

SMEs' Line of Credit under the COVID-19: Evidence from China*

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Abstract

How does the COVID-19 affect SMEs' financing in emerging markets? In this paper, we investigate the impact of the COVID-induced shock on Chinese SMEs' line of credit (LOC) using transaction-level data. We employ a difference-in-differences approach with the propensity score matching (PSM-DID) and compare Hubei SMEs' credit responses before and after the outbreak relative to those of non-Hubei SMEs. Our results suggest that Hubei SMEs' credit demand reduced significantly compared to that of non-Hubei SMEs, and the adverse effects were more pronounced for the non-state-owned enterprises (non-SOEs) and the SMEs without prior bank relationships. Moreover, we show a negative impact on non-Hubei SMEs having supply chain relationships with Hubei province. Such effects rippled through the supply chain and exerted an intensified strike on the SMEs with Hubei customers. Finally, we find a supportive role played by the state-owned banks during the pandemic outbreak.

Keywords: Chinese Economy, COVID-19, Line of Credit, SMEs.

JEL codes: D22, G21, G32, O16.

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1 Introduction

Small and medium-sized enterprises (SMEs) are the most common business form across developing countries (Abraham and Schmukler, 2017), with the largest share of total employment (Ayyagari *et al.*, 2011) and a pivotal role in economic growth (Beck *et al.*, 2005). However, SMEs are known to suffer from financing problems comparing to large and mature firms (Kuntchev *et al.*, 2013), which makes them vulnerable during financial crises and natural disasters (Berg and Schrader, 2012; Demirgüç-Kunt *et al.*, 2020).

Nevertheless, little empirical research has been done regarding the impact of a pandemic-induced recession on SMEs' financing and, in turn, the potential backup from the government. The recent outbreak of the coronavirus disease 2019 (COVID-19) brings about unprecedented demand contraction to the emerging market economies worldwide, thus providing a natural experiment on this research topic.¹ In this paper, we mainly focus on Chinese SMEs as they greatly contribute to the Chinese economic growth while are gravely hit by the COVID-19 pandemic due to their financing constraints.² Hence, this paper contributes to the literature by investigating and quantifying the impact of the COVID-induced recession on Chinese SMEs' line of credit (LOC). Besides, we also study the supportive role played by state-owned banks in supplying SMEs' credit.

We use deal-level data from Chinese firms listed in the Small and Medium Enterprise Board (SMEB) and Growth Enterprise Board (GEB) to examine the impact on SMEs' credit demand. Specifically, we are interested in the probability and the frequency of LOC applications and the aggregate credit amount applied. As Hubei province suffered the most during the COVID-19 pandemic in China, we adopt a difference-in-differences approach with the propensity score matching (PSM-DID) and compare Hubei SMEs' credit responses before and after the outbreak relative to non-Hubei SMEs.

The empirical results show economically and statistically significant effects of the pandemic on SMEs' LOC applications. Compared to non-Hubei SMEs, the probability and the frequency of LOC applications and the aggregate credit amounts initiated by Hubei SMEs dropped by 53, 75, and 94 percentage points, respectively. Thus, the onset of the COVID-19 caused a systemic contraction in SMEs' credit demand, with Hubei firms being depressed the most. These findings

¹Take China as an example, the GDP shrank by 6.8% in the first quarter of 2020 compared with a year earlier, the fixed-assets investment dropped by 25%, and the industrial output dipped by more than 13.5%, according to the latest release by the National Bureau of Statistics of China (NBS).

²The Chinese SMEs have grown significantly since the economic reforms in the 1980s. By the end of 2018, SMEs have accounted for more than 60% of China's GDP, 80% of the urban employment, and 90% of the total numbers of enterprises. Documented by Fernandes (2020), the Chinese SMEs were hit with only 60% operating rate on average even after the resumption of business at the end of February 2020.

complement the existing literature studying firms' credit demand during a crisis (Demirgüç-Kunt *et al.*, 2020; Ivashina and Scharfstein, 2010). In addition, we also investigate the heterogeneities across different types of SMEs identified by their ownerships and firm-bank relationships. We find that the decline in credit applications was particularly pronounced among the non-state-owned enterprises (non-SOEs) and those without prior bank relationships.

