang (2023) [22] and other scholars, where the lagged term of the financial technology index is selected as the instrumental variable, and the regression results of the two-stage least squares (2SLS) method are presented. The results show that financial technology (FinTech) passes the statistical significance test at the 1% level, with a negative coefficient. This means that, even after considering the influence of reverse causality, the benchmark regression conclusion still holds. Additionally, this paper has tested the identification and validity of the instrumental variable, passing the statistical significance tests for both the unidentified test (Kleibergen-Paap rk LM statistic) and the weak identification test (Cragg-Donald Wald F statistic), indicating that the instrumental variable fully identifies the model and does not have weak identification issues. The test results support the effectiveness of the instrumental variable.

Model (2) is the regression result after considering sample selection bias. The specific operation mainly refers to the research of scholars such as Cai Zhen (2023) [3], Zhao Xinyu (2024) [26]. The propensity score matching (PSM) method is used to test the benchmark regression results. The specific steps are as follows: (1) Sort the financial technology index by size and select the median, defining the portion above the median as the treatment group (Treat = 1) and the rest as the control group (Treat = 0); (2) Define the generated binary variable as the treatment variable and the control variables in this paper as covariates, performing caliper matching with a radius of 0.01 and a matching ratio of 1: 1 based on the Logit model, and testing the matching results; (3) Regress on the matched samples. The results show that financial technology (*FinTech*) passes the statistical significance test at the 5% level, and the coefficient sign is consistent with the benchmark regression conclusion.

Model (3) is the regression result after further considering omitted variables. During the regression process, this paper refers to the research of Chen Taoqin (2023) [4] and adopts the control function method. With the help of propensity score matching on the grouping results of the financial technology index, the Probit model extracts the possibly correlated part between the financial technology index and the error term into the residual, and the residual is introduced as the explanatory variable into the second-stage regression model to observe whether the significance of the core explanatory variable changes. The regression results show that financial technology

(*FinTech*) passes the statistical significance test at the 1% level.

The regression results of Models (1)–(3) in Table 3 indicate that the improvement in the level of financial technology could enhance the efficiency of enterprise capital allocation, consistent with the benchmark regression results, thus demonstrating the high scientific validity and credibility of the benchmark regression conclusions.

(IV) Analysis of Empirical Results

The empirical research results indicate that the improvement in the level of financial technology could reduce the deviation of capital allocation from the ideal state and enhance the efficiency of capital allocation. Even after fully considering the influence of reverse causality, sample selection bias, and omitted variables, the research conclusions remain robust. The reasons for this conclusion are as follows:

1. Technology-Driven Financial Innovation: The essence of financial technology is technology-driven financial innovation. As the level of financial technology improves, financial institutions could provide more financing methods and tools to continuously expand the scope of financial services, supporting enterprise technological innovation. This means that the improvement in the level of financial technology allows financial institutions to provide enterprises with greater space and more convenient channels for financing, thereby enhancing the flexibility and efficiency of enterprise financing and optimizing capital allocation, thus improving the efficiency of enterprise capital allocation.

2. Reducing Market Imperfections: The improvement in the level of financial technology could reduce the imperfection of the capital market caused by information asymmetry and incomplete contracts. As the capital market continues to improve, market activity gradually increases, and transactions in the market become fairer and more just. In this process, capital would transfer according to market laws from low-efficiency enterprises to high-efficiency enterprises, that is, to realize the decisive role of the market in resource allocation, thereby improving the efficiency of enterprise capital allocation.

3. Financial System Reform: The report of the 19th National Congress of the Communist Party of China clearly points out the need to "deepen the reform of the financial system and enhance the ability of financial services to serve the real economy." For a long time, the key factor restricting the quality and efficiency of China's financial industry in serving the real economy has been the imbalance between financing models and financial supply and demand. The improvement in the level of financial technology could significantly reduce the impact of the imbalance between financing models and financial supply and demand on the real economy. Financial technology could create financial supply and solve the practical problem of insufficient financial supply, further optimizing the space for capital allocation and promoting the improvement of enterprise capital allocation efficiency.

