Study of Digital Inclusive Finance, Financing Constraints and M&A Frequency based on Empirical Data of Technology-based Enterprises

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Abstract. Stimulating the vitality of the M&A market of technology-based enterprises is a critical approach for driving high-quality development through technological innovation. As a new engine propelling the high-quality and healthy development of our national economy, digital inclusive finance influences the optimization of financial-economic structure and elevates the M&A frequency of technology-based enterprises. This paper empirically tests the influence of digital inclusive finance on the M&A frequency of technology-based enterprises using a sample of companies listed on the GEM from 2011-2021, employing the PSM-DID method. The study indicates that, generally, digital inclusive finance significantly raises the M&A frequency of technology-based enterprises. Financing constraints plays a mediating role within this. The research provides a theoretical basis for how the financial market in the new development stage can better serve the national innovation-driven strategy and contribute to high-quality development of the real economy.

Keywords: Digital Inclusive Finance; Technology-based Enterprises; M&A Frequency; Financing Constraints.

1. Introduction

In recent years, the COVID-19 pandemic and the rise of trade protectionism have caused the global economic recovery to stagnate. Under tremendous operating pressure, companies have accelerated their entry into the stage of transformation and integration: companies with competitive advantages are focusing on expanding their business layout, while companies in a dilemma are also eager to seek new investment opportunities. Mergers and acquisitions have therefore become a high-priority strategy. Mergers and acquisitions have always been an important way for companies to acquire external innovation resources and gain competitive advantages. Technology-based enterprises, as an important carrier of the national innovation-driven development strategy, tend to launch multiple mergers and acquisitions activities in a short period of time to quickly acquire professional technology and generate technological innovation effects [1]. However, the high frequency of mergers and acquisitions activities has brought great pressure on the cash flow of technology-based enterprises. Enterprises can only rely on internal accumulation to meet the funding needs of mergers and acquisitions activities. Therefore, external financing support has become a key factor in determining whether technology-based enterprises can successfully implement continuous mergers and acquisitions strategies [2]. Under the traditional financial system, technology-based enterprises are excluded due to their high investment risks, long cycles, and lack of effective collateral assets. The financial services they can enjoy are relatively limited, and there is a large gap in financial demand, which is not conducive to their mergers and acquisitions activities [3]. The emergence and rapid development of digital inclusive finance can provide sufficient external financing support for technology-based enterprises and provide breakthroughs and opportunities for stimulating the vitality of the technology-based enterprises merger market. In 2013, the "Decision of the Central Committee of the Communist Party of China on Several Major Issues Concerning Comprehensively Deepening Reforms" officially proposed "developing inclusive finance and encouraging financial innovation"; in 2016, the release of the "G20 Digital Inclusive Finance High-Level Principles" (hereinafter referred to as "Principles") marked China's inclusive finance officially entering the digital

development stage; in 2022 National Two Sessions government work report once again emphasized that digital inclusive finance should become a key layout area for national strategic planning.

Existing research on digital inclusive finance focuses more on how it affects the endogenous growth of enterprises. For example, Qiao et al. (2022) [4] empirically tested that digital inclusive finance promotes enterprise innovation by solving problems such as information asymmetry and unreasonable allocation of funds. Zhang et al. (2020) [5] found that digital inclusive finance improves the product quality of export-oriented enterprises by alleviating financing constraints. However, few studies focus on the impact of digital inclusive finance on enterprise extensional development. At the same time, corporate merger frequency has always been a hot topic in academic research. At the micro level, scholars have studied how management power and personality [6], executive compensation [7], family culture [8], etc., affect corporate merger frequency; macro-level research points out that macro-environmental uncertainty [9], environmental changes triggered by national industrial structure adjustment, capital activity [10], market merger conditions [11] and other factors will have a certain impact on corporate merger frequency. For technology-based enterprises, existing research believes that corporate R&D capabilities, industry competitiveness, merger experience, etc., are important factors affecting their merger frequency [12]. Existing research has certain reference and reference significance for understanding the merger frequency of technology-based enterprises from the perspective of operating environment. However, there are relatively few studies focusing on how macroeconomic policies and financial development affect the merger frequency of technology-based enterprises. Based on this, this paper attempts to study how financial development affects the merger frequency of technology-based enterprises from the perspective of digital inclusive finance.

