

Credit risk contagion and firm investment efficiency: From the perspective of credit debt defaults

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Abstract. Frequent credit debt defaults can constitute credit risk contagion causing systemic financial risk across the macroeconomy. In this paper, we find that credit risk contagion that occurs in a city or industry has a negative influence on the investment efficiency of firms within the scope, and this effect is amplified as the size of credit debt defaults grows. This conclusion is still robust after a series of tests. The mechanism analysis results show that credit risk contagion reduces firms' investment efficiency by affecting their bank lending, trade credit along the supply chain, credit allocation towards mortgage loans, and financial constraints. Furthermore, we find that private firms and firms located in regions with decentralized banking sectors are less affected by credit risk contagion, which validates the impact of firm ownership and regional banking sector concentration. Finally, we according to the test result of firm performance reveal that credit risk contagion increases the prudence of firm investment decisions, making this contraction of firm investment show a positive effect. This paper provides both theoretical support and policy insights for strengthening credit debt market regulation and preventing systemic financial risks.

Keywords: Credit debt default, Credit risk contagion, Firm investment efficiency.

1. Introduction

With the process of reform and opening up and the development of the market economy, China's bond market has also developed at a high speed. By April 10, 2022, the total size of China's bond market was about 134 trillion yuan. The credit bond market, an integral segment of the bond market, has a stock of 44 trillion yuan. Compared with interest-rate bonds, credit bonds have higher interest rates and can earn higher returns. But in reality, the benefits and risks go hand in hand. Credit bonds, also known as unsecured bonds, are issued by entities other than the government. Since it lacks state credit backing, there is a risk of default due to the poor management of the issuing entity, i.e. credit risk. In recent years, there have been repeated cases of credit bond market thunderstorms, such as the default of BMW Brilliance Group's "17HUA05 Bond" on October 24, 2020, and the plunge of Ziguang's bond price from RMB100 to RMB16 on October 30, which involved huge amounts and many parties causing a negative impact on social economy. As credit risk accumulates and the momentum of default grows, the probability of systemic financial risk increases.

Prevention of financial risks is an important issue of concern for China's social and economic development. Since the reform and opening up, China's economic growth trend is rapid. However, the booming socialist market economy is often accompanied by opportunities and risks. In the full fight for the great rejuvenation of the Chinese nation, we need to take into account some crises such as systemic financial risks that have a high impact on the national economy and are highly destructive. General Secretary Xi Jinping pointed out that "preventing and resolving financial risks, especially preventing the occurrence of systemic financial risks, is a fundamental task of financial work". The 19th Party Congress clearly stated that we should "improve the financial supervision system and guard the bottom line of no systemic financial risks". In order to prevent systemic financial risks, China has also taken institutional measures. The People's Bank of China and regulatory authorities have issued the "Guidance on Improving the Supervision of Systemically Important Financial Institutions", "Systemically Important Banks Assessment Measures", etc., and "Systemically Important Insurance Companies Assessment Measures" for public consultation. The system of rules for the supervision of systemically important financial institutions is basically established.

The so-called systemic financial risk mainly refers to a single financial event, such as institutional bankruptcy, debt default, and financial price volatility, that may cause a crisis in the entire financial system, leading to significant losses in economic and social welfare (Chen, 2019). One of the most important problems is that risk contagion and systemic financial risk have strong negative externalities, and this risk can originate from one institution or market and gradually contagious to other subjects, finally forming systemic market volatility, which seriously threatens the overall stability of the macroeconomy.

The impact of such risk contagion on firms, an important subject in the market, is enormous. Take the Evergrande thunderstorm that occurred in September 2021 as an example, the collapse of Evergrande not only made it difficult to protect itself but also generated a considerable spread of harm. According to the estimation of Evergrande by Capitol Macro, as of June 2021, Evergrande Group was constructing 1.4 million units of commercial housing units (Zhang, 2023). It also means that there are a large number of suppliers docking and cooperating with Evergrande, and the bankruptcy of Evergrande would make these partners unable to receive their Receivables. This event destroyed the capital chain of these firms and negatively affected the operation and investment of these firms. Generally speaking, when a subject in the market defaults on credit debt, other firms in the market will inevitably be affected by the defaults, and the credit level of the whole market will drop. When banks and other financing institutions receive this signal of credit risk, they will take a series of countermeasures such as raising the threshold of loan issuance and reducing the amount of loan issuance. Then it will affect the capital operation of firms and make firms' investment behavior difficult and unable to achieve investment efficiency under normal credit levels.

Based on the above analysis, to validate the impact of credit debt default behavior on firm investment efficiency, this paper takes A-share listed companies from 2009-2021 as the research sample to investigate whether credit debt defaults reduce the efficiency of firm investment in terms of both city default size and industry contagion, respectively. We find that whether the default of credit debt occurs within the city or within the industry, the investment efficiency of firms will be affected, and the larger the scale of default, the greater the impact on investment efficiency. On this basis, this paper further conducts a more in-depth study on its impact mechanism, as well as the impact on the investment efficiency of firms under different banking industry concentrations and different ownership systems.

Compared with the existing studies, the contributions of this paper are as follows: (1) For credit risk, most of the existing literature focuses on issues related to credit risk formation, such as the path of credit risk formation and the influencing factors of formation. This paper analyzes the role of credit risk contagion on firm investment efficiency, starting from the contagion effect of credit risk and its impact on the social economy, which enriches the research on credit risk. (2) There is a lot of literature on investment efficiency, but there are few empirical studies on the impact of credit risk on firm investment efficiency, and this paper fills this gap by providing a new entry point for research on the impact factors of investment efficiency. (3) For practical significance, this paper confirms the contagion effect of credit risk and its negative impact on firm investment efficiency, providing a stronger and more credible theoretical basis and policy inspiration for preventing credit default risk and even systemic financial risk.

2. Literature Review

2.1. Credit debt default and credit risk contagion

The credit debt defaults that have occurred in recent years have involved huge amounts of money and many subjects, and have had a negative impact on the social economy. It has also drawn the attention of some scholars, with a focus on the contagion effects that can be caused by the default of a single firm on its credit debt.

Regarding the causes of credit risk contagion, Wang and Jiang (2019) explored four main paths that generate firm credit risk contagion, namely, supply chain contagion, commercial credit contagion,

capital bond contagion, and financial guarantee contagion. Based on complex network theory, Zhang and Li (2020) investigated the formation and transmission mechanisms and paths of heterogeneous individual credit risks and find that the high-density, low-centered network structure of firm groups amplifies the risk contagion effect. Using the basic ideas of the macro balance sheet and network analysis method, He et al. (2022) measured the financial linkage among institutional sectors and the financial risk contagion effect due to credit debt default. It is concluded that the financial sector has the greatest impact on risk propagation. Shan et al. (2015) studied the credit risk contagion association between firms in the pharmaceutical industry and the steel industry. They conclude that the frequency and intensity of credit risk contagion are higher in the former than in the latter while pointing out that the important factors leading to credit risk contagion in the supply chain are the integration of upstream and downstream firms and the introduction of credit technology. By studying the relationship between credit risk contagion and firm surplus management, Ning et al. (2020) found that credit risk contagion caused by credit debt also exists between regions. Zhou and Pang (2022) structurally examined bond market risk by compiling a provincial credit bond index in China and reflecting bond risk profiles with credit bond prices, and found that the probability of risk spillover is higher between provinces and cities with closer geographical proximity and more similar economic and financial structures.

