Analysis of the Financing Constraints of Banking Competition on Small and Medium-sized Science and Technology-based Enterprises and Research on Countermeasures to Mitigate Them

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Abstract: *Small and medium-sized enterprises (SMEs) generally face financing constraint difficulties in their rapid development process. In order to promote the healthy development of small and medium-sized science and technology enterprises, the research on the analysis of the financing constraints of banking competition on small and medium-sized science and technology enterprises and the mitigation countermeasures are proposed. Firstly, the relationship between banking competition and enterprise financing is analyzed by combining the information disintermediation theory and the financing order theory. The non-financial listed science and technology enterprises of small and medium-sized boards are selected as research samples, and the cash-cash flow model is used to test the financing constraints of SMEs, and the impact of banking competition on the financing constraints of SMEs is examined through the expansion model, and the financial data of SMEs used are empirically analyzed. The analysis concludes that banking competition can alleviate enterprise financing constraints and broaden credit channels for SMEs, while balancing the service and financing costs of both parties to the transaction. It also puts forward countermeasure suggestions, including improving the enterprise credit system, improving the enterprise information disclosure system, and improving the degree of enterprise financial technology utilization, etc., aiming to promote the smooth cooperation between the two sides of the credit and to promote the better service of finance to the real economy.*

Keywords: *small and medium-sized enterprises; banking competition; credit financing; financing constraints; empirical study*

1. Introduction

Small and Medium-sized Enterprises (SMEs), equipped with agile business models, profound market understanding, and robust innovative prowess, have emerged as pivotal drivers of economic and societal advancement. Nevertheless, the challenges posed by the intricacies and costs associated with securing financing have emerged as a primary impediment to their continued growth. At the heart of the financial ecosystem, the banking sector wields a profound influence on the financing landscape for technology-driven SMEs. Amid the ongoing banking reforms and heightened market rivalry, leading banks have embarked on crafting innovative financial offerings to secure a foothold in the SME market[1]. In this context, delving into the implications of banking competition on the financing constraints faced by small and medium-sized technology enterprises holds immense practical and theoretical significance. The issue of financing constraints stands as a focal point of academic scrutiny, eliciting diverse perspectives within the scholarly community. These include the "market dominance hypothesis," which postulates the influence of banking concentration, and the "information asymmetry hypothesis," emphasizing the role of information access. By dissecting the intricate linkages between banking competition and SME financing constraints, this research endeavor endeavors to contribute to the enrichment and refinement of the existing theoretical framework[2]. It aims to provide fresh insights and research avenues for academics, building upon the extensive body of work conducted by scholars globally on the subject matter. Thus, the study not only addresses a pertinent concern for SMEs but also advances the understanding of the intricate dynamics at play within the financial sector and its impact on enterprise growth. Some scholars believe that banking competition can alleviate the financing constraints of SMEs by optimizing the allocation of credit resources and lowering the credit threshold[3]. While some other scholars point out that although banking competition can promote

financial innovation and improve service quality to a certain extent, it may also lead to some banks neglecting credit support for SMEs in pursuit of high risks and high returns. These research results provide a rich theoretical foundation and reference basis for this study. However, there are relatively few studies on the specific group of small and medium-sized science and technology enterprises, and most of them focus on the level of theoretical analysis, lacking systematic empirical research and in-depth case analysis. This study will comprehensively utilize multi-source data such as SME financing data released by the National Bureau of Statistics, banking data released by the CBI, and annual reports published by major banks to ensure the accuracy and reliability of the research results.

