

The Impact of Banking Structure on SME Financing in China: Based on The Theory of Small Bank Advantage

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Abstract. Small and medium-sized enterprises (SMEs) are essential to China's national economy, but the financing difficulties constrain their long-term development. Based on the data of listed companies of SME and GEM (Growth Enterprise Market) from 2016 to 2023, this paper systematically analyzes the impact of small and medium-sized banks on SMEs' financing by using the double fixed effect model. The results show that: (1)The development of small and medium-sized banks significantly reduces the financing constraints of SMEs, which verifies the validity of the theory of "small bank advantage" in modern times. (2)The development of digital finance weakens the marginal role of small and medium-sized banks, and large banks break through the geographic limitations and improve the efficiency of information processing through technological empowerment, weakening the traditional advantages of small and medium-sized banks. (3)The central and western regions rely more on the information advantages of small and medium-sized banks, while the role of small and medium-sized banks is limited in the eastern regions. This paper enriches the analysis of the economic effects of the advantages of small and medium-sized banks in the modern era, while providing empirical support for the financing of SMEs, the transformation of small and medium-sized banks and the optimization of regional financial resources in China.

Keywords: SME Financing, Digital Finance, Small Bank Advantage, Small and Medium-sized Banks.

1. Introduction

Small and medium-sized enterprises (SMEs), as pivotal drivers of economic growth, innovation, employment, and social stability, face many financing constraints. So, resolving this dilemma is critical not only for SMEs to overcome developmental bottlenecks but also for achieving high-quality, sustainable national economic growth.

In China's financial system, indirect financing occupies a dominant position, and banks are the core pillar of the indirect financing system[1]. The formation of this pattern stems from the choice of fit between the vigorous and complex financing needs of enterprises and the supply of the financial market in the process of China's economic development. And in the process of development, SMEs need a lot of financial support, but because of their small scale and weak risk-resistance, it is difficult for them to obtain funds through direct financing, such as issuing stocks and bonds. The formation of China's indirect financing system is rooted in multiple factors such as historical development, financial market structure and corporate financing habits, and its long-term attributes are significant and difficult to be fundamentally changed in a short period of time.

China's SME financing policy has undergone a significant pivot. The 1990s Commercial Bank Law and financial reforms catalyzed SME growth, yet financing bottlenecks emerged. Concurrently, China adopted the Western "information-cost advantage" theory, leveraging small banks' localized soft information and efficient approvals to reduce transaction costs under a "small bank advantage strategy"[2]. Initial expansion of small banks eased financing pressures. However, post-2018 economic slowdown and regional credit risks triggered asset quality deterioration and profit margin compression, rendering their homogeneous local operation model unsustainable. Tightened

regulations exposed governance deficiencies and operational vulnerabilities, accelerating compliance and stability risks. Policy adjustments followed, including 2018 credit assessment requirements to refine the financing ecosystem.

Stepping into the era of digital economy, the booming development of financial technology has reshaped the pattern of the financial industry, and banks, as an important mainstay of the financial industry, have been affected by the multi-dimensional impact, presenting a brand new situation in serving SMEs[3]. Large banks are becoming more mature in the application of big data credit and can accurately screen high-quality SMEs and extend credit through big data. This technological breakthrough, in sharp contrast to the risk exposure of small and medium-sized banks, has profoundly changed the landscape of SME financing and shocked the theory of “small bank advantage”.

Therefore, existing research centers on the combination of digital technology and “small bank advantage” to explore the two-way mechanism of action. On one hand, based on the information asymmetry theory, digital technology undermines the traditional soft information and geographic advantages of small banks through information “hardening” and interaction “de-contacting”, quantifying the differences between banks of different sizes in terms of information costs, risk control efficiency and other dimensions (Liberti & Petersen, 2019)[4]. On the other hand, some studies focus on the path of small banks to integrate technology and strengthen localized information processing capabilities through digital transformation (Yilin Zhang et al., 2019)[5].

The marginal contribution of this paper is mainly reflected in the following three aspects. First, transcend traditional paradigms by constructing a multidimensional framework integrating policy dynamics, market actor behaviors, and fintech evolution, thereby enriching the “small bank advantage” theory with policy-digital synergy, a novel lens for examining institutional adaptability in complex environments. Second, innovatively employ digital finance as a moderating variable, systematically decoding its regulatory mechanisms on small banks’ credit decisions through fixed-effects modeling. Third, propose a regionally differentiated empowerment framework, offering institutional innovation pathways for reconstructing competitive advantages based on localized resource endowments, effectively addressing regional SME financing disparities.

2. Literature review

2.1. SME Financing

SMEs occupy an important position in China’s economy, but their financing difficulties have long constrained their innovative capacity and sustainable development.