Regarding the impact of credit risk contagion, Zhang (2019) through a study of the bond market found that investors are more sensitive to firms that have incurred credit debt defaults, resulting in firms in the same industry requiring higher debt issuance costs for financing. Li (2022) found that due to the existence of industry differences, credit risk contagion can lead to greater volatility and variability in credit spreads in the secondary market, thus triggering a break in the funding chain and thus increasing the credit crisis in the bond market as a whole. Xie (2022) found that credit risk from firm bond defaults can have a risky impact on non-defaulting firms in the same industry to innovate through financing.

2.2. Firm investment impact factors

As an important tool for firms to develop production, control risk, expand strategically, and achieve financial goals, the control of investment is closely related to the lifeblood of firms in the current competitive environment. Firm investment has also been a proposition that has been the focus of domestic and foreign scholars. This paper summarizes the literature on factors affecting firm investment, further links these factors to credit risk, and seeks the theoretical basis for the role of credit risk contagion in firm investment efficiency.

For the external institutional environment perspective, in terms of macro policy, Zhong et al. (2023) used a heterogeneous stochastic frontier model to test that the joint coordination of monetary policy and macroprudential policy alleviated firm financing constraints, reduced uncertainty about future firm financing, and improved firm investment efficiency. With respect to the marketization process, Liu and Su (2020) found that the level of regional marketization mitigates the impact of financing constraints on underinvestment and shows some governance effects.

From the internal firm governance perspective, in terms of management decision-making, Lai et al. (2019) adopted the theory of the ratio of secured loans to credit loans for firm loans to specify the bank's evaluation of firm risk in their study of management investment behavior. This paper also draws on this approach to study the bank's perception of credit-risk firms through the change in the number of these two types of loans after the occurrence of credit default, and thus the impact of credit risk on firm investment. As for internal incentives, Gao (2021) found that within a certain range, the internal disparity in executive compensation can effectively improve firm investment efficiency, but too large an internal disparity in executive compensation can deteriorate firm investment efficiency. Regarding the equity structure, Yin (2021) found that dual equity structure indirectly causes inefficient investment behavior of firms by intensifying agency conflicts and increasing agency costs. Yang (2020) found that the higher the equity checks and balances, the higher the investment efficiency of firms.

From the perspective of market participants, by studying the relationship between the bank-firm

relationship and firm investment efficiency, Lei (2023) found a significant effect on the improvement of investment efficiency of non-state firms and firms with a higher level of marketization. The outbreak of firm credit risk will inevitably affect the relationship between banks and firms, which also inspires the heterogeneous analysis of the restrictions on the ownership of firms in this paper's research. In a theoretical study, Pan et al. (2020) claimed that in the case of credit debt defaults, under the influence of credit risk contagion, creditors may naturally reduce their trust in non-defaulting firms and become more cautious and conservative in providing financial support, making non-defaulting firms face greater financing constraints. Wei (2022) constructed a model to verify that increased bank competition expands firms' investment and reduces their inefficient investment, and this paper draws on his ideas to analyze the heterogeneity of competition in the regional banking industry by using regional bank concentration as a proxy.

3. Theoretical analysis and model construction

3.1. Theoretical Analysis and hypothesis formulation

Theoretically, how does credit risk contagion lead to a decline in the efficiency of firm investment? On the one hand, when a firm default on its credit debt, creditors will reduce their trust in the firm and become more cautious and conservative in providing financial support, making non-defaulting firms face greater financing constraints. On the other hand, banks and other financial institutions will react to the default risk of firms by raising the threshold of firm financing and changing the structure of firm credit, resulting in the restriction and shrinkage of firm investment. At the same time, by summarizing previous studies, we find that the risk of credit default by a single firm is more likely to be limited to a specific radius of risk contagion. At the regional level, Zhou and Pang (2022) found that the probability of risk spillover is higher between provinces and cities with closer geographical proximity and more similar economic and financial structures. Cities have close financial market networks within them, and this close connection provides a channel for credit risk contagion. A firm's credit debt default does not only mean that it cannot repay the bonds it has issued but also that other debts that the firm has taken from the local financial market are equally difficult to repay, which will have a significant impact on the local financial market (Ning et al., 2020). At the industry level, changes in business risks in the same industry tend to be synchronized (Zhang, 2019), and when a firm experiences credit risk, investors and banks are prone to believe that other firms in the same industry with it also have such credit risk, thus reducing the level of trust in firms in the whole industry and causing negative impacts on the whole industry.

In summary, this paper argues that credit risk contagion caused by credit bond defaults can result in a decline in firm investment efficiency. By summarizing the literature, both city-wide and industry-wide credit debt defaults will lead to a shrinkage of investment and a decrease in investment efficiency for the range of firms. Therefore, this paper proposes the following hypothesis:

Hypothesis 1: When a city defaults on its credit debt, the efficiency of firm investment decreases.

Hypothesis 2: When the industry defaults on credit debt, the efficiency of firm investment decreases.

It is worth noting that the same is credit debt defaults, but there is a difference in the size of their defaults. The larger the default, the worse the credit level of the firm represents, the contagion effect produced will be worse, and the investment efficiency of the affected firms will be weakened. Accordingly, this paper proposes further hypothesis 1a for hypothesis 1.

Hypothesis 1a: The larger the city's credit debt defaults, the less efficient the firm's investment.

3.2. Data description

This paper selects A-share listed companies from 2009-2021 as the research sample and does the following screening: (1) exclude financial listed companies such as banks, securities, and insurance; (2) exclude companies in the ST category; (3) exclude samples with missing observations in the sample interval. In order to avoid the influence of extreme values, the continuous variables are subjected to a 1% tail shrinkage up and down. The firm financial data in this paper are taken from the Cathay

United (CSMAR) database, and the credit debt default data are taken from the WAND (Wind) database.

3.3. Variable Description and model design

3.3.1. Dependent variable

The main explanatory variable of this paper is the investment efficiency of firms. Referring to Cohen and Li (2020) and Liu et al. (2019), the explanatory variable *investment*, is constructed to be equal to capital expenditures/capital stock at the end of the previous period, with capital expenditures equal to cash paid to build fixed assets, intangible assets, and other long-term assets, and capital stock equal to the net value of depreciable tangible assets.

3.3.2. Independent variables

The explanatory variables in this paper are constructed from both region and industry. 500 million credit debt default size is selected as the threshold to construct the *cfi* variable, which takes 1 when a city has a credit debt default of 500 million or more, and 0 otherwise, and the *ii* variable, which takes 1 when an industry has a credit debt default of 500 million or more, and 0 otherwise. this paper also sets the same for city and industry in this paper, we also set continuous variables for city and industry to conduct regressions, and construct *InCityWei* to indicate the absolute amount of credit bond defaults occurring in a city. This paper also considers the credit risk amplification effect of credit bond default size and constructs the *dCityWei* variable. *dCityWei* takes 1 when a city has a credit bond default, and 0 otherwise.