Compared with existing researches, this paper's innovations may include: (1) Incorporating digital inclusive finance into the research framework of technology-based enterprises merger frequency and empirically testing how digital inclusive finance affects technology-based enterprises merger frequency The mechanism provides some reference for future development direction of digital inclusive finance. (2) This paper enriches research on economic effects of digital inclusive finance from perspective of merger frequency while expanding research on factors affecting corporate merger frequency providing theoretical basis for developing digital inclusive finance to help development of technology-based enterprises serve national innovation-driven strategy through developing digital inclusive finance. (3) This paper uses PSM-DID estimation method to study driving effect of digital inclusive finance on merger frequency of technology-based enterprises. Implementation of digital inclusive finance policy has nature of "quasi-natural experiment" reducing interference endogeneity on results this study.

2. Literature References

Finance is the core of the modern economy and an important component of the technology-based enterprise merger and acquisition (M&A) market. The effective supply of finance directly affects the development of M&A activities in technology-based enterprises. Specifically, the financial environment directly influences the financing costs and investment plans of enterprises. Enterprises that have long been under soft financing constraints are more inclined to actively expand M&A activities, while those facing financing difficulties are forced to abandon advantageous investment plans [13]. In the traditional financial system, large enterprises and state-owned enterprises, which are less numerous, are more likely to receive favor from credit institutions. technology-based enterprises, which make significant contributions to the national innovation-driven strategy and economic development, face higher investment risks, longer cycles, and a lack of effective collateral. Consequently, they enjoy relatively limited financial services. As a result, their advantageous investments and M&A plans are forced to be put on hold, which severely suppresses the vitality of the technology-based enterprise M&A market and affects the implementation of the innovation-driven strategy.

The shortcomings of traditional finance have given rise to new financial models. The goal of inclusive finance policies is to provide comprehensive, efficient financial services for all social classes and groups with financial needs. The wide application of financial technology has driven the rapid rise of digital inclusive finance, and digital technology has further promoted the sinking of inclusive financial services. This effectively solves the problem of financial exclusion, and digital inclusive finance is increasingly becoming a new trend in the development of inclusive finance. From a micro perspective, digital inclusive finance significantly improves the financial accessibility of enterprises and provides convenience for their digital transformation. From a macro perspective, digital inclusive finance optimizes the financial and economic structure and promotes high-quality and healthy economic development.

In recent years, research on the relationship between M&A frequency and corporate economic performance has attracted scholars' attention. Schipper & Thompson (1983) were the first to define serial M&A as "at least three M&A activities within three years by a company." The term "serial" emphasizes the frequency of M&A activities rather than the time. To better measure and assess the serial M&A behavior of enterprises, Jia Changjie (2003) [14]. proposed the concept of M&A frequency, which is the total number of M&A activities initiated by a listed company within a year. Zhang Guangbao (2012) [15] found that high-frequency M&A activities initiated for self-serving purposes have negative effects on corporate performance. Qu Haitao et al. (2015) [16] discovered a nonlinear inverted "U" relationship between M&A frequency and performance. Jiang Zhixiong and Wang Yulu (2022) [17] focused on technology-acquiring enterprises and concluded that the M&A frequency of such enterprises has a positive long-term impact on M&A performance. In summary, in the short term, there are certain negative effects of significantly increasing M&A frequency for managerial self-interest. However, from a long-term perspective, a reasonable increase in M&A frequency can improve corporate M&A performance.

Regarding the impact of digital inclusive finance on enterprise development, existing research has found that it can promote enterprise innovation, optimize capital structure, alleviate financing constraints, and improve M&A performance. Research on factors influencing the M&A frequency of technology-based enterprises mainly falls into two categories: on the one hand, from an internal perspective, high-frequency M&A in the short term can restructure the industry chain to achieve resource complementarity and create competitive advantages, while also rapidly expanding scale. Furthermore, it can optimize and adjust the capital structure [18], quickly acquire technology to enhance core competitiveness, improve innovation performance [19], and expand the industrial scale to increase market share [20]. On the other hand, from an external perspective, the innovation output of target enterprises [21] and the impact of political and economic factors [22] will also affect the M&A frequency of technology-based enterprises. However, few studies have focused on the possible impact of digital inclusive finance on the M&A frequency of technology-based enterprises. In fact, the inclusiveness and precision of digital inclusive finance are more in line with the characteristics and financing environment of technology-based enterprises. Therefore, whether in terms of incremental scale supplementation or stock scale optimization, there is room for further verification of the impact of digital inclusive finance on the M&A frequency of technology-based enterprises. Is the digital inclusive finance policy, which relies on digital technology and inclusive financial service application scenarios, effective? Can it help technology-based enterprises smoothly implement continuous M&A strategies and increase their M&A frequency? What are the underlying mechanisms? These questions have become valuable and meaningful research issues.