First, the financing difficulties of SMEs stem from their endogenous defects. SMEs generally suffer from irregular financial systems and low credibility of statements, making it difficult for banks to assess their credit risk through standardized processes (Wang & Zhao, 2012)[6]. Rising labor costs further exacerbate corporate financing constraints (Liu & Liu, 2020)[7], while small and illiquid collateral assets push up non-performing loan rates (Huang & Tao, 2019)[8]. Behavioral economics perspectives point out that SMEs’ willingness to repay is significantly affected by the economic cycle. Their risk resilience is weaker during economic downturns, and the probability of non-performing loans is higher than that of large firms (Boot & Thakor, 1994)[9].

Second, there is a fundamental conflict between large banks’ credit decision-making model that relies on “hard information” (e.g., financial statements and collateral assets) and SMEs’ lack of standardized information (Lin & Sun, 2005)^[10]. Due to the high cost of due diligence for small loan amounts, large banks discriminate against SMEs (Yao & Sheng, 2002)[11]. At the same time, it is difficult for banks to obtain “soft information” such as the real market share and supply chain stability of enterprises, which leads to the tilting of credit resources in favor of SOEs (Zhao et al., 2012)[12].

As a result, SMEs often choose to build long-term cooperative relationships with local banks in order to meet their financing needs, especially small and medium-sized banks, which will be described in the next section.

2.2. Relevant research on the small bank Advantage

The “small bank advantage” theory, as a core framework explaining financing constraints for SMEs, continues to spark extensive academic debates regarding its theoretical implications and practical value. Traditional studies generally posit that small and medium banks, leveraging their flat organizational structures (Stein, 2002)[13], geographic embeddedness (Zhang, 2002)[14], and efficient processing of “soft information” (Berger & Udell, 2006)[15], can address the “hard information deficiency” of micro and small enterprises through relationship-based lending. This establishes a size-matching pattern between small banks and small enterprises (Lin & Li, 2001)[16]. Ogura and Uchida (2014), in an empirical study of Japanese SMEs, found that mergers of small banks significantly weaken their soft information production capacity, thereby reducing loan support for small businesses[17]. This inversely validates the existence of the “small bank advantage.”

However, disruptive innovations in digital technology are fundamentally reshaping traditional credit market dynamics, challenging the “small bank advantage” theory through two pathways. First, in terms of “information hardening,” Liberti and Petersen (2019) proposed that digital technologies can convert transactional and supply chain data into quantifiable “hard information,” breaking the dominance of soft information in credit assessments[18]. Cheng et al. (2024), based on empirical data from 183 commercial banks, revealed that digital transformation reduces information collection costs and enhances risk control precision through natural language processing[19]. This enables large banks to surpass small banks in market share growth within micro-credit markets, particularly in digitally advanced regions, indicating a shift in competitive advantages driven by technological empowerment. Second, in “de-contactization” of bank-enterprise interactions, Huang and Huang (2018) identified digital finance platforms’ role in replacing loan officers’ subjective judgments with algorithmic scoring, diminishing the centrality of physical branches in information transmission[20]. Cross-regional evidence supports this shift. Frame and Srinivasan (2023) found that the adoption of AI credit models by large banks led to a sustained decline in small banks’ market share for SME loans, aligning with domestic findings[21].

3. Theoretical analysis and research hypotheses

The core issue of financing difficulties for SMEs lies in information asymmetry. Compared to large enterprises, SMEs generally suffer from opaque financial information and a lack of qualified collateral, making traditional “hard information”-based lending techniques ineffective in assessing their credit risks (Berger & Udell, 2006)[22]. In this context, relationship-based lending technology has emerged as a critical solution to SME financing challenges. Relationship-based lending relies on “soft information” accumulated by banks through long-term, multi-channel interactions with enterprises and their owners. This type of information is inherently difficult to quantify, verify, or transfer. Small and medium-sized banks possess a natural advantage in collecting and processing such soft information, known as the “small bank advantage,” which encompasses four key dimensions.

First, organizational efficiency empowers small and medium-sized banks to handle soft information more effectively. Drawing on Stein’s (2002) hierarchy control theory, complex bureaucracies cause signal attenuation during soft information transmission[23]. Small and medium-sized banks’ flat structures (Berger et al., 2005)[24] boost information conversion efficiency via two mechanisms: (1)Frontline loan officers directly influence credit decisions, preventing soft information distortion in hierarchical transmission (Jensen & Meckling, 1992)[25]. (2)Streamlined decision layers create an “information production-decision power” mechanism (Berger & Udell, 2002), motivating officers to accumulate local market knowledge through frequent visits[26].

Second, geographic embeddedness endows small and medium-sized banks with social capital advantages. Proximity reduces information costs and fosters social network integration (Uzzi, 1999)[27]. Through continuous regional engagement, small and medium-sized banks embed in business ecosystems, accessing supplementary information from supply chains, credit records, and informal networks.