3.3.3. Control variables

The control variables in this paper are as follows: firm size (*Size*), debt level (*Lev*), profitability (*ROA*), cash flow (*Cashflow*), revenue growth (*Growth*), number of independent directors on the board (*Indep*), whether dual positions are held (*Dual*), financial performance of the firm (*TobinQ*), years of establishment (*FirmAge*), fixed assets ratio (*TANG*), and institutional ownership (*Instit*). The specific variables are defined in Table 1.

3.3.4. Fixed effect

The model in this paper also includes both individual fixed effects μ_i and year fixed effects γ_t to form a two-way fixed effect.

3.3.5. Model Construction

This paper sets up a fixed effects model (see model (1)) to test the effect of credit risk contagion on the efficiency of firm investment. The main concern is the coefficient β_1 , which reflects the extent of the impact of credit risk on the efficiency of firm investment

$$invest_{it} = \beta_0 + \beta_1 cfi_{it} + \beta control_{it} + \mu_i + \gamma_t + \varepsilon_{it} \quad (1)$$

3.3.6. Descriptive statistics

Table 1 presents the results of descriptive statistics for the main variables

Table 1. Variable Definitions and descriptive statistics

Variable Name	Variable Definition	Obs	Mean	SD	Min	50th	Max
<i>invest</i>	Investment efficiency, see text for calculation	22150	0.134	0.030	0.005	0.141	0.169
<i>cfi</i>	Does the city have greater than 500 million credit debt default size	22150	0.276	0.447	0.000	0.000	1.000
<i>Size</i>	Firm size, natural logarithm of total annual assets	22150	22.213	1.289	19.939	22.040	26.063
<i>Lev</i>	Debt level, total liabilities at year-end / total assets at year-end	22150	0.418	0.206	0.061	0.407	0.905
<i>ROA</i>	Profitability, net income / average balance of total assets	22149	0.039	0.069	-0.276	0.039	0.207
<i>Growth</i>	Operating income growth rate, operating income growth amount / total operating income of the previous year	20748	0.155	0.414	-0.574	0.090	2.475
<i>Cashflow</i>	Cash flow ratio, net cash flow from operating activities/period-end current liabilities	22150	0.048	0.067	-0.149	0.047	0.230
<i>TANG</i>	Fixed assets ratio, fixed assets/total assets	22149	0.204	0.158	0.002	0.170	0.690
<i>FirmAge</i>	Year of company establishment	22150	2.922	0.305	2.079	2.944	3.497
<i>Indep</i>	Percentage of independent directors, number of independent directors/directors	22147	0.377	0.054	0.333	0.364	0.571
<i>TobinQ</i>	Firm financial performance, firm market value / asset replacement cost	21632	2.117	1.390	0.852	1.671	8.864
<i>Dual</i>	Whether the two positions are combined and whether the chairman of the board and the CEO are the same person	21838	0.300	0.458	0.000	0.000	1.000
<i>Instit</i>	Institutional shareholding ratio, institutional capital contribution/registered capital	22120	37.229	24.109	0.000	37.579	326.727

4. Analysis of the empirical results

4.1. Baseline regression results

After the previous theoretical analysis, this paper first verifies the relationship between credit risk contagion in cities and the efficiency of firm investment. Table 2 has four columns of regression results. Columns (1) (2) are the results of the multiple regression of whether a city has credit debt defaults greater than 500 million on the level of firm investment. Column (1) is the result without imposing control variables, while column (2) imposes control variables. Both columns present the regression coefficient of credit debt default size *cfi* on the level of firm investment *invest* at the 1% level is significantly negative, indicating that firms with cities with credit debt size greater than 500 million have a significantly lower level of investment and that there is credit risk contagion in the same city and weaken the efficiency of firm investment. Hypothesis 1 is verified. On the basis of the first two columns, columns (3) and (4) change the explanatory variable from whether a city has a credit debt default size greater than 500 million to a continuous variable of the absolute amount of city credit debt default size. Column (3) is the regression result without imposing control variables and column (4) is the result with imposing control variables. Both regression results also indicate that the default amount variable of city credit debt The coefficient of *InCityWei* is significantly negative at the 1% level, i.e., the same evidence that city credit defaults reduce the efficiency of firms' investments. When a city generates an overall credit debt default risk, this risk is contagious among firms, causing the overall credit level of firms to decline, the flow of capital to be poor, the scale of investment to shrink, and the efficiency of investment to be impaired.

Among the control variables, net profit (*ROA*), cashflow ratio (*Cashflow*), revenue growth rate

(*Growth*), fixed assets ratio (*TANG*), and firm age (*FirmAge*) have a significant positive relationship with firm investment level *invest*, indicating that firms with high profitability, long survival time, and smooth capital flow are more efficient in investment. The variable of whether or not two offices are combined (*DUAL*), i.e., the firm's CEO is also the chairman of the board, is negatively related to the firm's investment efficiency.

Table 2. Baseline regression

	(1)	(2)	(3)	(4)
	<i>invest</i>	<i>invest</i>	<i>invest</i>	<i>invest</i>
<i>cfi</i>	-0.0017***	-0.0014***		
	(-4.4005)	(-3.5716)		
<i>Size</i>		-0.0004		-0.0004
		(-0.5837)		(-0.5784)
<i>Lev</i>		-0.0011		-0.0012
		(-0.4573)		(-0.4657)
<i>ROA</i>		0.0299***		0.0298***
		(7.3307)		(7.2936)
<i>Growth</i>		0.0073***		0.0073***
		(14.4184)		(14.4194)
<i>Cashflow</i>		0.0398***		0.0398***
		(13.2335)		(13.2308)
<i>TANG</i>		0.0230***		0.0230***
		(7.4605)		(7.4482)
<i>FirmAge</i>		0.0100**		0.0101**
		(2.1904)		(2.2061)
<i>Indep</i>		0.0040		0.0041
		(0.8996)		(0.9252)
<i>TobinQ</i>		-0.0003		-0.0003
		(-1.6118)		(-1.6104)
<i>Dual</i>		-0.0016***		-0.0016***
		(-2.9076)		(-2.9069)
<i>Instit</i>		0.0000*		0.0000*
		(1.6976)		(1.6790)
<i>lnCityWei</i>			-0.0005***	-0.0004***
			(-4.2763)	(-3.5673)
<i>_cons</i>	0.1342***	0.1052***	0.1343***	0.1049***
	(914.6811)	(5.2878)	(837.4903)	(5.2721)
N	21750	19689	21750	19689
R ²	0.770	0.793	0.770	0.793

4.2. Default Size and industry contagion

In the following, we investigate the effect of intra-industry risk contagion of city credit debt default size on firms' investment efficiency. Columns (1) and (2) of Table 2 consider the impact of changes in the size of city credit debt defaults on firms' investment levels based on Table 1, using the presence or absence of city credit debt defaults *dCityWei* as the explanatory variable. *dCityWei* relaxes the amount of credit debt defaults compared to the explanatory variable *cfi* in the benchmark regression, where no control variable is imposed in column (1) and a control variable is imposed in column (2). By comparing the absolute value of the regression coefficient of -0.0014 for *cfi* to the absolute value of -0.0010 for *dCityWei*, it can be seen that the expansion of the default size of urban credit debt has an impact on the level of firm investment at the 1% level. correspondingly expand, i.e., the larger the size of a city's credit debt default, the more pronounced the contraction of that city's investment efficiency. Validating hypothesis 1a. For industry risk contagion, in columns (3) and (4) we use

whether the industry has a credit debt default size of greater than 500 million *ifi* as the explanatory variable. In both columns the regression coefficients of the explanatory variables for firm investment level *invest* are significantly negative at the 1% level, i.e., credit debt defaults in the industry will reduce the investment efficiency of firms in the industry, and the risk of credit default will have a contagion effect among the firms in the industry, making all firms in the industry affected, verifying hypothesis 2.