3. Theoretical Analysis and Hypotheses

3.1 The Impact of Digital Inclusive Finance on the Merger and Acquisition Frequency of Technology-based Enterprises

Digital inclusive finance can enhance the capital guarantee of technology-based enterprises and increase their merger and acquisition frequency, specifically reflected in reducing external financing costs and reducing corporate financial risks.

Firstly, the merger and acquisition frequency of enterprises is affected by the cost of capital. When the capital cost decreases, the principal and interest repayment pressure of the main merging enterprises is relieved, and the decision-makers of mergers and acquisitions will choose to expand the scale of mergers and acquisitions, and increase the frequency of mergers and acquisitions [23]. Under the traditional financial system, the merger and acquisition capital cost of technology-based enterprises is relatively high. From the perspective of financing channels, technology-based enterprises have a high investment risk, a long cycle, a lack of effective collateral assets, and are easily excluded by the traditional financial system. The financing channels are single, and they are also affected by factors such as insufficient government-specific funds and an imperfect financing guarantee system, which can only be forced to choose more stringent conditions and higher financing cost channels [24]. In addition, in the choice of financing methods, technology-based enterprises have a heavy operating burden, high internal operating costs, and limited internal funding available, so they tend to choose external financing methods with higher capital costs. Digital inclusive finance can design more accurate risk products for technology-based enterprises, facilitate financial institutions to conduct risk assessment more quickly, and break through the geographical restrictions of financial services to obtain funds more conveniently and at a lower cost. To a certain extent, it broadens the financing channels of technology-based enterprises, improves the availability of funds, reduces external capital costs, and thereby increases the merger and acquisition frequency of technology-based enterprises.

Secondly, digital inclusive finance helps to reduce the financial risks generated in the merger and acquisition process of technology-based enterprises and increase the frequency of mergers and acquisitions. Financial risks run through the entire merger and acquisition activities, among which payment risk and financing structure risk have the most significant impact on technology-based enterprises, specifically manifested as: first, high-frequency merger and acquisition activities require enterprises to raise and pay large amounts of funds in a short period of time, which will impose a huge burden on the enterprise's cash flow and increase the company's payment risk [25]. The large amount of cash flow occupied by merger and acquisition activities will also affect the innovation and R&D investment of technology-based enterprises, reduce investment efficiency, and be detrimental to the future development of enterprises; second, due to the customer quality preference of financial institutions and the characteristics of technology-based enterprises themselves, traditional financial institutions have very limited credit issuance to technology-based enterprises, resulting in a low proportion of debt capital in the financing structure of technology-based enterprise mergers and acquisitions, which will deteriorate the capital structure to a certain extent. It can be seen that the financial risks of mergers and acquisitions will bring about the deterioration of the main merging enterprise's financial situation, thereby suppressing the enthusiasm for mergers and acquisitions of technology-based enterprises and reducing their merger and acquisition frequency. Digital inclusive finance can effectively reduce corporate financial risks, specifically manifested in: first, digital inclusive finance improves the financing environment of technology-based enterprises, promotes the financial sustainability of technology-based enterprises, enhances the ability of enterprises to allocate resources, improves the cash flow and capital structure of enterprises, and thereby reduces financial risks [26]; second, digital inclusive finance creates a diverse and inclusive credit financing environment for technology-based enterprises, creating conditions for enterprises to adjust their capital structure through debt financing, reducing the financial risks of technology-based

enterprises[27], and thereby increasing their merger and acquisition frequency. Based on this, this paper proposes the following hypothesis:

Hypothesis 1: The implementation of digital inclusive finance policies has increased the merger and acquisition frequency of technology-based enterprises.