Third, the scale economics paradox bolsters small and medium-sized banks' comparative edge. Contrary to traditional theory, scale expansion increases costs in SME financing (Berger et al., 2005). Capital constraints drive small and medium-sized banks to specialize in SME markets, adopting niche risk management. Their profit models, relying on "relationship rent" rather than short-term loans, incentivize tolerance of high upfront costs to build client loyalty (Degryse & Van Cayseele, 2000)[28].

Fourth, a flexible organizational culture enhances small and medium-sized banks' adaptability. Unlike large banks' standardized approaches, small and medium-sized banks thrive in informal governance (Macneil, 1978)[29]. They customize repayment schedules and solutions for distressed firms, enabled by loan officers' autonomy to adjust strategies based on soft information.

Based on the above analysis, the first research hypothesis of this paper is proposed.

H1. The development of small and medium banks alleviates financing constraints for SMEs.

However, the "small bank advantage" theory faces challenges. Scholars such as Xie et al. (2020)[30], Li & Wang (2021)[31], Chen & Ma (2019)[32], and Zhang & Liu(2022)[33] argue that while SMBs retain relative advantages in soft information utilization, digital transformation is reshaping how information asymmetry is addressed, thereby altering competitive dynamics between banks of different sizes. Digital technologies "harden" soft information into quantifiable data, eroding SMBs' reliance on interpersonal interactions. Large banks, with superior resources and technological capabilities, leverage digital transformation to offset their traditional weaknesses in soft information processing. This trend drives three structural shifts.

First, digital transformation narrows the gap in soft information processing between large and small banks. Large banks deploy AI risk models, blockchain data verification, and nationwide digital networks, shifting from "human-experience-driven" to "algorithm-intelligence-driven" information processing (Wang et al., 2023)[34]. By integrating multi-source data (e.g., business registries, tax records, judicial data), large banks' digital risk models monitor SME operations in real-time, compressing information processing time from days to minutes.

Second, digital technologies dismantle geographic barriers. Through big data and cloud computing, large banks penetrate local credit markets with online products, directly challenging SMBs' regional information advantages (Broen et al., 2020)[35].

Third, rising efficiency in large banks' soft information utilization squeezes small and medium-sized banks' traditional markets. Large banks' "cream-skimming" strategy prioritizes SMEs with complete operational data and strong credit histories, causing structural downgrading of small and medium-sized banks' client pools. This triggers a "catfish effect": (1) Large banks' market entry forces small and medium-sized banks to pivot toward "deep relationship lending" in niche sectors; (2) Digital competition lowers industry-wide credit costs, compelling SMBs to adopt digital tools for operational efficiency (Chen & Wang, 2019)[36].

Based on the above analysis, the second research hypothesis of this paper is proposed.

H2. Digital finance development exerts a negative moderating effect on the relationship between small and medium-sized banks and SME financing.

The mechanism of theoretical analysis and hypotheses is illustrated in Figure 1.

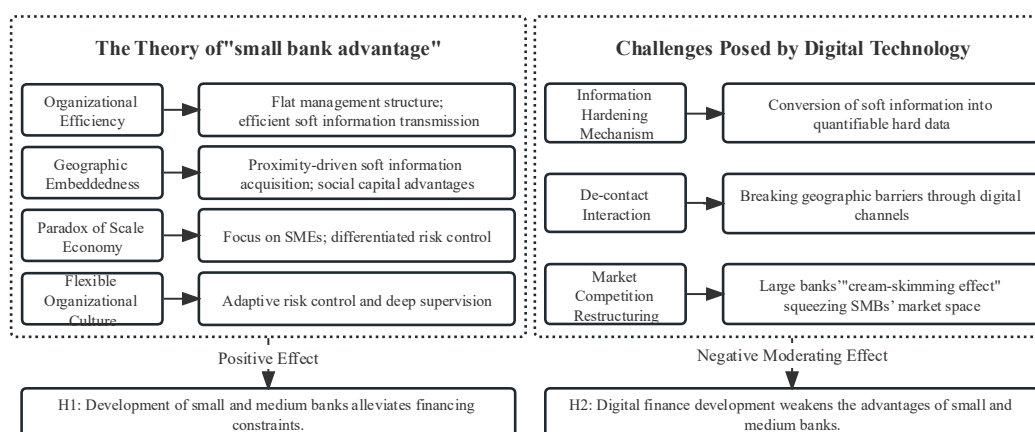


Figure.1. Theoretical analysis and research hypothesis mechanism diagram

4. Research design

4.1. Data sources and sample selection

The data selected in this paper are from the Cathay Pacific database, the digital financial development data are taken from the digital financial inclusion index released by the Digital Finance Research Center of Peking University, and the regional economic data and financial market data are from the National Bureau of Statistics and the Wind database. Considering the data completeness and the timeliness of the study, the combined SME and GEM panel data of each province from 2016 to 2023 are selected as the research interval. And in order to ensure the quality of the data and the reliability of the empirical analysis, this study refers to the prevailing practice of the established literature and systematically processes the raw data. First, referring to the study of Wang Family and Sheng Nan (2024)[37], the sample of firms with financial anomaly warnings (ST, *ST) is excluded, while observations with serious data deficiencies are screened out. Secondly, referring to Gao Ling's research[38], the interpolation method is used to fill in some of the missing data. Finally, a 5% level of tailing is applied to the main variables to reduce the interference with the results by replacing the extreme values, so as to improve the reliability of the data and the robustness of the model[39]. Following the aforementioned data processing, a final observation sample containing 1,245 companies is formed for empirical analysis.