Table 3. Default size and industry contagion

(1)		(2)		(3)		(4)
<i>invest</i>		<i>invest</i>		<i>invest</i>		<i>invest</i>
<i>Size</i>		-0.0005				-0.0005
		(-0.5992)				(-0.6948)
<i>Lev</i>		-0.0011				-0.0010
		(-0.4361)				(-0.4202)
<i>ROA</i>		0.0300***				0.0301***
		(7.3528)				(7.3892)
<i>Growth</i>		0.0073***				0.0074***
		(14.4377)				(14.5128)
<i>Cashflow</i>		0.0398***				0.0397***
		(13.2042)				(13.1830)
<i>TANG</i>		0.0230***				0.0230***
		(7.4555)				(7.4761)
<i>FirmAge</i>		0.0099**				0.0097**
		(2.1663)				(2.1278)
<i>Indep</i>		0.0040				0.0038
		(0.9017)				(0.8505)
<i>TobinQ</i>		-0.0003				-0.0003
		(-1.5930)				(-1.6130)
<i>Dual</i>		-0.0016***				-0.0016***
		(-2.9321)				(-2.8834)
<i>Instit</i>		0.0000*				0.0000*
		(1.7214)				(1.7434)
<i>dCityWei</i>	-0.0011***	-0.0010***				
	(-3.1311)	(-2.6765)				
<i>ifi</i>				-0.0014***		-0.0015***
				(-3.9833)		(-4.4763)
<i>_cons</i>	0.1341***	0.1056***		0.1341***		0.1079***
	(874.3698)	(5.3071)		(975.6682)		(5.4144)
N	21750	19689		21750		19689
R ²	0.770	0.793		0.770		0.793

5. Robustness test

In order to improve the reliability of the conclusions of this paper, we take the following robust type tests:

5.1. The impact of specific years

A possible explanation exists in this paper that firms experienced a decline in investment efficiency, possibly due to a special event with a significant impact in the market in that year. Hence, the negative impact of firm investment could be the result of such an event rather than a factor of credit bond defaults. For this reason, we exclude the extreme year of 2015 in Table 4, column (1), when a violent shock occurred in financial markets, to avoid regression results being affected by this special the results in column (1) show that, after excluding the extreme years, the regression results of the size

of honest credit debt defaults on firm investment are consistent with the main regression, and the regression coefficient is still significantly negative at the 1% level. This indicates that the main regression is not affected by the exceptional years.

5.2. The influence of unobservable factors

Ignoring the unobservable factors associated with the explanatory variables may lead to biased estimates of their regression coefficients and thus bias the entire model. For this reason, this paper controls for individual and year-fixed effects in columns (2) and (3) of Table 4, respectively. In both regressions, the regression results of *cfi* on *invest* are consistent with the main regression, and the regression coefficients are still significantly negative at the 1% level

5.3. The impact of specific cities

China's vast territory and regional development have certain differences between cities in different regions, the degree of development of capital markets varies, in cities with developed capital markets and a high concentration of listed companies, their firm investment may be more sensitive to credit risk problems. In order to exclude this influence, we in column (4) of Table 4 exclude the four cities of Beijing, Shanghai, Guangzhou, and Shenzhen. The results show that the regression coefficient of credit debt default size *cfi* for firm investment level *invest* is significant at the 10% level after excluding the special cities, indicating that the main regression is less influenced by the degree of urban development and urban capital concentration, which maintains the same conclusion as the main regression.

Table 4. Robustness tests - excluding special years and industry effects, considering regions

	(1)	(2)	(3)	(4)
	<i>invest</i>	<i>invest</i>	<i>invest</i>	<i>invest</i>
<i>cfi</i>	-0.0013*** (-2.9197)	-0.0014*** (-3.6566)	-0.0014*** (-3.5808)	-0.0009* (-1.8404)
<i>Size</i>	-0.0002 (-0.2685)	-0.0006 (-0.8037)	-0.0004 (-0.5762)	-0.0009 (-1.1281)
<i>Lev</i>	-0.0017 (-0.6171)	-0.0012 (-0.4765)	-0.0011 (-0.4364)	-0.0012 (-0.4257)
<i>ROA</i>	0.0314*** (7.2523)	0.0303*** (7.5540)	0.0299*** (7.3415)	0.0303*** (6.2220)
<i>Growth</i>	0.0072*** (12.9236)	0.0074*** (14.4674)	0.0073*** (14.3571)	0.0072*** (12.4605)
<i>Cashflow</i>	0.0349*** (11.0598)	0.0397*** (13.3317)	0.0397*** (13.1979)	0.0422*** (11.5603)
<i>TANG</i>	0.0217*** (6.1239)	0.0225*** (8.0037)	0.0230*** (7.4625)	0.0260*** (7.3831)
<i>FirmAge</i>	0.0110** (2.1410)	0.0088** (1.9873)	0.0099** (2.1779)	0.0088 (1.5853)
<i>Indep</i>	0.0016 (0.3397)	0.0028 (0.6402)	0.0040 (0.8985)	0.0043 (0.7898)
<i>TobinQ</i>	-0.0003 (-1.1394)	-0.0004* (-1.8597)	-0.0003 (-1.6042)	-0.0006** (-2.3171)
<i>Dual</i>	-0.0015** (-2.4652)	-0.0015*** (-2.8265)	-0.0016*** (-2.9082)	-0.0010 (-1.5281)
<i>Instit</i>	0.0000* (1.9307)	0.0000* (1.6957)	0.0000* (1.6705)	0.0000* (1.7852)
<i>_cons</i>	0.0989*** (4.3978)	0.1129*** (5.7212)	0.1052*** (5.2904)	0.1181*** (5.3116)
N	17375	19689	19686	14311
R ²	0.801	0.796	0.793	0.792

5.4. Endogeneity test

5.4.1. PSM-DID model

In this paper, the propensity score matching method (PSM) is used to solve the sample self-selection problem. Specifically, the propensity score is calculated by using a logit model for the characteristics of debt level (*Lev*), profitability (*ROA*), cash flow (*Cashflow*), and growth of operating income (*Growth*), based on which nearest neighbor matching is performed. At the same time, for the reliability of the results, this paper conducts a balance test on the matched variables, and there is no significant difference between the matched variables of the experimental group and the control group after matching, indicating that the balance hypothesis is satisfied. The regression results of the PSM-DID model are presented in column (1) of Table 5, and it can be seen that the regression coefficient of credit debt default behavior *cfi* for firm investment level *investment* is still significant, which proves the weakening effect of credit risk contagion on firm investment efficiency.