Further exploration of the pandemic transmission through supply chains documents that SMEs in provinces with all-round inter-province logistics were affected the most. Besides, non-Hubei SMEs with Hubei customers were even more disturbed than those with Hubei suppliers. These results are consistent with the literature studying supply-chain network's roles during industry downturns (Benmelech and Bergman, 2011; Carvalho, 2015), and the reasons behind these findings could be the asymmetric bargaining power along the supply chains illustrated by Lanier *et al.* (2010).

Lastly, we conduct bank-side analysis, as financial intermediaries could play a crucial role in dampening the COVID-induced recession under government initiatives. Intriguingly, we find that state-owned banks responded to government calls by lowering the collateral requirement and improving the credit approving rate to keep SMEs afloat. In contrast, the non-state-owned financial institutions behaved oppositely. Our results suggest that the credits easing from state-owned banks are politically-motivated and counteract the credit tightening from the non-state-owned counterparts in crisis times, echoing Brei and Schclarek (2013).

This paper contributes to the following strands of literature. First, we complement the works studying the impact of the economic crisis on corporate activities (Liu *et al.*, 2012; Vermoesen *et al.*, 2013; Lins *et al.*, 2017), especially those focusing on emerging markets (Mitton, 2002; Park and Mercado Jr, 2014) and bank loans (Popov and Udell, 2012; Kahle and Stulz, 2013). Different from these studies with attention on large and mature firms, we concentrate on SMEs in one of the largest emerging markets, as SMEs are more vulnerable to a pandemic.

Second, we provide new insights into the COVID-19 related literature on firms (Ding *et al.*, 2020; Hassan *et al.*, 2020) and SMEs in particular (Bartik *et al.*, 2020). Our work is among the first to investigate and quantify the financing problems for SMEs in emerging markets. Besides, we highlight the transmission along the supply chains during the pandemic outbreak.

Third, our study is also related to some recent papers about governments' policy response under the COVID-19 pandemic (Dergiades *et al.*, 2020; De Marco, 2020; Gonzalez-Uribe and Wang, 2020), which mainly aim at the government's loan guarantees to SMEs in developed countries. Instead, we address state-owned banks' responses to policy calls in China, one of the largest developing countries.

The remainder of this paper is as follows. Section 2 introduces the institutional backgrounds of the COVID-19 pandemic, the Chinese SMEs, and the state-owned banks' financing policy responses. Section 3 develops the hypotheses. Section 4 discusses the identification strategy and describes the data sources. Section 5 presents our main empirical results. Section 6 shows the robustness checking results, and Section 7 concludes with policy implications.

2 Institutional Background

2.1 The COVID-19 Outbreak in China

As of late December 2019, some clinicians from Hubei province found an emerging cluster of people infected with pneumonia with unknown causes, and all the four initial patients were linked to the Huanan seafood market in Wuhan city, Hubei province. By January 3, 2020, China informed the unknown pneumonia outbreak, reporting a total of 44 cases. The increasing suspected and confirmed cases crowded in Wuhan's hospitals and medical institutions in mid-January 2020. Some sporadic cases were also reported in the neighboring cities and provinces, as passengers returned to homes from or via Wuhan before the Chinese New Year. On January 20, 2020, the authorities and the experts affirmed the human-to-human transmission. The National Health Commission classified the novel coronavirus pneumonia as a Category II infectious disease, the same category as the Severe Acute Respiratory Syndrome (SARS).³ The public panicked, and protective supplies went short across the nation.