3.2 Digital Inclusive Finance, Financing Constraints, and the Frequency of Mergers and Acquisitions in Technology-based Enterprises

Digital inclusive finance can alleviate the financing constraints of technology-based enterprises, thereby increasing their frequency of mergers and acquisitions. On the one hand, the intrinsic characteristics and financing features of technology-based enterprises are severely mismatched with the traditional financial system, and factors such as narrow financing channels, potential financing risks, and high transaction costs have increased the financing threshold of technology-based enterprises, causing them to face higher financing constraints. Firstly, technology-based enterprises have limited financing channels and significant financing gaps, while digital inclusive finance can promote financial product and service innovation through supply-side competition mechanisms, leading to an increase in financial service supply and expanding financing channels for technology-based enterprises. Secondly, technology-based enterprises have higher financing risks, and they are excluded from the traditional financial system due to the lack of tangible assets as collateral, high risks in technology innovation projects, large funding requirements, and unstable returns. Digital inclusive finance can accurately profile technology-based enterprises, form their own credit capital, increase the trust between the two parties of capital supply and demand, and enhance the willingness of financial institutions to lend. Thirdly, high transaction costs are the primary barriers hindering financial services for technology-based enterprises, and digital inclusive finance relies on digital technology to improve the efficiency of financial resource allocation, effectively reducing financial service and transaction costs, and alleviating financing constraints for technology-based enterprises.

On the other hand, alleviating financing constraints can increase the frequency of mergers and acquisitions of technology-based enterprises through the following two channels. First, alleviating financing constraints can improve the cash flow of technology-based enterprises[28]. The high-input, high-risk, and continuous innovation characteristics of technology-based enterprises result in large cash demands and generally insufficient internal cash flow. The existence of financing constraints further limits the ability of technology-based enterprises to obtain funds externally, forcing enterprises to abandon advantageous investment projects and reduce the frequency of mergers and acquisitions[29]. The alleviation of financing constraints reduces the burden on technology-based enterprises' cash flow, lowers the cost of debt financing and the ratio of high-cost liabilities, accelerates the flow of funds, and provides strong support for the mergers and acquisitions activities of technology-based enterprises, thereby increasing their frequency to some extent . Second, alleviating financing constraints reduces the cost of mergers and acquisitions financing for technology-based enterprises, thereby increasing their frequency. Traditional MM theory suggests that in a perfect capital market, the capital costs of endogenous and exogenous financing for enterprises are the same, and the investment activities of enterprises are not directly related to financing methods. However, due to the imperfections in the capital market, information asymmetry, and agency problems, enterprises face varying degrees of financing constraints, and the cost of exogenous financing is much higher than that of internal financing. The internal funds of technology-based enterprises are generally insufficient to meet the demands of multiple mergers and acquisitions activities in the short term, and high exogenous financing costs further limit their mergers and acquisitions activities. The alleviation of financing constraints makes the cost of obtaining external funds lower for technology-based enterprises, increasing the frequency of mergers and acquisitions. Based on this, the following hypothesis is proposed:

Hypothesis 2: Financing constraints play a mediating role between digital inclusive finance and the frequency of mergers and acquisitions in technology-based enterprises, i.e., digital inclusive

finance increases the frequency of mergers and acquisitions by alleviating the financing constraints of technology-based enterprises

4. Study Design

4.1 Definition of Variables

4.1.1 Dependent Variable

In this study, the total number of mergers and acquisitions (M&A) activities within a year is defined as M&A frequency [30], and M&A is limited to asset acquisitions, mergers, tender offers, and equity transfers, excluding debt restructuring, asset divestitures, asset swaps, and share buybacks.

4.1.2 Independent Variables

Setting up two dummy variables, finance and time. Finance=1 represents the treatment group, following Sun Jiguo and Hu Jinyan (2020) [31] in dividing treatment and control groups according to the intensity of the impact of inclusive finance policies on the regions where the enterprises are located. This study calculates the median growth rate of the digital inclusive finance indices of 34 provinces from 2017 to 2021. If the growth rate of the digital inclusive finance index in the province where the enterprise is located from 2017 to 2021 is greater than the median, it is set to 1, representing the treatment group, indicating that the enterprise is significantly affected by the digital inclusive finance policy; otherwise, it is set to 0, representing the control group. The "Principles" were promulgated in 2016, with time=0 representing the years before the promulgation of the "Principles" (2011-2015), and time=1 representing the years after the promulgation of the "Principles" (2017-2021).

4.1.3 Control Variables

Following the papers on corporate M&A, inclusive finance, and regional financial development by Zhang Xiaodong (2021) [2b], Zhang Guangbao and Shi Jikun (2012)[6b], etc., this study selects the following control variables: debt-to-asset ratio (DAR), cash flow (CASH), return on equity (ROE), firm size (SIZE), revenue growth rate (GROWTH),, equity concentration (TOP1), ownership nature (SOE), dual positions held by one person (DUAL), and management shareholding (SHARE). Following the practice of Yu Yihua et al. (2017), we control for provincial effects and year effects.