4.2. The model setting

In order to test the impact of the share of small and medium-sized banks (*Bank*) on corporate financing constraints (*SA*) and to analyze the moderating effect of the development of digital finance (*Digital*), this paper constructs the double fixed effect model.

$$SA = \beta_0 + \beta_1 Bank_{i,t} + \beta_2 Digital_{i,t} + \beta_3 (Bank \times Digital)_{i,t} + \gamma_1 X_{i,t} + \gamma_2 Z_{i,t} + \lambda_i + \mu_t + \varepsilon_{i,t} \quad (1)$$

Among them, the explanatory variable *SA* indicates the degree of financing constraints of enterprise *i* in period *t*. Larger *SA* indicates more severe financing constraints. The core explanatory variables are the proportion of assets of small and medium-sized banks in the region where the enterprise is located. $Digital_{i,t}$ represents the level of regional digital financial development. The cross-multiplier term $(Bank \times Digital)_{i,t}$ is used to capture the moderating effect of digital finance. $\gamma_1 X_{i,t}$ is the set of regional control variables and $\gamma_2 Z_{i,t}$ is the set of firm control variables. λ_i and μ_t denote the individual fixed effects and province fixed effects, respectively. $\varepsilon_{i,t}$ is the random error term.

4.3. Variable definition

4.3.1 Explanatory variable

In this paper, the *SA* index is selected as explanatory variable and calculated as $SA = -0.737 \times Size + 0.043 \times Size^2 - 0.04 \times Age$. Where *Size* is the size of the firm and *Age* is the age of the firm. The index is based on the quadratic relationship between firm size and age, which portrays a variable for corporate finance constraints. Given that this paper focuses on the impact of banking sector structure on SME financing, an accurate measure of firm size is required, hence the selection of this indicator.

4.3.2 Core explanatory variable

The ratio of small and medium-sized banks is selected as the core explanatory variable, which is measured by the proportion of the total assets of regional small and medium-sized banks to the total assets of banking financial institutions, to analyze the relative size and market position of small and medium-sized banks in the regional financial system. Small and medium-sized banks refer to commercial banks other than large state-owned commercial banks and policy banks. The construction of this indicator is based on two points. First, the asset share can reflect the actual influence of small and medium-sized banks in the allocation of credit resources. Second, the expansion of small and medium-sized banks' market share can be achieved by optimizing the financing channels (Lin & Li, 2001) [16] or intensify competition and other mechanisms, which directly affect the availability of credit to enterprises.

4.3.3. Moderator variable

This variable is measured by Peking University's Digital Inclusive Finance Index. Specifically, the index covers secondary indicators such as account penetration rate, mobile payment scene coverage rate, availability of digital credit for micro and small enterprises, and application rate of intelligent risk control technology, which can portray the substitution and complementary effects of digital technology on traditional financial services. The indicator has been widely used in China's regional financial studies, and its multidimensional and dynamically comparable characteristics provide a robust measurement basis for testing technology-driven financial structure change.

4.3.4 Control variable

This study incorporates control variables from the firm level and regional level to eliminate confounding factors. The firm level covers growth (revenue growth rate), profitability (ROA), capital structure (equity ratio), market valuation (book-to-market ratio), investment opportunities, and governance structure (proportion of independent directors and shareholding concentration), while the regional level controls for industrial structure (proportion of secondary and tertiary industries) and the level of economic development (log GDP per capita). Variables are selected to isolate the potential bias of firm heterogeneity and regional endowment on the core causal inference. Table 1 shows the definitions for each variable.