On January 22, the State Council Information Office held a press conference and initiated that non-Wuhan residents were strongly advised to make fewer trips to Wuhan while Wuhan citizens should not leave the city except in exceptional circumstances. The Wuhan Epidemic Prevention and Control Center echoed the statement at midnight. They announced a suspension of all public transportations and a closure of the public transport stations to curb the population flow rigidly.⁴

This lockdown is now widely referred to as the Wuhan Lockdown, and it sets a precedent for similar policies implemented in other 15 cities in Hubei.⁵ By January 27, all Hubei cities were blockaded to contain the outbreak. The tightening policies soon became nationwide actions. The

³We follow the WHO and name the virus COVID-19 in our paper.

⁴This lockdown on transit came in effect from 10 a.m. on January 23, and Wuhan residents were banned from leaving the city until further notice. Daily necessities were provided directly to their homes by volunteers to strengthen the prevention and control at the community level. The Ministry of Transport also ordered that other parts of the country should suspend the passenger traffic into Wuhan by road or by waterway.

⁵Within hours after the lockdown in Wuhan, two other cities in Hubei province, Huanggang and Ezhou, swiftly followed and restricted public transports. On the other day, similar restrictions were enacted in 12 additional prefecture-level cities in Hubei.

exchange of physical capital, goods, and services across provincial borders was severely affected, as all inter-provincial coaches and passenger trains bound to Hubei were suspended.⁶ Reported by the Ministry of Transport, the cargo transportation volume was 7.82 billion tons in the first quarter of 2020, dropping by 18.4% on a year-on-year growth rate. Specifically, the highway freight volume decreased by 22.2%, and the waterway freight volume fell by 15.5%. It was not until on April 8 that the 76-day lockdown effectively ended in Wuhan, and the local businesses resumed as usual. The end of the Wuhan Lockdown is believed to be a signal sent by the Chinese government that the COVID-19 was under control across the country. Despite the loosening, Hubei's recovery was painfully slow due to the lack of effective vaccines.

2.2 The Chinese SMEs during the COVID-19

The nationwide lockdowns from late January to early February hit the SMEs' demand severely. The SMEs' Development Index (SMEDI), compiled by the China Association of Small and Medium-sized Enterprises, was 11.9% lower in the first quarter of 2020 than that of the previous year, at its lowest quarterly level in a decade.⁷ Under the lockdowns, SMEs faced cancellations in procurement, production, sales, and orders, but rigid expenditures such as employees' salaries, social security, taxes, and fees. According to Tsinghua PBC School of Finance (2020), the pandemic reduced SMEs' revenues by 69.5% in the first quarter on a year-on-year basis. Moreover, most SMEs highly depend on supply chains. When the upstream and downstream business partners are in Hubei province, these SMEs are likely to risk losing more orders and experience the supply chain disruption.

From a regional perspective, Hubei SMEs' operating income dropped the most, with a slump of approximately 90% of the operating revenue last year. SMEs are vital to Hubei, as they account for more than 99% of the 355,100 enterprises by the end of 2019. Hubei SMEs roughly paid 301.28 billion RMB (45.81 billion USD) in taxes and contributed to 57.5% of the province's total tax revenue (Chutian Metropolis Daily, 2020).

2.3 The state and policy banks' supportive policy to SMEs

During this challenging period, the Chinese government launched several financial assistance programs, advocating the state-owned banks to favor SMEs' borrowing by cutting loan interest

⁶By January 30, Beijing, Shanghai, Tianjin, and other seven provinces had suspended road passenger transport. Meanwhile, 16 provinces had restricted inter-provincial passenger transport, and numerous cities in the 28 provinces had suspended or partially suspended urban bus lines.