4.1.4 Mediating Variable

Financing constraints play a mediating role in the impact of digital inclusive finance on the M&A frequency of technology-based enterprises. Current methods for measuring financing constraints include single firm characteristic indicators and multi-indicator composite indices, where single firm characteristic indicators include dividend payout ratio, debt ratio, bond rating, etc. However, using a single indicator to measure the overall financing constraints of a firm has certain randomness and anomalies. Constraint indices include KZ index, WW index, and SA index. However, the calculation of WW index and KZ index includes endogenous financial variables such as firm cash flow and leverage ratio, while the calculation of SA index is not affected by endogenous financial variables such as firm operating conditions and financing methods, and the results are more robust and reliable. The estimation model is as follows:

$$SA = -0.737 * Size + 0.043 * Size^2 - 0.04 * Age \quad (1)$$

Where Size is the logarithm of the total assets of the company at the end of the period, and age is the age of the company. This paper retains the absolute value of the SA index. The larger the absolute value, the lower the degree of financing constraints for the enterprise. The main variable definitions are shown in Table 1.

4.2 Sample Selection and Data Sources

This paper selects the initial sample of Chinese Growth Enterprise Market (GEM) listed companies from 2011 to 2021 based on the China Securities Regulatory Commission's (CSRC) 2012 Industry Classification and the technology-based enterprise standards defined in the "technology-based Industry Statistical Information Compilation and Release Format" published by the National Bureau of Statistics. Data are obtained from the CSMAR and WIND databases, and the digital inclusive finance index is taken from the "Peking University Digital Inclusive Finance Index" [32]. The sample is then screened as follows: (1) Excluding companies with missing major variables, those that have undergone IPOs during the period, firms with a debt-to-asset ratio greater than 1, and firms with negative owner equity book values, as these data anomalies and missing values may affect the reliability of the study's results; (2) Excluding ST-type companies data; (3) To eliminate the influence of extreme values, a 1% winsorization is applied to the main continuous variables, ultimately yielding 5,126 valid samples.

Table 1. Variable definition1

	Variable	Symbol	Notes
Dependent Variable	M&A Frequency of technology-basednology Enterprises	M&A	Total number of M&A in a year
Explanatory Variable	Enterprises Significantly Affected by Digital Inclusive Finance Policies	Finance	From 2017 to 2019, when the growth rate of the digital inclusive financial index of the province where the enterprise is located is greater than the median of 34 provincial administrative regions, take 1, otherwise it is 0
	Principle Issuance Time	Time	Before the promulgation of the principles (2013 - 2015), take 1, otherwise it is 0
Mediating Variable	SA index	SA	Metrics for financing constraints
Control Variables	Debt-to-Asset Ratio	DAR	Total liabilities / total assets
	Cash Flow	CASH	(Net operating cash flow- capital expenditure) / total assets
	Return on Equity	ROE	Net profit / net assets
	Enterprise Size	SIZE	The logarithm of the total assets of the enterprise at the end of the period
	Operating Income Growth Rate	GROWTH	Growth rate of main business income in one year
	Shareholder Concentration	TOP1	Shareholding ratio of the largest shareholder
	Ownership Nature	SOE	State-owned enterprises take 1, otherwise take 0
	Dual Positions	DUAL	If the chairman and the CEO are the same person, take 1, otherwise take 0
	Management Shareholding	SHARE	Executive shareholding ratio
	Year	Year	Year fixed effect
	Province	Province	Provincial fixed effect

4.3 Model Setup

This paper examines the impact of digital inclusive finance on the merger and acquisition (M&A) frequency of technology-based enterprises, simulating the implementation of digital inclusive finance policies as a "quasi-natural experiment" and constructing a "counterfactual control group" to study the M&A frequency differences between companies significantly affected by policies (treatment group) and those not significantly affected (control group). Based on this, this paper draws on the research of Wu Xianming and Zhang Yumei (2019) [33], using Propensity Score

Matching (PSM) and Difference-in-Differences (DID) methods to explore the impact of digital inclusive finance on the M&A frequency of technology-based enterprises and sets up the following DID regression model:

$$M\&A_{it} = a_0 + a_1 finance_{it} + a_2 time_{it} + a_3 time_{it} finance_{it} + a_4 control_{it} + a_5 year_t + a_6 province_i + \varepsilon_{it} \quad (2)$$