5.4.2. Dynamic panel

Table 5. Endogeneity test: PSM, dynamic panel

	(1)	(2)
	<i>invest</i>	<i>invest</i>
<i>cfi</i>	-0.0007	-0.0008**
	(-1.0534)	(-2.3860)
<i>Size</i>	0.0014	-0.0012
	(0.9843)	(-1.4292)
<i>Lev</i>	-0.0032	-0.0023
	(-0.6583)	(-0.8980)
<i>ROA</i>	0.0374***	0.0083**
	(5.6349)	(2.2985)
<i>Growth</i>	0.0064***	0.0107***
	(6.6877)	(18.3909)
<i>Cashflow</i>	0.0333***	0.0506***
	(6.6831)	(17.8879)
<i>TANG</i>	0.0209***	0.0172***
	(3.2931)	(5.9280)
<i>FirmAge</i>	0.0121	0.0160***
	(1.3098)	(3.4158)
<i>Indep</i>	0.0083	0.0030
	(1.0784)	(0.7483)
<i>TobinQ</i>	-0.0007*	-0.0003*
	(-1.7036)	(-1.6810)
<i>Dual</i>	-0.0031***	-0.0017***
	(-3.3125)	(-3.5058)
<i>Instit</i>	0.0000*	0.0000
	(1.9247)	(1.3997)
<i>L. inversus</i>		0.4028***
		(17.7936)
<i>_cons</i>	0.0584	0.0513**
	(1.4581)	(2.3527)
N	7484	16977
R ²	0.842	0.851

Since the investment status of firms in the previous year may influence the investment plans and decisions of firms in the next year, for example, if listed companies had a more positive investment behavior last year, this year's investment may receive the influence of the previous year and continue a positive trend, i.e., the dependent variable has dynamic characteristics. Therefore, this paper uses

dynamic panel regression and introduces the previous year's investment efficiency *L.invest* as an instrumental variable in the regression equation. As can be seen from column (2) of Table 5, the regression coefficient of credit risk contagion is still significant after taking into account the dynamic characteristics of the dependent variable, thus verifying the negative relationship between credit risk contagion and firm investment efficiency.

6. Scalability analysis

In the extended analysis, this paper first analyzes the specific impact mechanisms; then delves into the firm ownership, regional banking concentration, and firm investment performance convenience.

6.1. Mechanism analysis

6.1.1. Model introduction

In this paper, a mediating effects model is used in the first two parts of the mechanism analysis with the following expressions:

$$\begin{aligned} Y &= i_1 + cX + e_1 \\ Y &= i_2 + c'X + bM + e_Y \\ M &= i_3 + aX + e_M \end{aligned}$$

where coefficient a represents the effect of the independent variable acting on the mediating variable, and coefficient b represents the effect of the mediating variable acting on the dependent variable, both of which constitute the indirect effect of the relationship between the variables in the graph. The coefficient c' represents the effect of the independent variable acting on the dependent variable after considering the control of the mediating variable, which is the direct effect between the independent and dependent variables. e_Y , e_M denote the residuals of the variables Y and M .

In this paper, we use urban credit debt default *cfi* as the independent variable X , with firm investment efficiency *invest* as the dependent variable Y , and bank borrowing *Loan_res* and business credit *ntc_cost* as the mediating variables in the two regressions.

6.1.2. Theoretical analysis

(1) Bank lending. When there is credit debt default risk contagion among firms, the credit level of firms decreases, and banks consider risk factors to reduce loan issuance to firms accordingly, which makes firms have insufficient funds for investment and eventually leads to a decrease in investment efficiency. To verify this mechanism of action, this paper draws on the study of Zhong (2022) and constructs the bank borrowing variable *Loan_res* as one of the mediating variables, where bank borrowing refers to the excess amount of goods obtained by firms in addition to borrowing from banks to meet production and operation. *Loan_res* can reflect the financing advantage of firms with. In this paper, the following model is used to obtain the residuals (*Loan_res*) as the measurement variable of the excess bank loan, and the specific model is as follows:

$$\begin{aligned} Loan_{i,t} = & \beta_0 + \beta_1 TobinQ_{i,t-1} + \beta_2 Size_{i,t-1} + \beta_3 Cashflow_{i,t-1} + \beta_4 Lev_{i,t-1} + \beta_{i,t-1} ROA_{i,t-1} \\ & + \beta_6 TANG_{i,t-1} + \beta_7 Growth_{i,t-1} + \sum Year + \sum Industry + \varepsilon_{i,t-1} \end{aligned}$$

In terms of regression analysis, firstly, it is known from the main regression that credit debt default size has a significant negative relationship with firm investment efficiency. Secondly, it can be seen from columns (1) and (2) of Table 6 that the regression coefficients of credit debt default size *cfi* on bank lending size *Loan_res* are significantly negative at the 1% level, regardless of whether the control variables are imposed. It means that the occurrence of credit defaults will bring a significant increase in firm investment efficiency, as can be seen from columns (3) and (4). Meanwhile, the path coefficient of credit debt default *cfi* on investment level *investments* decreases significantly after including bank lending as a mediating variable, indicating that bank lending plays a partially mediating role in the main regression.

Table 6. Mechanism analysis: bank lending

	(1)	(2)	(3)	(4)
	<i>Loan_res</i>	<i>Loan_res</i>	<i>invest</i>	<i>invest</i>
<i>cfi</i>	-0.0253***	-0.0229***	-0.0004	-0.0001
	(-3.2720)	(-2.9824)	(-1.4758)	(-0.5361)
<i>Size</i>		-0.0422**		0.0019***
		(-2.4121)		(3.8252)
<i>Lev</i>		-0.0922		0.0017
		(-1.5295)		(1.0646)
<i>ROA</i>		-0.1796**		0.0366***
		(-2.3406)		(13.7596)
<i>Growth</i>		0.1420***		0.0010***
		(13.2084)		(3.1380)
<i>Cashflow</i>		0.5419***		0.0159***
		(8.9522)		(7.6570)
<i>TANG</i>		0.0066		0.0209***
		(0.1009)		(10.7015)
<i>FirmAge</i>		0.2149**		0.0064**
		(2.0928)		(2.1173)
<i>Indep</i>		0.0053		0.0064**
		(0.0597)		(2.0214)
<i>TobinQ</i>		-0.0072		-0.0002
		(-1.4634)		(-1.3896)
<i>Dual</i>		-0.0215**		-0.0006*
		(-2.0197)		(-1.7486)
<i>Instit</i>		0.0005**		0.0000
		(2.1383)		(1.4310)
<i>Loan_res</i>			0.0445***	0.0434***
			(58.0436)	(55.8603)
<i>_cons</i>	0.0074**	0.3079	0.1343***	0.0634***
	(2.3718)	(0.6398)	(1310.7789)	(4.5854)
N	16215	15604	16215	15604
R ²	0.783	0.799	0.932	0.941