⁷The SMEs' Development Index (SMEDI) is a comprehensive technical index, reflecting the overall economic operation of SMEs by surveying 3000 enterprises in eight industries of the national economy and regarding specific industry production and operation conditions.

rates and financing expenses. On January 31, the People’s Bank of China (PBC) provided a total of 3 trillion targeted loans to major state-owned banks and policy banks so as to support the additional credit flows to small businesses. The PBC stressed that credit supports should be inclined to the manufacturing, small and micro businesses, and private enterprises. On March 13, the China Banking Regulatory Commission (CBRC) further stated that the state-owned banks should keep a 30% year-on-year growth rate in SMEs’ loan balances in the first half of 2020, and policy banks should raise credit lines to SMEs by 350 billion RMB at preferential rates compared to those last year. Besides, the collateral requirement is also lowered, especially for SMEs. For instance, SMEs are allowed to use their accounts receivable and inventories as collateral when they borrow from state-owned banks. It is worth noting that all these policies mainly target Hubei SMEs.

Though the government has provided various lending packages to SMEs, bottlenecks still exist. The COVID-19 outbreak has caused a domestic market demand slump, and it is hard for the government to bolster SMEs’ confidence amid the spike of the disruptions from the ongoing economic downturns. Besides, Tsinghua PBC School of Finance (2020) shows that 90% of the SMEs are likely to go bankrupt even with the national bailout policies if the pandemic continues for more than six months.

3 Hypotheses Development

In this section, we develop hypotheses regarding the SMEs’ credit demand during the COVID-19 pandemic, which are empirically tested later.

SMEs’ credit demand could be severely inhibited during a crisis for two reasons. First, debt covenants are closely monitored by lenders, and the monitoring costs are nevertheless endured by firms in equilibrium conditions (Bjerre, 1999; Ayotte and Bolton, 2011). Under volatile economic situation, firms would lower their demand for debts with covenants to ensure financial flexibility (Brunnermeier and Oehmke, 2013). Small firms value financial flexibility highly during the crisis due to their limited access to external finance (Demirgüç-Kunt *et al.*, 2020). Second, firms may suspend expansion plans during economic downturns, resulting in a decline in credit demand (Ivashina and Scharfstein, 2010). A more recent study by Demirgüç-Kunt *et al.* (2020) documents a deleveraging of SMEs during the 2008 financial crisis, which is associated with a reduction in the long-term credit demand. This decline is found more pronounced in lower-middle and low-income countries. Similarly, under the COVID-19 shock, SMEs also experience a severe contraction in future investment (Gourinchas *et al.*, 2020). Thus, we posit our first hypothesis:

Hypothesis 1 *SMEs would reduce credit demand in response to the COVID-induced shock. Such*

reduction is more substantial for SMEs in more pandemic-affected areas.

Next, we investigate the heterogeneous credit demand responses for the state-owned enterprises (SOEs) and the non-state-owned enterprises (non-SOEs). It is well documented in the literature that the SOEs have long been enjoying interest rate subsidies from the government and are subject to a lower interest rate than the non-SOEs (Song *et al.*, 2011). Chen and Lin (2019) also confirm that Chinese state-owned banks support SOEs by providing low-interest loans. Moreover, loans to SOEs are under low default risks since the Chinese government would bail out the SOEs if they encounter financial problems (Wang *et al.*, 2008). Thus, a higher non-SOEs' interest rate suggests that the non-SOEs shall, *ceteris paribus*, reduce the loans more saliently than their SOEs peers. The relevant hypothesis is as follows:

Hypothesis 2 *The non-SOEs' credit demand is more depressed than the SOEs' in the wake of the COVID-induced shock.*

We also study the heterogeneous responses across SMEs with different firm-bank relationships. On the supply side, banks would exert efforts to obtain information about firms to mitigate the frictions when processing the LOC applications (Diamond, 1991). On the demand side, firms may build economic ties with banks to secure financing resources (Lu *et al.*, 2012). Such firm-bank relationships are theoretically studied by Bolton *et al.* (2016), which states that relationship banks obtain more firms' information than transaction banks and firms financed by relationship banks are less likely to default during a crisis. Their empirical analysis also confirms that relationship banks offer continuation-lending with favorable terms in crisis periods. Besides, Dewally and Shao (2014) find that established lending relationships increase firms' access to credit during a crisis since such firms' information is less opaque to the market. Therefore, we develop the following hypothesis:

Hypothesis 3 *SMEs with prior credit applications would experience lesser contraction in more pandemic-affected areas than SMEs in less affected areas.*

Then, we explore the pandemic transmission through supply chains as COVID-induced nationwide lockdowns caused a sudden transportation disruption and brought supply-chain vulnerabilities to firms having business partners in the affected areas (Zhang, 2020). Literature documents that shocks to firms may be amplified through supply chains (Barrot and Sauvagnat, 2016), and this supply-chain externality is even substantial during industry downturns (Benmelech and Bergman, 2011; Carvalho, 2015). For instance, Carvalho (2015) finds that financially constrained firms would impose a negative externality on their industry peers and thus significantly amplify the effects of industry downturns. Moreover, the supply-chain externality could be asymmetric. Lanier *et al.* (2010) show that downstream firms usually obtain most

industrial chain profits due to higher bargaining power. In the context of the COVID-19 pandemic, SMEs with suppliers from the affected areas would switch to suppliers from other regions to minimize their losses, while SMEs with pandemic-affected customers would suffer the losses as alternative customers could be scarce. The following auxiliary hypothesis states our posit:

Auxiliary Hypothesis 1 *Under the COVID-19 shock, SMEs having supply chain relationships with more pandemic-affected areas would decrease credit demand, and would inhibit more if their customers are in more affected areas.*

Last, we analyze the government’s role in mitigating the pandemic impacts on SMEs’ credit demand. Brei and Schclarek (2013) find that governments play a counter-cyclical role directly through government-owned banks. During a crisis, state-owned banks’ lending gets increased compared to normal times and counteracts the slowdown of private banks’ lending. Coleman and Feler (2015) empirically present that government-owned banks’ lending is politically motivated and can dampen economic recessions. In China, state-owned banks are also susceptible to political pressures and instructed to provide policy loans to keep low-performing firms afloat (Bailey *et al.*, 2011). The findings are consistent with Podpiera (2006) that Chinese state-owned commercial banks are directed to provide credit support to provinces with weaker enterprise profitability. To avoid a slump in SMEs’ profits and employment, Chinese state-owned banks may ease SMEs’ credit access under government initiatives, described by the following auxiliary hypothesis:

Auxiliary Hypothesis 2 *During the pandemic outbreak, Chinese state-owned banks respond to government calls by easing SMEs’ credit access in more affected regions.*

4 Empirical strategies, data sources and summary statistics

4.1 Empirical Strategies

To test the causal impact of the COVID-19 on Chinese SMEs’ credit line demand, we treat the lockdown in Hubei province as an exogenous event. Specifically, we compare the credit line applications in the 76-day lockdown period (from January 23, 2020, to April 8, 2020) with those in the pre-lockdown period last year (*i.e.*, from January 23, 2019, to April 8, 2019) between Hubei and non-Hubei SMEs. Concretely, we construct a balanced two-period firm-level data. For each SME i in each period t , we make four variables from deal-level credit applications: 1) whether the firm filed any credit line application, 2) the aggregate credit line applied, 3) whether the credit

line application is pledged with collaterals or not and 4) whether the application is approved by the bank or not. The corresponding difference-in-differences (DID) model is as follows:

$$Dep_{it} = \beta_0 + \beta_1 Post_t + \beta_2 Post_t \times Hubei_i + \beta_3 Controls_{i,t-1} + \theta_i + \epsilon_{it}, \quad (4.1)$$