In the model, M&A represents the M&A frequency of technology-based enterprises, control it represents the set of control variables, year t is the year effect, province i is the province effect of the enterprise, t is the year identifier, i is the province identifier, and the interaction term finance*time is the core explanatory variable. Table 2 provides an intuitive interpretation of the regression model:

Table 2. The meaning of Parameter in DID model23

	Before the promulgation of the principles	After the promulgation of the principles	Difference
Experimental group	a0+a1	a0+a1+a2+a3	a2+a3
Control group	a0	a0+a2	a2
DID			a3

As shown in Table 2, the change in M&A frequency for the treatment group before and after the implementation of digital inclusive finance policies is a2+a3, and for the control group, it is a2. The difference in M&A frequency before and after policy implementation for the treatment and control groups, DID=a3, is the coefficient of the interaction term time*finance. If this coefficient is significantly positive, it indicates that digital inclusive finance policies have a significant positive impact on the M&A frequency of technology-based enterprises.

To examine the mediating role of financing constraints in Hypothesis 2, this paper follows the mediation effect testing procedure proposed by Wen Zhonglin and Ye Baojuan (2014) [34], constructing the following regression models:

$$SA_{it} = \beta_0 + \beta_1 finance_{it} + \beta_2 time_{it} + \beta_3 time_{it} finance_{it} + \beta_4 controls_{it} + \beta_5 year_t + \beta_6 province_i + \varepsilon_{it} \quad (3)$$

$$M\&A_{it} = \gamma_0 + \gamma_1 finance_{it} + \gamma_2 time_{it} + \gamma_3 finance_{it} time_{it} + \gamma_4 SA_{it} + \gamma_5 control_{it} + \gamma_6 year_t + \gamma_7 province_i + \varepsilon_{it} \quad (4)$$

Among them, financing constraints (SA) are the intermediary variables that affect the frequency of M&A of technology-based enterprises in digital inclusive finance, and the meanings of other variables are consistent with Model (1).

5. Empirical Analysis

5.1 Descriptive Statistics

Table 3 shows the results of descriptive statistics for each variable. There is no significant difference among the mean values of the financial index control variables, and the maximum and minimum values are relatively close, indicating a uniform distribution of the sample and strong comparability between the two groups of data. From the results of the t-test, the mean value of the merger frequency for the experimental group is 85% higher than that of the control group, and the difference is significant, preliminarily verifying that the implementation of digital inclusive finance policies can increase the merger frequency of technology-based enterprises.

Table 3. Descriptive statistics 45

Variable	Group	Mean value	Standard deviation	Minimum value	Maximum value	T
M&A	Experimental group	1.151	1.292	0.000	21.00	-8.071***
	Control group	0.621	0.915	0.000	5.00	
DAR	Experimental group	0.310	0.166	0.021	0.976	0.898
	Control group	0.320	0.172	0.029	0.989	
CASH	Experimental group	0.046	0.068	-0.454	0.372	-1.003
	Control group	0.042	0.074	-0.350	0.652	
ROE	Experimental group	0.045	0.556	-27.595	0.528	-1.017
	Control group	0.042	1.325	-19.672	0.494	
SIZE	Experimental group	9.252	0.367	8.346	11.001	1.187
	Control group	9.282	0.337	8.346	10.470	
GROWTH	Experimental group	0.269	1.630	-0.911	82.699	0.055
	Control group	0.275	0.763	-0.864	6.431	
Top1	Experimental group	30.375	12.443	3.003	81.184	0.106
	Control group	30.467	12.650	6.985	61.479	
SOE	Experimental group	0.049	0.216	0.000	1.000	2.243*
	Control group	0.093	0.292	0.000	1.000	
DUAL	Experimental group	0.439	0.496	0.000	1.000	-3.593**
	Control group	0.321	0.468	0.000	1.000	
SHARE	Experimental group	28.963	20.917	0.000	93.936	-1.667
	Control group	26.546	20.737	0.000	79.758	

Note(s):The symbols ***, ** and * indicate significant at confidence level of 1%, 5% and 10%.The value of T are in parentheses,the same goes for the following.