Table.1. List of variable definitions

Variable type	Variable Name	Variable Symbol	Variable Description
Explanatory Variable	Corporate Finance Constraints (SA Index)	<i>SA</i>	$SA = -0.737 \times Size + 0.043 \times Size^2 - 0.04 \times Age$
Core explanatory Variable	Percentage of Small and Medium-sized Banks	<i>Bank</i>	Total assets of small and medium-sized banks/total assets of banks in the region
Moderator Variable	Digital Financial Development	<i>Digital</i>	Derived from the Digital Finance Research Center of Peking University
Firm-level Control Variable	Corporate Growth	<i>Growth</i>	(Sales revenue of the current period - sales revenue of the previous period)/sales revenue of the previous period
	Return on Assets	<i>ROA</i>	Net profit/average total assets×100%
	Equity Ratio	<i>Equity</i>	Total liabilities/total owners' equity
	Book-to-market Ratio	<i>Market</i>	Book value of shareholders' equity/total market capitalization of the enterprise
	Investment Opportunities	<i>Investment</i>	Enterprise market value/replacement cost of enterprise assets
	Proportion of Independent Directors	<i>INDIR</i>	Number of independent directors/total number of board members
	Shareholding Concentration	<i>Concentration</i>	$\sum_{i=1}^5$ shareholding ratio
Area-level Control Variable	Industrial Structure	<i>Industry</i>	(Value added of secondary industry + value added of tertiary industry)/gross domestic product
	Level of Economic Development	<i>Economy</i>	Gross regional product/regional resident population

4.4. Descriptive analysis

Table 2 demonstrates the results of descriptive statistics for the main variables. As a whole, the observations of each variable are relatively complete, with a sample size of 9,960. Regarding the financing constraint index, the mean value of the *SA index* is -3.87, which is in the range of [-4.238,-3.525], and the standard deviation is 0.195, reflecting that the sample firms generally face certain financing constraints. When calculating the *SA index*, the data after selecting the natural logarithm for the enterprise size variable is located on the left side of the symmetry axis x ($x=8.57$), corresponding to the third quadrant region of the two-dimensional coordinates. In this interval, as the enterprise size increases, the *SA index* decreases, meaning that the degree of financing suffered by SMEs is smaller.

Table.2. Descriptive statistics for key variables

Variable	Number of Observations	Mean	Standard Deviation	Minimum Value	Maximum Values
<i>SA</i>	9,960	-3.866	0.195	-4.238	-3.525
<i>Bank</i>	9,960	0.578	0.042	0.505	0.670
<i>Digital</i>	9,960	356.688	62.604	248.000	457.480
<i>Growth</i>	9,960	0.131	0.259	-0.306	0.748
<i>ROA</i>	9,960	0.045	0.065	-0.114	0.160
<i>Equity</i>	9,960	0.825	0.675	0.118	2.651
<i>Market</i>	9,960	0.571	0.213	0.224	0.967
<i>Investment</i>	9,960	1.982	1.042	0.404	4.462
<i>INDIR</i>	9,960	0.372	0.050	0.330	0.480
<i>Concentration</i>	9,960	47.767	13.372	24.730	71.605
<i>Industry</i>	9,960	0.948	0.033	0.885	0.997
<i>Economy</i>	9,960	4.914	0.187	4.570	5.240

5. Results of the empirical analysis

5.1. Baseline regression results

Column (1) of Table 3 reports the results of the benchmark regression of the share of small and medium-sized banks and corporate financing constraints.

The regression coefficient of the core explanatory variable, the proportion of small and medium-sized banks (*Bank*), on corporate financing constraints is significantly negative at the 1% level, indicating that small and medium-sized banks can significantly reduce corporate financing constraints, which confirms the theory of the “small bank advantage”. H1 is verified, which means that small and medium-sized banks, by virtue of their flat organizational structure, geographic embeddedness, and soft information processing capabilities, can mitigate information asymmetry between banks and enterprises more effectively through relationship-based lending techniques, thus significantly reducing SME financing constraints.

The regression coefficient of the moderator variable digital finance development (*Digital*) is significantly negative at the 1% level, indicating that *Digital* can also help to reduce enterprise financing constraints. However, the cross-multiplier term *Bank*×*Digital* is significantly positive at the 1% level, a result suggesting that digital financial development exerts a negative moderating effect between small and medium-sized banks and SME financing. This implies that as large banks break through geographical constraints and improve the efficiency of soft information processing through digital technology, their competition with small and medium-sized banks in the SME credit market intensifies, resulting in the partial substitution of the traditional information advantages of small and medium-sized banks, and H2 is verified.