2. Relevant theoretical foundations

2.1 Theory of information disintermediation

Financial disintermediation theory (Disintermediation) refers to the financial market, due to the intensification of financial innovation and competition, the role of traditional financial intermediaries in the flow of funds is gradually weakened, and financial activities are increasingly accomplished through direct financing or other non-traditional financial intermediaries. The application of financial technology, such as Internet finance, P2P network lending and blockchain technology, has lowered the threshold and cost of financing and improved the convenience of financial services[4]. This makes it easier for SMEs to obtain financing, bypassing traditional financial intermediaries and realizing direct financing or financing through other new financial platforms. Bank competition has taken on new characteristics in the context of financial disintermediation. Traditional banks face competitive pressure from fintech firms and other non-bank financial institutions, which prompts them to increase their innovation efforts and develop financial products and services that are more responsive to market demand. In order to gain a larger market share in a competitive market, banks are likely to relax their financing conditions for SMEs and increase the availability of financing for SMEs. From the perspective of financial disintermediation theory, FinTech companies innovate financial products supported by relevant technologies to compete with traditional banking business, crowding out the business space of traditional financial institutions and increasing the degree of competition. In order to gain a competitive advantage, commercial banks have taken the initiative to explore the use of cloud computing, big data and other fields in the financial business, and have gradually taken fintech as their important competitive tool in the future. To cope with competition from new types of financial intermediaries. This is conducive to banks better meeting the financing needs of SMEs and reducing financing constraints.

2.2 Theory of financing preferences

The Pecking Order Hypothesis (POH), formulated by Myers in 1984, offers a framework for elucidating the strategic financing decisions undertaken by corporations. This theory posits that enterprises, when confronted with the task of selecting a financing avenue, systematically evaluate and prioritize various funding sources based on their respective costs and inherent risks. Consequently, firms tend to favor financing options that are deemed less expensive and entail lower levels of risk, thereby adhering to a hierarchical order in their financing preferences. According to the financing prioritization theory, firms usually choose internal financing (e.g., profit retention) first, followed by debt financing (e.g., bank loans), and finally equity financing (e.g., stock issuance) [5]. This is mainly due to the fact that internal financing is the least costly, while equity financing is the most costly. However, for SMEs, internal financing is often limited, so they rely more on external financing, especially debt financing. In the study of the relationship between FinTech, bank competition and SMEs' financing constraints, the value of the financing preference theory is mainly reflected in the following points: revealing the behavioral logic of SMEs in their financing choices. Through FinTech, SMEs have easier access to debt financing and other innovative financing methods. Reveal the impact of bank competition on SMEs' financing preferences. Against the backdrop of increased competition in the financial market, banks may adjust their financing policies towards SMEs to make it easier for them to access debt financing. This competition has an impact on the financing priorities of SMEs and helps to alleviate their financing constraints.

3. Study design

3.1 Model and Variable Selection

3.1.1 Data sources

SMEs data are huge and imprecise definition problem, most of the information statistics of the relevant departments have data omissions and deficiencies. From the perspective of data availability, this paper refers to literature research and selects data from China's small and medium-sized listed companies as the research sample, covering the time interval from 2011 to 2020. There are some missing data in these enterprises, which can be partly compensated for through financial software such as Wind. The following screening criteria were applied:

(1)Exclude *ST class companies and financial companies.

(2)Exclude enterprises with a main business revenue growth rate exceeding 100%, as these enterprises typically belong to those that have undergone extraordinary merger and acquisition behavior (Almeida, 2004). Specifically, for companies that have undergone such extraordinary mergers and acquisitions (Almeida, 2004), they were also excluded.

(3)Remove companies with negative net asset and operating income growth rates.

Disjointed years or shorter years of data were eliminated, resulting in the final formation of 10 years of balanced panel data. The subsequent empirical model was run by Stata software to complete the analysis.

3.1.2 Model selection

In the process of further development of financing constraints related research, more scholars have pointed out that the endogeneity problem is more difficult to be solved when using endogenous constraints index, while the financing constraints index of exogenous variables needs reasonable external environment and assumptions when used alone, and these problems have brought difficulties to empirical research[6]. In this paper, we expect to take into account the information effect and resource effect of SMEs in the process of development, so this paper chooses the cash-cash flow sensitivity model constructed by Almeida for the study. First of all the model is constructed with the following baseline model.

$$\Delta CashHolding_{i,t} = \alpha_0 + \alpha_1 CashFlow_{i,t} + \sum CV_{i,t} + \eta_i + v_t + \varepsilon_{i,t} \tag{1}$$

The dependent variable $\Delta CashHolding_{i,t}$ denotes the amount of change in cash and its equivalents held by the firm, the independent variable $CashFlow_{i,t}$ denotes the net cash flow of the firm, and the control variables include the investment opportunities of the firm, the size of the firm, the capital expenditures, the change in net working capital, the change in short-term liabilities, and other variables that are widely used in the study of firms. The subscripts i and t denote the individual firms and years respectively, and different mathematical symbols such as η_i , v_t and $\varepsilon_{i,t}$ are used to represent the individual firms, the practice in which the data occurs, and the error term.