(2) Trade credit. Trade credit along the supply train is an important financing tool for firms. Credit debt default will negatively affect the upstream and downstream trade credit of firms. Given that, the investment of firms who use trade credit along the supply chain will be affected. In order to verify this mechanism. This paper constructs trade credit *ntc_cost* as a mediating variable, referring to the method of Zhong (2022), the method of business income definition is selected, and the calculation method as (accounts receivable + notes receivable + prepayments)/business revenue. In addition, the net commercial credit measure is further adopted, calculated as: (accounts receivable + notes receivable + prepayments - accounts payable - notes payable - prepayments) / operating revenue. In Table 7, same as the above analysis, credit debt default size has a significant negative relationship with business investment efficiency. Then from the results of columns (1) and (2) of Table 7 the regression coefficient of credit debt default size *cfi* on business credit *ntc_cost* is significantly negative at the 1% level, regardless of whether control variables are imposed. It means that the occurrence of credit defaults brings about a significant decline, and the firm that incurs credit default receives less business credit from other firms, which also constrains one of its information flows to some extent. From columns (3) and (4), it can be seen that the regression coefficient of firm commercial credit *ntc_cost* on firm investment efficiency *invest* is significantly positive at the 1% level, regardless of whether control variables are imposed. It suggests that the expansion of firm commercial credit will bring a significant increase in firm investment efficiency. In the same way as the mechanism analysis above, after including commercial credit as a mediating variable, the

coefficient of investment level is significantly lower, which shows that commercial credit plays a partially mediating role in it.

Table 7. Mechanism analysis: commercial credit

	(1)	(2)	(3)	(4)
	<i>ntc_cost</i>	<i>ntc_cost</i>	<i>invest</i>	<i>invest</i>
<i>cfi</i>	-0.0263*** (-3.1185)	-0.0247*** (-2.8619)	-0.0012*** (-3.4113)	-0.0009** (-2.5748)
<i>Size</i>		-0.0942*** (-5.5255)		0.0016** (2.1432)
<i>Lev</i>		0.6263*** (11.2392)		-0.0141*** (-6.4726)
<i>ROA</i>		-0.0113 (-0.1452)		0.0301*** (8.0024)
<i>Growth</i>		-0.0097 (-0.8914)		0.0075*** (16.1100)
<i>Cashflow</i>		0.5642*** (8.0359)		0.0280*** (9.8153)
<i>TANG</i>		-0.0142 (-0.2060)		0.0232*** (8.2166)
<i>FirmAge</i>		0.2138** (2.2123)		0.0056 (1.4088)
<i>Indep</i>		0.0619 (0.6042)		0.0027 (0.6688)
<i>TobinQ</i>		-0.0064 (-1.1686)		-0.0002 (-0.9970)
<i>Dual</i>		-0.0117 (-1.0091)		-0.0013*** (-2.6951)
<i>Instit</i>		0.0005** (2.2410)		0.0000 (0.7861)
<i>ntc_cost</i>			0.0200*** (23.2257)	0.0209*** (23.6835)
<i>_cons</i>	-0.0383*** (-11.6416)	1.1206*** (2.5946)	0.1350*** (968.8220)	0.0809*** (4.4535)
N	21748	19686	21748	19686
R ²	0.747	0.758	0.813	0.837

(3) Credit allocation

The aforementioned analysis found that the occurrence of credit debt default bank lending was reduced. In order to study whether the firm initiative to reduce or the bank considers the firm sub-risk factors correspondingly reduce the loan issuance, we can use the principle of the number of mortgage loans and credit loans issued by banks to firms. Theoretically, if the firm initiative to reduce the number of loans, it should first consider reducing mortgage loans. Because a mortgage loan requires the use of collateral, which means higher financing costs, at the same time it can't play collateral for other purposes, which reduces the potential revenue. The main loans that banks are considering reducing are credit loans because if a company experiences credit risk, mortgage loans can be used to protect against the risk by obtaining collateral. In order to study the mechanism of the impact of the initiative of the firm in the credit process after the occurrence of credit debt default, this paper conduct the analysis as follows. The regression coefficients of credit default size for mortgage loans are significant, but the regression coefficients of credit loans do not pass the significance test. It suggests that when a firm has defaulted on credit debt, banks will issue more mortgage loans to the firm, while the number of credit loans does not change, which proves that when the firm has defaulted on credit debt, it is the banks that consider the risk factor to limit the loans to the firm. The bank's risk

factor is the reason for the bank to limit the loans to the firm, thus having a contraction effect on the firm's credit.

Table 8. Mechanism analysis: credit allocation

	(1)	(2)	(3)	(4)
	<i>ln cr</i>	<i>ln cr</i>	<i>ln g</i>	<i>ln g</i>
<i>cfi</i>	0.0625*	0.0562	0.0621*	0.0640*
	(1.7301)	(1.6195)	(1.7046)	(1.8018)
<i>Size</i>		1.0253***		0.6439***
		(19.4287)		(12.6393)
<i>Lev</i>		2.8009***		2.1296***
		(14.2778)		(11.6184)
<i>ROA</i>		0.3778		-0.1071
		(1.2056)		(-0.3705)
<i>Growth</i>		-0.0951***		-0.0149
		(-2.6918)		(-0.4814)
<i>Cashflow</i>		-1.8730***		-1.0983***
		(-8.2094)		(-4.7569)
<i>TANG</i>		0.0201		1.8921***
		(0.0897)		(8.0061)
<i>FirmAge</i>		-0.3208		-0.0471
		(-0.7595)		(-0.1117)
<i>Indep</i>		-0.2246		0.4959
		(-0.6238)		(1.3339)
<i>TobinQ</i>		0.0220		-0.0310
		(1.1131)		(-1.5968)
<i>Dual</i>		0.0577		0.0330
		(1.2941)		(0.8127)
<i>Instit</i>		0.0017*		-0.0015
		(1.6495)		(-1.5012)
<i>_cons</i>	19.3924***	-4.2610***	18.6623***	2.7109*
	(1362.4079)	(-2.6785)	(1352.1511)	(1.6719)
N	11620	10913	9125	8431
R ²	0.813	0.843	0.802	0.827

(4) Financing constraints

Index calculation: Table 9, on the other hand, is a direct regression analysis of the financing constraints of firms, and two indices were selected to measure the financing constraints of firms: the SA index and the WW index, and the SA index is calculated as follows:

$$SA_{i,t} = -0.737Size_{i,t} + 0.043Size_{i,t}^2 - 0.04Age_{i,t}$$

where $Size_{i,t}$ is equal to the natural logarithm of inflation-adjusted total assets, and $Age_{i,t}$ is the age of the firm, equal to the difference between the year of observation and the year of listing of the firm, the SA index is constantly negative, and the larger its absolute value, the greater the degree of financing constraint of the firm.