Table.3. Benchmark regression results and robust type test results

Variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)
<i>Bank</i>	-0.718*** (0.075)	-0.904*** (0.085)	-0.424** (0.199)	-0.056** (0.028)	-0.159*** (0.024)	-0.677*** (0.111)	-1.039*** (0.113)
<i>Digital</i>	-0.002*** (0.000)	-0.002*** (0.000)	-0.001*** (0.000)	-0.001*** (0.000)	-0.002*** (0.000)	-0.002*** (0.000)	-0.002*** (0.000)
<i>Bank</i> × <i>Digital</i>	0.002*** (0.000)	0.002*** (0.000)	0.001** (0.000)	0.000* (0.000)	0.000*** (0.000)	0.001*** (0.000)	0.002*** (0.000)
<i>Growth</i>	-0.012*** (0.002)	-0.014*** (0.002)	-0.025*** (0.005)	-0.012*** (0.002)	-0.009*** (0.002)	-0.012*** (0.003)	-0.013*** (0.003)
<i>ROA</i>	-0.050*** (0.012)	-0.040*** (0.012)	0.228*** (0.031)	-0.048*** (0.012)	-0.037*** (0.011)	-0.054*** (0.016)	-0.065*** (0.018)
<i>Equity</i>	-0.002* (0.001)	-0.002 (0.001)	-0.096*** (0.003)	-0.002* (0.001)	-0.003** (0.001)	-0.006*** (0.002)	-0.002 (0.002)
<i>Market</i>	-0.005 (0.004)	-0.003 (0.004)	-0.132*** (0.011)	-0.006 (0.004)	-0.003 (0.004)	-0.010** (0.005)	-0.012* (0.006)
<i>Investment</i>	0.004*** (0.001)	0.004*** (0.001)	-0.004** (0.002)	0.004*** (0.001)	0.003*** (0.001)	0.004*** (0.001)	0.004*** (0.001)
<i>INDIR</i>	0.032** (0.015)	0.034** (0.016)	0.158*** (0.041)	0.035** (0.015)	0.031** (0.015)	0.043** (0.019)	0.026 (0.024)
<i>Concentration</i>	0.001*** (0.000)	0.001*** (0.000)	-0.001*** (0.000)	0.001*** (0.000)	0.001*** (0.000)	0.001*** (0.000)	0.001*** (0.000)
<i>Industry</i>	1.301*** (0.118)	1.335*** (0.131)	-1.330*** (0.313)	1.484*** (0.117)	1.003*** (0.141)	1.360*** (0.150)	1.291*** (0.166)
<i>Economy</i>	-0.245*** (0.016)	-0.265*** (0.018)	0.061 (0.044)	-0.262*** (0.017)	-0.095*** (0.017)	-0.303*** (0.020)	-0.274*** (0.022)
Area fixed effect	Controlled	Controlled	Controlled	Controlled	Controlled	Controlled	Controlled
Individual fixed effect	Controlled	Controlled	Controlled	Controlled	Controlled	Controlled	Controlled
Obs.	9960	8715	9960	9960	8715	9960	4980
Prob > F	1481.12** *	1229.31** *	96.98***	1463.57** *	1226.42** *	969.32** *	652.33** *
R ²	0.8365	0.8321	0.2509	0.8349	0.8318	0.7700	0.8408

Note: *, **, *** indicate significant correlation at the 10%, 5%, and 1% levels, respectively.

5.2. Robustness check

To ensure the reliability of the findings, this paper uses six methods to test the robustness of the model. (1) Excluding contemporaneous policy disturbances. The sample of 2017 during the period of strong financial regulation is excluded to avoid the systematic impact of policy shocks in 2017 on bank structure and corporate financing behavior. (2) Replacement of explanatory variables. Adopt the FC index instead of the SA index to re-measure financing constraints. A larger FC index indicates greater corporate financing constraints. (3) Reconstruct core explanatory variables. The penetration rate of small and medium-sized banks is changed from “total assets” to “number of branches”. (4) Lagged core variables. Referring to the method of Xie & Zhao (2021), the proportion of small and medium-sized banks (*Bank*) is lagged by one period to alleviate the reverse causality problem^[40]. (5) Adjust the criteria for handling outliers. Increase the shrinkage ratio from 5% to 10% to control the extreme value interference (Zhu et al., 2025)^[41]. (6) Alternate-year sampling test. Use alternate-year data to shorten the period and eliminate the systematic effect of time fluctuation on variables.

The regression results in columns (2)-(7) of Table 3 show that the coefficients of the share of small and medium-sized banks (*Bank*) are always significantly negative, and the direction and significance level of digital financial development (*Digital*) and its moderating effect (*Bank* × *Digital*) are

consistent with those of the baseline regression. The hypotheses H1 and H2 are again verified, confirming the robustness of the conclusions.

5.3. Endogeneity test

5.3.1 Instrumental variable approach (2SLS)

In order to avoid endogeneity issues such as reverse causality that lead to biased results in the benchmark regression, this paper uses whether or not the province in which the firm's office is located has implemented a pilot private bank access policy (*policy*) prior to 2016 as an instrumental variable for 2SLS estimation.

The specific results are shown in Table 4, with columns (1) and (2) showing the first-stage as well as the second-stage regression results, respectively. The relationship between the instrumental variable (*policy*) and the share of small and medium-sized banks (*Bank*) in the first-stage regression results is significantly positive, indicating that small and medium-sized banks in the policy pilot areas have significantly increased their market share. The second-stage regression results show that the share of small and medium-sized banks (*Bank*) still has a significant negative effect on corporate financing constraints, a result that is consistent with the benchmark regression results. And the results pass the weak IV test and identifiability test.

In summary, after considering the endogeneity problem, the regression coefficients of the share of small and medium-sized banks on corporate financing constraints are all significant at the 1% level, indicating that the results of the benchmark model are robust.