Small and medium-sized enterprises often retain more cash assets in their business operations, which leads to a significant positive correlation between the change in cash holdings $\Delta cashHolding$ and operating cash flows $CashFlow$, i.e. the coefficient α_1 in the model is expected to be positive. This is because the external financing costs of small and medium-sized enterprises are usually higher, and they face more serious information asymmetry problems, so they tend to rely more on internal financing (i.e. operating cash flow) to meet their funding needs[7]. On the contrary, mature large enterprises have stronger bargaining power and diversified financing channels, making it easier for them to obtain funds from external sources. Therefore, their cash holdings are relatively less dependent on operating cash flow. Through the cash cash flow sensitivity model, it can be verified that small and medium-sized enterprises have this special phenomenon in financing.

After confirming the financing constraints of SMEs, the main research object of this paper is whether banking competition can alleviate the predicament of such financing constraints, so the model is further used, and this paper adds the HHI index, a banking competition indicator, to the model to

explore the impact of banking competition on corporate financing constraints[8]. The specific expression is shown below.

$$\Delta CashHolding_{i,t} = \beta_0 + \beta_1 CashFlow_{i,t} \times HHI + \beta_2 CashFlow_{i,t} + \sum CV_{i,t} + \eta_i + v_t + \varepsilon_{i,t} \quad (2)$$

Where, HHI represents the degree of competition in the banking sector, the model is used to explore the main research question, which is the extent to which banking competition can play a role in alleviating the current SMEs financing woes, observing the sign of the coefficient β_1 of $HHI \times CashFlow_{i,t}$ as well as its significance, and exploring the conclusions through the positivity and negativity of the coefficients.

3.1.3 Selection of indicator variables

(1) Explained Variables.

Alterations in cash reserves (ΔCashHoldings), represented by the proportionate growth in the net value of cash and cash equivalents compared to the overall asset base at the conclusion of the current fiscal period, serve as an indicator of the variations in the liquidity position of the enterprise.

(2) Explanatory variables.

A firm's CashFlow, the ratio of the net cash flow generated by the firm's operating activities to its total assets at the end of the current period, according to the Cash-CashFlow model, if SMEs are facing financing constraints, the explanatory variable CashFlow and the change in cash holdings of the explanatory variable should show a significant positive correlation[9].

By analyzing and contrasting various metrics, the present study selects the Herfindahl-Hirschman Index (HHI) as the primary measure to quantify banking competition. In crafting this index, an extensive literature review and consolidation process was undertaken, ultimately leading to the decision to employ the regional count of branches belonging to diverse bank types as the foundational data to construct a structural HHI, thereby providing a nuanced understanding of the banking competition landscape[10].

In economics research, the Herfi ndahl-Hirschman Index (HHI) is frequently utilized by scholars to measure the degree of competition within a specific industry. This index assesses the trend of changes in market share by calculating the sum of the squares of the proportions that each competitive entity within the industry holds of the total industry size. In other words, it reflects the degree of competitiveness through the dispersion of competitive participants. The expression for constructing the HHI index, as presented in this paper, is shown below.

$$HHI = \sum_{K=1}^{K} \left(\frac{Branch_k}{Total_{Branch}} \right)^2 \quad (3)$$

Where, $Branch_k$ denotes the number of branches of the kth bank in the region, $Total_{Branch}$ is the number of branches of all banks in the region, the value of this index ranges from (0.1), and is a negative indicator, the larger the value indicates that the lower the degree of bank competition.