5.2 Propensity Score Matching (PSM)

To reduce data bias and confounding factors, this paper adopts the Propensity Score Matching (PSM) method proposed by Rosenbaum & Rubin (1985) [35] for Nearest Neighbor Matching. First, the effects of multiple variables are analyzed using a logistics regression model, and the propensity scores for the experimental and control groups are calculated. To improve matching efficiency, a resampling method is used. Table 4 presents the ATT effect analysis, showing that after matching, the ATT effect value is significant. After PSM analysis, a significant difference is revealed between finance and M&A, with an ATT effect value of 0.716, indicating a positive effect of finance on M&A.

Rosenbaum & Rubin (1985)concluded that when the absolute value of the standardized bias is less than 20%, the matching effect is better. Table 5 shows the PSM parallel hypothesis test results, indicating that after matching, the absolute values of the standardized biases are all less than 20% and the "standardized bias" declines significantly. Therefore, the selection and matching results of the matching variables in this paper are effective.

Table 4. The analysis of ATT effect67

Treatment effect	Experimental group	Control group	ATT effect value	Standard error	T
Before matching	1.151	0.628	0.523	0.064	8.214***
ATT	1.166	0.450	0.716	0.029	24.46***

Table 5. PSM parallel hypothesis test89

Variable	Sample	Average value		Standardized deviation (%)	Decrease in standardization deviation (%)	T-test	
		Experimental group	Control group			T	P
DAR	Before matching	0.299	0.314	-8.46	81.22	-1.312	0.100
	After matching	0.299	0.297	1.59		0.631	0.528
SIZE	Before matching	9.231	9.267	-10.2	88.66	-1.66	0.097
	After matching	9.231	9.235	-1.16		-0.46	0.646
CASH	Before matching	0.043	0.026	22.56	85.40	3.27	0.001
	After matching	0.045	0.04	3.29		1.31	0.191
ROE	Before matching	0.047	0.026	7.86	74.19	0.99	0.324
	After matching	0.047	0.057	-2.03		-0.81	0.420
SHARE	Before matching	28.963	26.096	13.78	94.61	2.06	0.041
	After matching	28.974	28.822	0.74		0.28	0.778
DUAL	Before matching	0.439	0.342	20.03	90.77	3.21	0.001
	After matching	0.441	0.449	-1.85		-0.73	0.463
SOE	Before matching	0.048	0.108	-22.36	81.32	-3.087	0.002
	After matching	0.047	0.04	4.18		1.659	0.102

5.3 Regression Results Analysis

5.3.1 The Impact of Digital Inclusive Finance on the Merger Frequency of Technology-based Enterprises

Table 6. Regression analysis10

VARIABLE	M&A (1)	
	Coefficient	T
TIME*FINANCE	0.539	6.218***
DAR	0.331	2.185**
CASH	0.152	0.463
ROE	-0.004	-0.110
SIZE	0.585***	8.311
GROWTH	0.019	1.328
DUAL	0.063	1.345
SOE	-0.111	-1.054
SHARE	0.000	0.301
TOP1	-0.001	-0.806
YEAR	Control	
PROVINCE	Control	
CONSTANT	-4.897	-7.454***
OBSERVATIONS	5126	
ADJUSTED R ²	0.112	

Table 6 shows the baseline regression results for the difference-in-differences model. In column (1), the coefficient of time*finance is significantly positive at the 1% level, indicating that the implementation of digital inclusive finance policies increases the merger frequency of technology-based enterprises, thus supporting Hypothesis 1.

5.3.2 Test of the Mechanism through which Digital Inclusive Finance Affects the Merger Frequency of Technology-based Enterprises

Table 7 presents the results of the test for the path from digital inclusive finance policy to financing constraints of technology-based enterprises to M&A frequency. In column (2), the coefficient of time*finance is significantly positive at the 1% level, indicating that digital inclusive finance alleviates financing constraints for technology-based enterprises. Meanwhile, in column (3), the regression coefficient of SA is significantly positive at the 1% level, suggesting the existence of a mediating effect. According to the mediating effect test procedure, β3, γ4 and γ3 are all significant at the 1% level, indicating that financing constraints play a partial mediating role in the impact of digital inclusive finance on M&A frequency for technology-based enterprises. Hypothesis 2 is therefore supported.