where i and t denote the borrower SME and the relevant period. Dep_{it} is the four dependent variables of interest mentioned. $Post_t$ is a dummy variable that equals to one if the request is made during the lockdown period and zero otherwise. $Hubei_i$ is an indicator variable that equals to one if the SME's headquarter is in Hubei province and zero otherwise. $Controls_{i,t-1}$ is a vector of the lagged time-varying firm-level controls. The firm fixed effect is denoted as θ_i . Note that $Hubei_i$ is absorbed by the firm fixed effect, and thus is omitted from the above equation. In the deal-level analysis, we also control for some deal characteristics such as the loan type and the use of proceeds. The error term is ϵ_{it} . The standard error is clustered at the industry level to account for time-series correlation within each industry. Our coefficient of interest, β_2 , captures the change in the dependent variables during the lockdown period comparing to the pre-lockdown period between Hubei and non-Hubei SMEs.

One potential endogeneity concern is that Hubei SMEs could be systematically different from non-Hubei SMEs in many aspects. In other words, firms' locations may associate with other firm-level characteristics that bias our estimation results. To address this concern, we follow Weber and Ahmad (2014) and match the treatment and control groups across several observed dimensions. Following Dong and Men (2014), Ertugrul *et al.* (2017) and Lin *et al.* (2018), we select a set of firm characteristics that could affect the firm's credit line applications. Those variables include aspects of corporate governance, development, size, tangibility, solvency, and profitability.

4.2 Data sources and summary statistics

Our data comes from two sources. The first is the China Listed Firms' Bank Loans Research Database included in the China Stock Market and Accounting Research (CSMAR) Database. It provides the Chinese listed firms' line of credit (LOC) information. We also obtain firms' financial data and the COVID-19 statistics from the CSMAR database. The second is the Chinese Research Data Services (CNRDS). We obtain the railway freight data from the Chinese Regional Economy Database and the supply chain data from the Supply Chain Research Database.

Our sample selection criterion is as follows. We start from the universe (9,824) of the deal-level LOC applications of all listed firms in Shanghai and Shenzhen stock exchanges from January 23 to April 8 in the year 2019 and January 23 to April 8 in the year 2020. According to Bailey *et al.* (2011), we drop financial firms because of their non-standard financial reporting and exclude

Table 1: Descriptive Statistics

Variables	Obs.	Mean	Std. Dev.	Min	Max
<i>Panel A: Dependent variables</i>					
Outputs (log)	3,296	5.7478	1.2782	0.0000	11.1877
Whether applied	3,384	0.3029	0.4596	0.0000	1.0000
Number of applications	1,534	0.8744	0.8865	0.0000	5.0106
Credit amounts (log)	3,384	1.9187	3.0747	0.0000	11.7105
Railway freight volume (log)	3,354	8.5519	1.0945	4.2649	11.3535
Whether pledged	4,807	0.0739	0.2616	0.0000	1.0000
Whether signed	4,807	0.0098	0.0984	0.0000	1.0000
Loan increment	3,113	0.0136	0.0513	-0.2892	1.4982
<i>Panel B: Treatment variables</i>					
Hubei	3,384	0.0219	0.1463	0.0000	1.0000
Casualties ratio	3,357	0.0227	0.1410	0.0000	0.9614
Infections ratio	3,357	0.0289	0.1182	0.0000	0.8153
Hubei suppliers	3,310	0.0030	0.0549	0.0000	1.0000
Hubei customers	3,310	0.0042	0.0649	0.0000	1.0000
<i>Panel C: Classification variables</i>					
Previous application	3,384	0.3245	0.4682	0.0000	1.0000
SOEs	3,384	0.1028	0.3038	0.0000	1.0000
State-owned banks	4,807	0.2669	0.4424	0.0000	1.0000
<i>Panel D: Control variables</i>					
Largest shareholder rate	2,139	0.3093	0.1297	0.0877	0.6656
Separation of power	2,086	3.6209	6.3919	0.0000	26.5732
Financing demand	3,244	0.1307	0.1662	-0.2071	0.9180
Revenue growth	3,126	0.1454	0.3215	-0.5462	1.6770
Size	3,244	12.6394	0.9798	10.7893	15.3637
Fixed assets ratio	3,244	0.1793	0.1239	0.0022	0.5467
Solvency	2,648	18.8886	79.5103	-1.4247	645.3278
ROA	3,244	0.0308	0.1007	-0.4450	0.2354
EPS	3,244	0.3047	0.7284	-2.5938	2.8750