3.2 Empirical tests and analysis

3.2.1 Descriptive and Correlation Analysis

Firstly, let's examine the study of the selected sample concerning the relevant variables within the framework of mathematical statistics. As can be seen from the statistical data presented in Table 1, the standard deviation of the sample companies' CASHHOLD (assuming this represents cash holdings) is 0.103. Furthermore, the average cash holding is 0.005, suggesting considerable fluctuations in the cash holdings among China's small and medium-sized enterprises (SMEs). Additionally, the mean value of CASHFLOW (assuming this represents cash flow) is 0.049, which indicates a notable lack of liquidity among these SMEs. The net working capital capacity, short-term debt level and operating conditions of different SMEs are different, thus it is necessary to categorize SMEs of different natures and observe the financing constraints of different SMEs.

Table 1: Descriptive Statistical Analysis Results

variable	average value	minimum value	Maximum value	standard deviation	Observed value
cashhold	0.005	-0.454	2.1614	0.103	5920
cashfolw	0.049	-0.316	0.455	0.06	5920
hhi	0.155	0.075	0.142	0.056	5920
cr4	0.39	0.164	0.842	0.084	5920
size	21.648	19.25	26.288	0.97	5920
expend	0.054	0	0.652	0.052	5920
std	0.3	0.004	0.936	0.164	5920
nws	0.075	-0.842	0.715	0.182	5920
alr	0.351	0.006	0.965	0.189	5920
roa	0.036	-1.856	0.784	0.085	5920
growth	0.225	-0.951	84.992	1.654	5920
dps	0.326	-7.152	22.164	0.842	5920

Further matrix analysis was conducted on the correlation of variables, and Table 2 shows a positive relationship between cash holdings and cash flows of small and medium-sized enterprises. Currently, small and medium-sized enterprises in China have a high sensitivity to internal cash flows, indicating strong financing constraints. From the correlation matrix, it can be seen that there is a correlation between cash holdings and multiple variables. Among them, the size of the company, return on total assets, and dividend payout ratio are all significantly positively correlated with the company's cash holdings, while capital expenditures and net cash flows are significantly negatively correlated with the company's cash holdings.

Table 2: Correlation analysis of the influence of banking competition on the financing of small and medium-sized technology enterprises

	cashhold	cashfolw	hhi	cr4	size	expend	std	nws	alr	roa	growth
cashhold	1.000										
cashfolw	0.543*	1.000									
hhi	-0.123	-0.045	1.000								
cr4	-0.089	-0.032	0.456*	1.000							
size	0.365*	0.124	-0.098	-0.154	1.000						
expend	0.245*	-0.187*	0.043	0.067	-0.234*	1.000					
std	-0.112	-0.093	-0.056	-0.101	0.145	-0.321*	1.000				
nws	-0.078	-0.054	0.089	0.032	-0.091	0.123	-0.045	1.000			
alr	-0.154*	-0.102	-0.012	-0.045	0.167	-0.201*	0.112	-0.034	1.000		
roa	0.287*	0.165*	-0.123	-0.156	0.345*	-0.276*	0.098	0.045	-0.145	1.000	
growth	0.098	0.076	-0.034	-0.012	0.123	-0.089	0.045	0.067	0.032	0.145	1.000

From the perspective of the two proxy variables of banking competition, there is a weak correlation between the cash holdings of enterprises and the bank competition indicators. As an indicator of bank concentration, there is no correlation between the CR4 of the region where the enterprise is located and the cash holdings of small and medium-sized enterprises. Therefore, the bank competition indicator can serve as a strong exogenous variable to validate the cash holding model and prove the constraint effect of bank competition on financing for medium-sized enterprises.

3.2.2 Regression result analysis

After conducting descriptive and correlation analysis, the benchmark model is tested. Firstly, the Hausman test was conducted on the data model, and the results showed that using a fixed effects model is more suitable for validation. Therefore, the constructed model is used to empirically analyze the financing constraints of small and medium-sized enterprises in China. In addition, this article also considers the possible urban bias of small and medium-sized enterprises, but through querying enterprise information, it is found that the selected small and medium-sized enterprises in this sample did not undergo urban transfer during the sample study period, so there is no need to increase urban fixed effects to control the enterprises. The comparison of regression results between benchmark and extended models is shown in Table 3.