Table.4. Results of the instrumental variables approach to endogeneity testing

Variable	(1) First-stage	(2) Second-stage
<i>Bank</i>	0.022*** (0.001)	-1.194*** (0.238)
The Weak IV Test	403.170*** (16.380)	403.171*** (16.380)
The Identifiable Test	387.940*** (0.000)	387.936*** (0.000)
Control Variable	Controlled	Controlled
Area Fixed Effect	Controlled	Controlled
Individual Fixed Effect	Controlled	Controlled
R ²		0.1070
Prob > F	432.35***	195.62***
Obs.	9960	9960

Note: *** indicates significant correlation at the 1% levels.

5.3.2 Propensity score matching (PSM)

To mitigate the endogeneity problem caused by sample self-selection bias, this paper further employs the propensity score matching (PSM) method to verify the causal relationship between the share of small and medium-sized banks and corporate financing constraints by constructing a counterfactual framework. Referring to the existing literature (Pan and Han, 2016)^{42]}, the small and medium-sized bank share is grouped according to the median, and higher than the median is defined as the high share group, and vice versa as the low share group. Then the control variables in the baseline regression are used as the matching criteria, and the enterprise financing constraints are used as the outcome variables for the one-to-one, no-return, nearest-neighbor matching with 0.01 as the range of the caliper.

The results of the regressions using the matched samples are shown in Table 5, and the standardized deviations of the variables are shown in Figure 2. The results show that the coefficient

on the share of small and medium-sized banks (*Bank*) is significantly negative at the 10% level, indicating that the financing constraints of firms in the high share group are significantly lower than those in the low share group, consistent with the direction of the benchmark regression; the coefficients on the development of digital finance (*Digital*) and its interaction term (*Bank*×*Digital*) are both significant at the 1% level, again verifying the robustness of the conclusion.

Table.5. PSM endogeneity test results

Variable	(1) PSM
<i>Bank</i>	-0.286* (0.154)
<i>Digital</i>	-0.002*** (0.000)
<i>Bank</i> × <i>Digital</i>	0.002*** (0.000)
Control Variable	Controlled
Area Fixed Effect	Controlled
Individual Fixed Effect	Controlled
_cons	-3.928*** (0.239)
Obs.	3502
Prob > F	1195.96***
R ²	0.9811

Note: *and*** indicate significant correlation at the 10% and 1% levels, respectively.

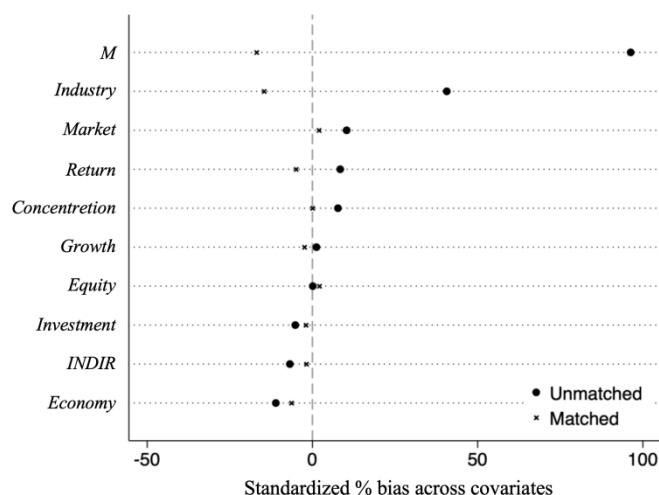


Figure.2. Graphical representation of standardized deviations for each variable

5.4. Heterogeneity test

In order to test whether there is regional heterogeneity in the role of small and medium-sized banks in alleviating the financing constraints of enterprises, this paper refers to the grouping method of Liu, Min et al. (2025), which divides the sample into eastern and central and western regions according to the province of the enterprise to conduct regression analysis[43].

The results in Table 6 show that the coefficient of the share of small and medium-sized banks (*Bank*) in the eastern region is negative but not significant, which may be due to the higher maturity of the financial ecology in the eastern region. On one hand, enterprises in the east can be financed through diversified channels such as large banks and capital markets. On the other hand, there is a high proportion of medium and large-sized enterprises in the region, and their complex financing

needs are beyond the capacity of small and medium-sized banks. On the contrary, in the Midwest region, the *Bank* coefficient is significantly negative at the 5% level, and both *Digital* and *Bank×Digital* are significantly positive. This may be due to the fact that the coverage of large financial institutions and large enterprises in the Midwest is relatively low, so small and medium-sized banks can fill the gaps of grass-roots financial services by their localized information advantages, and they can more accurately identify the credit risks of enterprises. As a result, they have become an important channel of financing for enterprises in the Midwest.