5. Further Discussion

(I) Mechanism Testing

The preceding theoretical hypothesis suggests that the mechanism by which financial technology affects the efficiency of corporate capital allocation is "the improvement in the level of financial technology promotes the enhancement of corporate governance, which in turn improves the efficiency of capital allocation." To test this mechanism, this paper introduces corporate governance (*Gov*) as an intermediate variable in model (I). Considering that traditional mediation effect models may have endogeneity issues, this paper follows the approach of Jiang Ting (2022) [27] and constructs the following mediation effect model based on model (I) to identify the impact of the core explanatory variable, the level of financial technology (*FinTech*), on the intermediate variable, the level of corporate governance (*Gov*), denoted as model (7):

$$Gov_{i,t} = \gamma_0 + \gamma_1 FinTech_{i,t} + \sum_j \lambda_j Controls_{j,i,t} + \eta_{ind} + \eta_{year} + \varepsilon_{i,t} \quad (7)$$

In model (7), *Gov* represents the level of corporate governance, which is the intermediate variable. The meanings of other variables are the same as those in the benchmark regression model. Following the research of Jiang Ting (2002) [27] and others, the existence of a mediation effect is recognized when both the regression coefficients of α_1 and γ_1 are statistically significant.

Among them, the level of corporate governance (*Gov*) is measured using principal component analysis (PCA) based on the practices of scholars such as Bai Zhong'en (2005) [28], Zhou Qian (2020) [29], and others. This method selects multiple indicators from aspects such as supervision, incentives, and decision-making to construct a comprehensive index that measures the level of corporate governance for enterprises in China. The selection of indicators for measuring corporate governance level is shown in Table 4.

Table 4. Measurement Indicators for the Mediation Variable Corporate Governance Level.

Primary Indicator	Secondary Indicator	Indicator Description
Supervision	Independent Director Ratio	Number of Independent Directors/Total Number of Directors
	Board of Supervisors Size	Natural log of the number of supervisors
	Equity Concentration	Calculated by summing the squares of the shareholding ratios of the top 3 major shareholders
Incentives	Audit Opinion	0 for unqualified audit opinions, 1 for qualified audit opinions
	Executive Compensation	Natural log of the total monetary compensation of the top 3 executives
	Executive Shareholding Ratio	Management shareholding data divided by the total number of shares outstanding
Decision-Making	Dual Role	1 if the chairman and general manager are the same person, otherwise 0
	Board Size	Natural log of the number of board members

Based on the preceding analysis, this paper uses corporate governance (*Gov*) as an intermediate variable to test the impact mechanism of financial technology on the efficiency of corporate capital allocation. The test results are presented in Table 5.

Table 5. Mediation Test Results.

Variables	(1) Einv	(2) Gov
FinTech	−0.0005 ***	0.0064 *
	(0.000)	(0.003)
Constant	0.1113 ***	0.0570
	(0.005)	(0.083)
Controls	YES	YES
Industry FE	YES	YES
Year FE	YES	YES
Observations	28,830	28,830
Number of id	3418	3418
R2_w	0.0340	0.0470
F test	342.56	109.55

Note: ***, **, * denote statistical significance at the 1%, 5%, and 10% levels, respectively. The values in parentheses are the standard errors.

Table 5′s regression results show that the core explanatory variable, the level of financial technology (*FinTech*), passes the significance test at the 1% and 10% levels in models (1) and (2), respectively, indicating that the improvement in the level of financial technology could reduce the deviation of capital allocation from the ideal state and enhance the efficiency of capital allocation, and that the improvement in the level of financial technology could also increase the level of corporate governance. This suggests that corporate governance plays

a mediating role in the process of financial technology enhancing the efficiency of corporate capital allocation, that is, the improvement in the level of financial technology could promote the enhancement of corporate governance, which in turn improves the efficiency of capital allocation.

(II) Heterogeneity Analysis

To more accurately assess the impact of financial technology on the efficiency of capital allocation, this section conducts an analysis from the perspective of heterogeneity: (1) There are two forms of capital allocation in China's A-share listed companies: over-investment and under-investment. Based on this, the sample is divided into over-investment (*Overinv*) and under-investment (*Underinv*) categories, respectively labeled as sub-sample 1 and sub-sample 2, with the regression results presented in Table 6. (2) Considering the impact of differences in financial technology levels, this paper uses the median level of financial technology as the critical point, labeling the samples below the threshold as sub-sample 3 and those above the threshold as sub-sample 4, with the regression results presented in Table 7.

Table 6. Heterogeneity Analysis Results (1).

Variables	Sub-Sample 1 (overinv)		Sub-Sample 2 (underinv)	
	Model (1)	Model (2)	Model (3)	Model (4)
FinTech	−0.0006 **	−0.0006 ***	−0.0003	−0.0003 **
	(0.000)	(0.000)	(0.000)	(0.000)
Constant	0.0513 ***	0.1593 ***	0.0352 ***	0.0570 ***
	(0.003)	(0.008)	(0.002)	(0.005)
Controls	NO	YES	NO	YES
Industry FE	YES	YES	YES	YES
Year FE	YES	YES	YES	YES
Observations	12,239	12,239	16,591	16,591
Number of id	2855	2855	3166	3166
R2_w	0.0269	0.0627	0.0192	0.0300
F test	4.84	366.82	2.40	192.06

Note: ***, **, * denote statistical significance at the 1%, 5%, and 10% levels, respectively. The values in parentheses are the standard errors.