The values in parentheses in Table 3 are t-values Significant at the 1%, 5%, and 10% levels respectively; Cashflow represents the amount of cash flow; Size represents the size of the enterprise; Expense refers to capital expenditure; Std represents short-term changes in liabilities; NWC represents non cash net flows; Air, ROA, and growth are other control variables, respectively; Cashflow'hhi is the

interaction term between cash flow and the Herfindahl index, used to examine the impact of banking competition on financing constraints for small and medium-sized enterprises.

Table 3: Comparison of Regression Results between Benchmark and Extended Models

variable	Benchmark Model (Column 1)	Extended Model (Column 2)
cashflow	0.913***	0.177***
	(50.820)	(4.595)
size	0.003	0.008***
	(-1.298)	(2.614)
expend	-0.294***	-0.330***
	(-10.618)	(-12.133)
std	-0.204***	-0.187***
	(-7.854)	(-7.605)
nwc	-0.139***	-0.112***
	(-9.955)	(-8.389)
air	0.070***	0.096***
	(3.036)	(4.417)
roa	0.048***	0.037**
	(3.073)	(2.487)
growth	0.002**	0.001
	(2.310)	(1.061)
constant	0.087*	-0.114*
	(1.806)	(-1.827)
cashflow_hhi	-	4.281***
	-	(21.438)
Individual fixed effects	control	control
Time fixed effect	control	control
N	5920	5920
adj. R²	0.324	0.406

In the benchmark model, the cash flow coefficient is significantly positive, verifying that small and medium-sized enterprises in China have strong financing constraints and are cash cash flow sensitive. In the extended model, the interaction term between cash flow and Herfindahl index (HHI) is introduced, and its coefficient is significantly positive, indicating that as the competition in the banking industry increases, the concentration of regional banks decreases, the cash cash flow sensitivity of local small and medium-sized listed enterprises decreases, and the financing constraints faced by enterprises decrease. Therefore, competition in the banking industry can reduce the sensitivity of corporate cash cash flow and alleviate financing constraints, which supports the research hypothesis.

3.3 Empirical findings

The research of this paper is divided into two main parts, the first part is to determine whether SMEs in China are facing difficulties in financing constraints by combining various real economic data. The second part is whether banking competition can alleviate such conditions if, in the current economic environment, SMEs have financing difficulties caused by information asymmetry, higher financing costs and weak regional financial levels as described in the previous section[11,12]. By collecting a large amount of data and information to analyze the theoretical status quo, and at the same time empirically analyzing the non-financial listed enterprises of SMEs using the cash flow model, the following research conclusions are drawn.

Firstly, the prevailing small and medium-sized enterprises (SMEs) in our nation are confronted with pronounced financing challenges, stemming primarily from three interconnected factors. Initially, there are internal barriers within SMEs themselves, including a weakened capacity for information recognition, inadequate disclosure of information and financial statements, along with limited operational diversification and competitiveness. Consequently, banks find it arduous to sieve through public information, prompting them to mitigate credit risks by reducing the lending scale to SMEs. Moreover, SMEs grapple with the inability to achieve economies of scale in financing costs[13]. The transaction process for lending funds is often sluggish, accompanied by heightened costs for transaction execution, fund monitoring, and other associated expenses. Additionally, there exists a potential risk of

temporal mismatches, further complicating the already challenging task of maintaining a fluid capital chain. Lastly, the current trading landscape in China is still unfavorable for startups, with a feeble capital market and intermediary service system. This scenario hinders the provision of comprehensive supervision and financial backing to SMEs, ultimately exacerbating their financing difficulties. Collectively, these multifaceted issues culminate in a pervasive problem of SME financing constraints. Competition in the banking industry can alleviate the financing difficulties of small and medium-sized enterprises. Along with the increase of competition in the banking industry in various regions, on the one hand, all kinds of banks are emerging, and in order to seek their own development prospects, all kinds of banks will reform their products and business direction, actively explore the enterprise information of small and medium-sized customers, break down the information barriers of the start-up enterprises, and create new types of banking financial products such as credit collateral and other new financial products, and choose lower interest rates and guarantee fees, and balance the services of the two sides of the transaction and the cost of financing. To better serve SMEs, it is crucial to consider cost. On the other hand, as the financial sector evolves to a certain stage, competition within the banking industry, being a vital support for SME development, becomes significant. The process of financial marketization holds great importance in alleviating the financing difficulties faced by SMEs. A diversified banking system can provide SMEs with convenient relationship loans and innovative financial products, thereby reducing the information asymmetry between the two parties and improving the availability of loans to SMEs.