The WW index is calculated by the following formula:

$$WW_{i,t} = b_1TLTD_{i,t} + b_2DIVPOS_{i,t} + b_3LNTA_{i,t} + b_4SG_{i,t} + b_5ISG_{i,t} + b_6CF_{i,t}$$

where $TLTD_{i,t}$ is the ratio of long-term liabilities to total assets, $DIVPOS_{i,t}$ is a dummy variable that takes the value of 1 when dividends are paid, and $LNTA_{i,t}$ is the natural logarithm of total assets, and $SG_{i,t}$ is the sales growth rate of the firm, and $ISG_{i,t}$ is the sales growth rate of the industry in which the firm operates, and $CF_{i,t}$ is the ratio of cash flow to total assets. The WW index is always positive, and the larger it is, the greater the financing constraint of the firm.

Theoretical analysis: In Table 9, columns (2) and (4) are the regression analysis of credit default size for SA index, WW index under the imposed control variables, respectively. It can be seen that

the significance of the two coefficients is significantly negative and significantly positive, which are consistent with the theory of the firm financing constraints index. The direction of both indices indicates that when the problem of credit debt default occurs will directly lead to the deepening of the degree of firm financing constraints, which in turn reduces the level of investment of firms.

Table 9. Mechanism analysis: financing constraints

	(1)	(2)	(3)	(4)
	SA	SA	WW	WW
<i>cfi</i>	-0.0198	-0.0273*	-0.0009	0.0012*
	(-1.0608)	(-1.8184)	(-0.8145)	(1.7263)
<i>Size</i>		1.2170***		0.0506***
		(49.9054)		(59.2686)
<i>Lev</i>		1.6913***		-0.0288***
		(18.2412)		(-8.6735)
<i>ROA</i>		-2.6706***		0.1047***
		(-18.8621)		(19.5525)
<i>Growth</i>		-0.0263*		0.0477***
		(-1.7544)		(43.6166)
<i>Cashflow</i>		0.3793***		0.1035***
		(3.4641)		(22.5994)
<i>TANG</i>		0.0444		-0.0072
		(0.3911)		(-1.6242)
<i>FirmAge</i>		1.4410***		-0.0306***
		(9.3174)		(-4.5791)
<i>Indep</i>		-0.0708		-0.0179**
		(-0.4221)		(-2.4664)
<i>TobinQ</i>		0.2086***		-0.0005
		(21.5755)		(-1.5200)
<i>Dual</i>		-0.0323*		-0.0003
		(-1.7021)		(-0.3281)
<i>Instit</i>		0.0022***		0.0000
		(5.2250)		(0.4248)
<i>_cons</i>	-2.9456***	-35.3513***	0.8299***	-0.2128***
	(-394.6185)	(-52.5985)	(1967.0874)	(-8.0980)
N	21132	19598	16197	15462
R ²	0.835	0.899	0.766	0.916

6.2. Heterogeneity analysis

6.2.1. Regional banking industry concentration

Different regions have certain differences in the concentration of the banking industry due to the differences in the degree of development and urban layout, and accordingly, the impact on the level of firm investment after the occurrence of credit debt default in different regions should also vary. For the construction of the concentration of the banking industry, this paper draws on Si (2022) to calculate the concentration of each prefecture-level city in each year based on the financial license data of national financial institutions, with the history of the establishment and withdrawal of each branch of the number of bank branches and accordingly measures the Herfindahl index of the regional banking industry, which represents the concentration of the regional banking industry. To investigate this heterogeneity, Table 10 conducts the effect of the concentration of the regional banking industry on the main regression, column (3) is adding control variables and assuming that the distribution of the banking industry in the region is concentrated ($H = 1$), and column (4) is adding control variables and assuming that the regional banking industry is dispersed ($H = 0$), and the regression results of these two columns show that the significance of the regression coefficient of *cfi* under the hypothesis

of the concentration of the regional banking industry is more This is because in areas with a concentrated banking sector, on the one hand, competition among banks is intense and sufficient, and in order to gain customers in the competition and maintain stable bank operations, relaxing the financing threshold is an effective way, which requires banks fully and carefully understand the specific risk situation faced by each firm, instead of viewing the risk of each firm as a level because of the occurrence of credit risk in one firm, so that they can effectively hedge the negative impact on firm investment due to credit risk contagion, which shows the need for healthy competition within the banking industry.

Table 10. Heterogeneity analysis: regional banking sector concentration

	(1)	(2)	(3)	(4)
	<i>invest</i>	<i>invest</i>	<i>invest</i>	<i>invest</i>
<i>cfi</i>	-0.0019***	-0.0016***	-0.0013*	-0.0017***
	(-2.7761)	(-3.0452)	(-1.8902)	(-3.1606)
<i>Size</i>			-0.0023**	0.0010
			(-2.2964)	(0.8122)
<i>Lev</i>			0.0053*	-0.0078**
			(1.6630)	(-1.9797)
<i>ROA</i>			0.0261***	0.0323***
			(4.6125)	(5.3922)
<i>Growth</i>			0.0073***	0.0073***
			(11.2479)	(9.2834)
<i>Cashflow</i>			0.0402***	0.0387***
			(9.9871)	(8.7388)
<i>TANG</i>			0.0183***	0.0299***
			(4.3346)	(6.1979)
<i>FirmAge</i>			0.0081	0.0152**
			(1.1700)	(2.2256)
<i>Indep</i>			-0.0064	0.0114*
			(-1.0089)	(1.7983)
<i>TobinQ</i>			-0.0003	-0.0004
			(-1.0080)	(-1.3548)
<i>Dual</i>			-0.0002	-0.0027***
			(-0.3186)	(-3.2600)
<i>Instit</i>			0.0000	0.0000***
			(0.1505)	(2.8174)
<i>_cons</i>	0.1357***	0.1328***	0.1564***	0.0559*
	(892.6846)	(485.2568)	(5.9341)	(1.7374)
N	10841	10759	9767	9775
R ²	0.775	0.781	0.800	0.803

6.2.2. Business ownership

Under the ownership of firms in China, state-owned firms are significantly more risk-resistant than private firms, because state-owned firms have national credit backing and policy support, with a large volume of high-quality and important resources. Therefore, when a contagion crisis of credit risk arises, the level of investment received by SOEs and private firms should also be different. To verify this heterogeneity, Table 11 examines the impact of ownership of firms. The impact on the main regression with column (3) is the inclusion of control variables and the assumption that the firm is a state-owned firm ($H = 1$), and column (4) is the inclusion of control variables and the assumption that the firm is a private firm ($H = 0$). As seen by the regression results of these two columns, the significance of the *cif* regression coefficient under the state-owned firm hypothesis is smaller than the significance of the coefficient of *cfi* under the private firm hypothesis. It indicates that credit debt default behavior has a greater impact on the investment efficiency of private firms. Because SOEs are

subject to lower credit discrimination than private firms, banks tend to lend more to SOEs because of their background and capital level for the same credit default risk. Reducing this credit discrimination and strengthening credit support for private firms play an important role in reducing the impact of credit risk contagion.