Table 7. Mediating effect test

VARIABLE	(1)	(2)	(3)
	M&A	SA	M&A
TIME*FINANCE	0.539***	0.190***	0.535***
	(6.218)	(2.665)	(0.963)
SA			0.334***
			(0.96)
DAR	0.331**	0.018	0.364**
	(2.185)	(0.565)	(2.348)
CASH	0.152	0.027**	0.063
	(0.463)	(2.859)	(1.352)
ROE	-0.004	0.014*	-0.005
	(-0.110)	(1.874)	(-0.131)
SIZE	0.585***	-0.011	0.579***
	(8.311)	(-0.756)	(8.204)
GROWTH	0.019	-0.000	0.019
	(1.328)	(-0.023)	(1.344)
DUAL	0.063	0.027***	0.063
	(1.345)	(2.859)	(1.352)
SOE	-0.111	-0.042*	-0.104
	(-1.054)	(-1.902)	(-0.986)
SHARE	0.000	0.000	0.000
	(0.301)	(0.603)	(0.324)
TOP1	-0.001	-0.000	-0.002
	(-0.806)	(-0.834)	(-0.868)
YEAR	Control	Control	Control
PROVINCE	Control	Control	Control
CONSTANT	-4.897***	1.011***	-4.861***
	(-7.454)	(7.487)	(-7.383)
OBSERVATIONS	5126	5126	5126
ADJUSTED R^2	0.112	0.162	0.115

5.3.3 Robustness Test

This paper follows the method of Sun Liang and Liu Chun (2022) [36] by advancing the policy shock time to 2015 and excluding the enterprise samples from the actual policy implementation year, conducting a placebo test in a counterfactual scenario. If the regression coefficient of time*finance is not significantly positive under this condition, it can be confirmed that there is no systematic difference in the merger frequency of technology-based enterprises between the experimental and control groups without the impact of digital inclusive finance policies. Table 8 presents the results of the robustness test:

As can be seen from columns 1-2, when the policy shock year is advanced, the coefficients of time*finance are not significantly positive, further verifying that digital inclusive finance can increase the merger frequency of technology-based enterprises and that the baseline regression results are robust.

Table 8. Robustness test1112

VARIABLE	M&A (1)	
	Coefficient	T
TIME*FINANCE	-0.246	-1.147
DAR	0.198	0.705
CASH	0.290	0.446
ROE	-0.161	-0.453
SIZE	0.831	5.278***
GROWTH	0.356	3.252***
DUAL	0.131	1.454
SOE	-0.463	-3.129***
SHARE	0.002	1.070
TOP1	-0.001	-0.346
YEAR	Control	
PROVINCE	Control	
CONSTANT	-7.395	-3.784***
OBSERVATIONS	5235	
ADJUSTED R ²	0.087	

6. Conclusion

technology-based enterprises are at the core of China's high-quality economic development. Only through continuous technological innovation can the country's economy achieve transformation and upgrading. Continuous mergers and acquisitions pose a significant challenge to the financing capabilities of technology-based enterprises. Digital inclusive finance policies aim to alleviate the difficulties faced by enterprises and enhance the financial service capacity of the real economy. Therefore, it is of great significance to explore the impact of digital inclusive finance on the merger frequency of technology enterprises. This paper uses listed companies on the Growth Enterprise Market (GEM) from 2011 to 2021 as the sample and employs Propensity Score Matching (PSM-DID), dynamic effect testing, and mediation effect testing methods to empirically test the influence of digital inclusive finance on the merger frequency of technology-based enterprises. The study concludes that digital inclusive finance policies have increased the merger frequency of technology-based enterprises, with financial constraints playing a mediating role. This research can provide a reference for the future development direction of digital inclusive finance policies and support the growth of technology-based enterprises to ensure China's sustained positive development in the global economic downturn.

Based on this, the paper proposes the following policy implications:1.Continue to promote the further development of digital inclusive finance and financial market reform, leveraging digital technology to drive high-quality development of inclusive finance, focusing on addressing the problem of financial resource misallocation, and allocating more resources to key areas and weak links in economic and social development to serve the national innovation-driven strategy.2.Seek a long-term mechanism for the sustainable development of digital inclusive finance, promote the sustainable development of digital inclusive finance, accelerate the digital transformation and construction of traditional financial institutions such as banks, advance the construction of a unified digital credit system, and improve digital inclusive finance policies and regulations.3.Further enhance the "inclusiveness" of digital inclusive finance, reduce the gap in regional financial development, tilt fiscal resources further, strengthen financial technology and financial service education in underdeveloped areas, and build and improve digital inclusive finance infrastructure in regions with relatively backward financial development.4.Although digital inclusive finance can increase the

merger frequency of technology-based enterprises, there are also financial risks. It is necessary to actively carry out strict supervision and anti-monopoly measures while controlling risks without stifling the vitality of digital inclusive finance development.

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