It is also worth noting that despite the larger sample size in the East, which is theoretically more likely to capture stabilizing effects through the law of large numbers, its *Bank* coefficient fails the test of significance, while the small sample in the Midwest exhibits a significant effect, which further corroborates the specificity of the latter's financial ecology. Small and medium-sized banks demonstrate irreplaceable marginal roles in underserved regions through the combination of localized services and digital technology. The conclusion suggests that the "Small bank advantage" is more prominent in the central and western regions, where financial resources are scarce, providing a basis for differentiated policy guidance.

Table.6. Heterogeneity test results

Variable	(1) Eastern Provinces	(2) Central and Western Provinces
<i>Bank</i>	-0.127 (0.101)	-0.421** (0.213)
<i>Digital</i>	-0.001*** (0.000)	-0.002*** (0.000)
<i>Bank×Digital</i>	0.000 (0.000)	0.001** (0.001)
Controlled Variable	Controlled	Controlled
_cons	-4.553*** (0.201)	-3.320*** (0.203)
Obs.	7802	2158
Prob > F	1686.77***	717.87***
R ²	0.8390	0.8435
Area Fixed Effect	Controlled	Controlled
Individual Fixed Effect	Controlled	Controlled

Note: **and*** indicate significant correlation at the 5%, and 1% levels, respectively.

6. Conclusions and policy recommendations

This study systematically examines the impact of small and medium-sized banks on financing for SMEs and the moderating role of digital finance, using data from listed companies on China's SME and GEM from 2016 to 2023. By employing a double fixed effect model, this paper re-evaluates the contemporary applicability of the "small bank advantage" theory. The findings are as follows.

First, the development of small and medium-sized banks significantly alleviates financing constraints for SMEs, confirming the continued validity of the "small bank advantage" theory. With geographic embeddedness and soft information processing expertise, small and medium-sized banks significantly reduce information asymmetry between banks and enterprises through relationship-based lending.

Second, the marginal contribution of small and medium-sized banks to SME financing weakens with the advancement of digital finance. As financial technology becomes deeply embedded in the financial system, large banks have substantially enhanced their application of transactional lending

technologies. Concurrently, large banks increasingly allocate credit resources to SMEs, intensifying market competition and gradually eroding the applicability of the “small bank advantage” theory.

Third, the mitigating effect of small and medium-sized banks on SME financing constraints exhibits significant regional heterogeneity. In the central and western regions, due to insufficient financial supply and serious information asymmetry, small and medium-sized banks play a significant role in filling the service gaps, while in the eastern regions, due to the mature financial ecology, diversified financing channels for enterprises and the high proportion of large enterprises, the role of small and medium-sized banks is limited.

Based on these findings, we propose the following policy recommendations.

First, the localized service advantages of small and medium-sized banks will continue to be strengthened. Encourage small and medium-sized banks to penetrate into the regional economy, set up additional service outlets in communities and counties, closely match the needs of local enterprises and the industrial chain, and accumulate “soft information” to accurately assess risks during long-term interactions between banks and enterprises. Innovative and flexible credit models can be explored, such as designing unsecured loan products based on the credit of business owners and supply chain transaction data to reduce reliance on traditional collateral. At the same time, small and medium-sized banks should be provided with cost-sharing support for serving SMEs through mechanisms such as financial risk compensation and interest rate subsidies, so as to enhance the sustainability and stability of their relationship-based lending.

Second, accelerate the digital transformation of small and medium-sized banks to adapt to fintech changes. Industry associations or regulatory authorities can take the lead in building a regional fintech sharing platform to provide small and medium-sized banks with low-cost big data risk control, intelligent approval and other technical tools, so as to narrow the technological gap with large banks. Small and medium-sized banks can focus on local characteristic industries or segments, combine localized experience with digital means, and form a hybrid risk control model of “quantitative analysis of hard information + empirical judgment of soft information” to avoid direct competition with large banks in the field of standardized digital credit. In addition, it will regulate the order of market competition, guide the formation of a differentiated and complementary pattern between large banks and small and medium-sized banks, and support small and medium-sized banks to improve their operational efficiency through compliance and technological cooperation.

Third, regional financial ecological differences should be emphasized and differentiated policy guidance should be implemented. In regions with insufficient financial supply in central and western China, small and medium-sized banks can be supported to set up more outlets in counties to fill the gaps in grass-roots financial services by relaxing the restrictions on the establishment of institutions, directional reductions in interest rates and other policies. And a cross-sectoral platform for the sharing of small and medium-sized enterprises’ credit information can be established to reduce small and medium-sized banks’ information-gathering costs and further amplify their advantages in terms of localized information. In the eastern region where the financial ecology is mature, small and medium-sized banks should be encouraged to transform to specialization and features, focus on science and technology enterprises and specialized SMEs, develop featured products of “technology valuation + scenario-based wind control”, explore innovative modes such as “investment and loan linkage”, and promote their connection with the capital market, so as to provide SMEs with diversified financing support, easing the financing challenges of China’s SMEs and empowering their development.

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