By comparing the coefficients of the core explanatory variable, the level of financial technology (*FinTech*), in models (1)–(4) of Table 6, it could be seen that financial technology could suppress, to some extent, the behaviors of excessive investment and under-investment in enterprises, reducing the deviation of capital allocation from the ideal state. At the same time, the core explanatory variable in sub-sample 1 all pass the statistical significance test, while in sub-sample 2, it does not pass the test. This indicates that when enterprises have excessive investment behavior, the effect of financial technology in suppressing excessive investment is more pronounced, and its impact on improving the efficiency of enterprise capital allocation is more significant.

In Table 7, the coefficients of the core explanatory variable, the level of financial technology (*FinTech*), in models (1)–(4) are all negative, indicating that the improvement in the level of financial technology helps to reduce the deviation of capital allocation from the ideal state and enhance the efficiency of capital allocation. Furthermore, in models (3) and (4), the level of financial technology (*FinTech*) passes the significance test at the 1% level and has a significantly higher coefficient value compared to models (1) and (2). This suggests that the higher the level of financial technology, the more significant its effect in improving the efficiency of capital allocation.

Table 7. Heterogeneity Analysis Results (2).

Variables	Sub-Sample 3		Sub-Sample 4	
	Model (1)	Model (2)	Model (3)	Model (4)
FinTech	−0.0005	−0.0003	−0.0007 ***	−0.0009 ***
	(0.000)	(0.000)	(0.000)	(0.000)
Constant	0.0438 ***	0.1193 ***	0.0423 ***	0.1032 ***
	(0.003)	(0.008)	(0.005)	(0.008)
Controls	NO	YES	NO	YES
Industry FE	YES	YES	YES	YES
Year FE	YES	YES	YES	YES
Observations	14,424	14,406	14,424	14,406
Number of id	2171	2768	2171	2768
R2_w	0.0145	0.0229	0.0291	0.0304
F test	1.80	7.02	187.95	180.49

Note: ***, **, * denote statistical significance at the 1%, 5%, and 10% levels, respectively. The values in parentheses are the standard errors.

6. Conclusions and Insights

Through the above analysis, the following conclusions could be drawn: (I) The improvement in the level of financial technology could significantly reduce the deviation of capital allocation from the ideal state and enhance the efficiency of capital allocation in enterprises. (II) The improvement in the level of financial technology could suppress the behaviors of excessive investment and under-investment in enterprises, promoting the improvement of capital allocation efficiency. The suppression of excessive investment behavior is significantly higher than that of under-investment behavior. (III) The higher the level of financial technology, the more significant its effect on improving the efficiency of capital allocation, which is more conducive to enhancing the efficiency of enterprise capital allocation. (IV) The mechanism by which financial technology affects the efficiency of capital allocation is that financial technology promotes the enhancement of corporate governance, thus producing the effect of promoting the efficiency of enterprise capital allocation.

From these conclusions, the following insights could be drawn: Firstly, further enhance the level of financial technology to promote enterprises to improve the efficiency of capital allocation. The capital market is an important part of the modern financial system. Chinese government departments need to take necessary policy guidance and support to promote the improvement of financial technology. By taking the level of financial technology as the starting point, we could promote the deepening of capital market reform, improve the system of capital market institutions, and give full play to the decisive role of the market in resource allocation, forcing enterprises to improve their innovation capabilities and enhance the efficiency of capital allocation. Secondly, take the improvement of the level of financial technology as a starting point to improve the corporate governance level of listed companies. Corporate governance level is an important mechanism by which financial technology affects the efficiency of capital allocation in enterprises. China needs to further advance the development of financial technology, accelerate the improvement of the capital market system, and improve the market-oriented price discovery mechanism and delisting system to continuously enhance the vitality of the capital market. By taking the development of financial technology as an opportunity, we could promote fair and just transactions, improve the corporate governance level of listed companies, and inject vitality into the improvement of the efficiency of enterprise capital allocation. Thirdly, promote the deep integration of finance and technology to enhance the effectiveness of financial services for enterprises. The key to the improvement of the level of financial technology lies in promoting the deep integration of finance and technology. The development of financial technology is a key factor in promoting the high-quality development of China's

economy. Enterprises are the micro-carriers for achieving high-quality economic development in China. Therefore, China needs to further promote the integration of finance and technology to provide enterprises with comprehensive, full-life cycle support for scientific and technological research and development, transformation of scientific and technological achievements, and technological innovation, promoting the transformation of scientific and technological innovation achievements into actual productive forces.

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