Table 11. Heterogeneity analysis: firm attributes

	(1)	(2)	(3)	(4)
	<i>invest</i>	<i>invest</i>	<i>invest</i>	<i>invest</i>
<i>cfi</i>	-0.0016***	-0.0017***	-0.0011*	-0.0015***
	(-2.6643)	(-3.3490)	(-1.7720)	(-2.8485)
<i>Size</i>			-0.0002	-0.0010
			(-0.1738)	(-1.1409)
<i>Lev</i>			-0.0009	-0.0010
			(-0.1698)	(-0.3510)
<i>ROA</i>			0.0378***	0.0290***
			(4.3327)	(6.1719)
<i>Growth</i>			0.0057***	0.0078***
			(6.1944)	(12.9588)
<i>Cashflow</i>			0.0304***	0.0435***
			(6.5802)	(11.2442)
<i>TANG</i>			0.0167***	0.0243***
			(3.3191)	(6.4639)
<i>FirmAge</i>			0.0050	0.0101*
			(0.6515)	(1.7375)
<i>Indep</i>			0.0101**	0.0031
			(2.0730)	(0.4760)
<i>TobinQ</i>			-0.0008**	-0.0002
			(-1.9969)	(-0.9383)
<i>Dual</i>			-0.0023***	-0.0018***
			(-2.9253)	(-2.7898)
<i>Instit</i>			0.0000	0.0000
			(1.4539)	(1.1462)
<i>_cons</i>	0.1420***	0.1308***	0.1216***	0.1147***
	(598.0134)	(716.1309)	(3.4361)	(4.5351)
<i>N</i>	6724	14929	6312	13288
<i>R</i> ²	0.796	0.762	0.813	0.786

6.3. Analysis of business performance

From the above regression we can conclude that the contagion of credit risk will cause a shrinking effect on the investment amount of firms, this paper then examines the changes in the investment performance of firms. For this reason, we add the cross-product term *cfi_invest* of credit default and investment level. from the regression results in Table 12. We can see that as the investment amount of firms *invests* rises, the investment performance *ROA* of firms will rise significantly. With the expansion of credit debt default, the *ROA* of the investment performance of firms will significantly decrease. As seen by the cross-product term *cfi_invest*, the occurrence of credit bond defaults increases the degree of impact of firm investment on investment performance *ROA*. The original impact coefficient of firm investment on *ROA* is 0.2076, and after adding the default event, the impact coefficient of firm investment on *ROA* becomes $0.2076 + 0.1916$. It can be seen that firm performance increases after the occurrence of credit default risk, which is due to the fact that after the occurrence of credit risk, firms strengthen their investment prudence and reduce inefficient investment, which has a positive effect on firm performance effect.

Table 12. Firm Investment Performance

	(1)	(2)	(3)	(4)
	ROA	ROA	ROA	ROA
<i>invest</i>	0.5324***	0.2691***	0.4412***	0.2076***
	(13.6783)	(7.3871)	(10.9131)	(5.5788)
<i>Size</i>		0.0251***		0.0250***
		(15.0283)		(14.9594)
<i>Lev</i>		-0.1989***		-0.1980***
		(-31.0317)		(-30.8948)
<i>Growth</i>		0.0320***		0.0319***
		(25.9120)		(25.8817)
<i>Cashflow</i>		0.1405***		0.1420***
		(16.0039)		(16.1808)
<i>TANG</i>		-0.1010***		-0.1000***
		(-13.0848)		(-12.9676)
<i>FirmAge</i>		-0.0283**		-0.0256**
		(-2.3585)		(-2.1344)
<i>Indep</i>		-0.0132		-0.0127
		(-0.9406)		(-0.9007)
<i>TobinQ</i>		0.0061***		0.0060***
		(10.5844)		(10.3124)
<i>Dual</i>		0.0019		0.0020
		(1.1491)		(1.2424)
<i>Instit</i>		-0.0000		-0.0000
		(-0.0654)		(-0.1932)
<i>cfi_invest</i>			0.2943***	0.1916***
			(6.5755)	(4.6180)
<i>cfi</i>			-0.0413***	-0.0274***
			(-6.5650)	(-4.6830)
<i>_cons</i>	-0.0326***	-0.3899***	-0.0198***	-0.3869***
	(-6.2222)	(-7.9049)	(-3.6246)	(-7.8399)
N	21749	19689	21749	19689
R ²	0.517	0.631	0.519	0.632

7. Conclusion and Insight

Credit debt defaults cause the contagion of credit risk, and as the risk intensifies and accumulates, more and more firms' investment behavior will be hit and the efficiency of firms' investment will be weakened. This paper takes credit debt defaults as the starting point to explore the changes in firms' business conditions under the conditions of credit risk contagion, and the results show that, first, the investment efficiency of firms decreases whether credit debt defaults occur within a city or within an industry. Second, further analysis finds that the larger the scale of credit debt defaults, the greater the weakening of firms' investment efficiency. Third, credit risk contagion with firm investment efficiency is found to be universal and independent of special years, special cities, and unobservable factors. Fourth, the mechanism analysis reveals that bank lending and commercial credit play a partial mediating role in the process of credit risk acting on firm investment, and credit debt default risk indirectly leads to the shrinkage of firm investment through the limiting effect on bank lending and commercial credit. The occurrence of credit debt defaults on the one hand correspondingly raises the number of firm mortgages, indirectly indicating a decline in banks' trust in credit risk institutions, and on the other hand directly acts as a financing constraint for firms, limiting their investment efficiency; fifthly, private firms and firms in regions with a fragmented banking sector are more severely affected by the efficiency of firm investment under credit risk contagion conditions. Finally, the analysis of

firms' investment performance leads to the conclusion that the contagion of credit risk makes firms consider their investment choices carefully and may have a positive effect on their investment performance.

Based on the above research findings, this paper draws the following three insights: first, Credit bond defaults have a huge and rapid effect of credit risk contagion, which can develop into a deeper systemic financial risk if not controlled in a timely manner. The research in this paper shows that credit risk contagion is universal, bringing a reduction in bank lending and deterioration of commercial credit for firms, and regulators should accelerate the improvement of the bond market, especially is the risk-related prevention mechanism of the credit bond market, to avoid but to the bad influence of credit bond defaults continue to expand. Second, to reduce the credit discrimination for private firms, strengthen the credit support for private firms and strengthen their risk resistance. This study shows that the same credit risk contagion environment, private firms relative to state-owned firms, the decline in investment efficiency is more obvious, the overall financial strength of private firms is not as strong as state-owned firms, its credit level is more vulnerable to shocks, in order to ensure the balanced development of the economy, pay attention to the survival of private firms is very necessary. Third, healthy competition in the banking industry should be stimulated and used as a way to prevent systemic risk. The research in this paper shows that firms in areas with a concentrated banking industry are less exposed to the impact of credit risk contagion, and adequate internal competition in the banking industry makes banks carry out business with greater demand, even if the firms have certain credit problems, banks will find ways to cooperate with them, which also provides the firms with funds that can survive the crisis and contribute to the stable and orderly development of the overall economic environment.

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