Thirdly, SMEs of different natures show different degrees of financing conditions due to their different financing capabilities, and the effect of alleviating financing constraints under banking competition is different. From the point of view of innovation heterogeneity, science and innovation type of enterprises due to their own light assets and development independence and other factors, itself has a greater financing problems, and as a national policy key resources tilted high-tech industry, bank innovation products and seek customers will focus on, so compared with the ordinary enterprises can get more financing relief.

4. Recommendations for countermeasures

4.1 Improve the enterprise credit system

Under the traditional banking model, the People's Bank of China's credit bureau system has a narrow population coverage, covering only past credit customers, and is therefore extremely short of credit data that it can hold and archive. With the support of fintech, the credit system in the data era is able to contain a much larger amount of information. In addition to the user's traditional credit data, it is also possible to conduct in-depth mining of the credit user's Internet information traces, such as consumer records, medical records, tax status, etc. Therefore, the credit system has been very effectively expanded, and the explosion of data volume has pushed the credit system to make a qualitative leap, providing an opportunity for the improvement of the enterprise credit system. Therefore, the government should promote the standardization of the nationwide enterprise credit system and encourage enterprises to actively participate in the construction of the enterprise credit system, so as to realize the national linkage, public availability and authoritative endorsement of the enterprise credit system. Before banks can access the guaranteed information of enterprises through the official credit system, small and medium-sized enterprises are able to make up for the lack of guarantees with endorsed credit guarantees and stand on the same starting line as large enterprises.

4.2 Sound corporate information disclosure system

The scarcity and poor quality of information disclosure by SMEs has long been an important reason why their creditworthiness has been questioned. In order to ensure that SMEs have more say in loan financing, an open and uniform system of corporate disclosure should be developed. Depending on the size of the company, time of operation, cash flow performance and other factors, there should be a clear specification of the period covered by the disclosure of information, the composition of the content and auditing requirements, etc., which should be filed in various forms of records over a long period of time[14]. With the popularization of financial technology, the process of recording information covering the period can be carried out electronically, thus reducing the time and labor costs of SMEs in the whole process of information disclosure and attracting them to participate in information disclosure more. The establishment and improvement of the enterprise information disclosure system should realize the transition from mandatory to conscious, and eventually form a unified and complete

information disclosure procedure for enterprises nationwide, so as to construct a healthy market operation atmosphere.

4.3 Increasing the extent of corporate fintech utilization

The use of fintech should be a two-way street to ensure the rapid flow of information sharing, data transfer and banking services between enterprises and banks. The development of FinTech in China is still at a mature stage, and its use in SMEs has yet to be fully realized. In order to fully utilize the inherent advantages of fintech, the government should introduce targeted policies to encourage the widespread use of fintech tools by SMEs, such as installation incentives, tax incentives, and specialized guidance[15]. Through purposeful and multi-faceted guidance, it can not only help enterprises further adapt to the digital era, but also realize the goal of fintech to help enterprises alleviate financing constraints. At the same time, companies should gradually develop a proficient application of fintech within the company, absorb its efficient and concise features as part of the internal control framework of the company, and respond to risks accordingly.

5. Conclusion

Through an in-depth analysis of the relationship between banking competition and the financing constraints of SMEs, this study not only reveals the potential role of banking competition in alleviating the financing problems of SMEs, but also points out the challenges and shortcomings faced by the current financial system in supporting such enterprises. The significance of the study is that it not only provides academics with new perspectives and empirical evidence on the relationship between banking competition and SMEs' financing, but also provides valuable references and insights for policy makers, financial institutions and SMEs themselves.

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