“Special Treatment” firms.⁸ As we focus on SMEs, we only keep firms listing on the SMEB and

⁸These “Special Treatment” firms are financially distressed firms defined by the Shanghai and Shenzhen stock

GEB following the existing SMEs literature (Huang *et al.*, 2016). Furthermore, we fill in the sample with firms not filing any LOC application during the sample period and construct a dummy variable indicating whether a firm demanded any credit during the shock period. We then aggregate the LOC amount at the deal level for each firm separately in the pre-shock and post-shock periods, respectively.⁹

To deal with the potential outliers, we winsorize all the continuous variables at the 99% level. Our firm-aggregate level sample has 1,692 firms and 3,384 firm-period observations, and the deal-level sample contains 4,807 loan deals made by 767 SMEs. Table 1 reports the descriptive statistics for variables, and Appendix Table II summarizes their definitions and sources.

Besides, we provide the summary statistics of SMEs in our sample by province and industry in Appendix Table III and Appendix Table IV. Appendix Table III shows that most SMEs are located in the eastern coastal regions such as Guangdong, Zhejiang, Jiangsu, Shandong, and Shanghai. Note that 2.21% of the sample SMEs are from Hubei, which has the highest proportion of casualties and infection cases during the COVID-19 pandemic.¹⁰ Appendix Table IV highlights that around 73% of the SMEs belong to the manufacturing sector, which receives the largest share of bank loans comparing with that of other industries in regular periods (Pan and Tian, 2018).

5 Empirical Results

5.1 Balancing test

We use the propensity score matching (PSM) based on the observed corporate governance and firm characteristics that affect firms' credit demand.¹¹ Specifically, each Hubei SME is matched to 5 non-Hubei firms (1-to-5 matching) with the closest propensity score.

Figure 1: Evaluating PSM results: P-Score before and after matching

Figure 1 plots the density curves of the treatment and the control groups before and after the exchanges.

⁹Firms could make multiple LOC applications during the sample period. A firm without LOC applications are labeled as 0, i.e., not borrowed, and has zero aggregate credit demand. Multiple loan application records in the before and after period made by the same firm are aggregated accordingly.

¹⁰The proportion of casualties or infections is the ratio of provinces' accumulated casualties or infections to that of China, multiplied by 100.

¹¹Following Dong and Men (2014), Ertugrul *et al.*, (2017) and Lin *et al.*, (2018), the matching variables include the largest shareholder rate, separation of power, financing demand, revenue growth, size, fixed assets ratio, solvency, return on assets, and earnings per share.

PSM. After matching, the two density curves are on the common support and almost overlapped. Table 2 presents the corresponding result of the two-sample t-test after the PSM. There are no statistically significant differences between the treatment and the control groups. In other words, Hubei and non-Hubei SMEs in our sample share similar characteristics, which passes the balancing test in the DID setting. Note that we use the matched sample throughout this study.

Table 2: Evaluating PSM results: t-test at period = 0

Variable(s)	Mean Control	Mean Treated	Diff.	t	Pr(T > t)
Largest shareholder rate	0.308	0.297	-1.119	0.52	0.6060
Separation of power	3.524	2.891	-0.633	0.59	0.5579
Financing demand	0.124	0.134	0.010	0.36	0.7217
Revenue growth	0.174	0.197	0.023	0.41	0.6841
Size	12.630	12.482	-0.148	0.90	0.3706
Fixed assets ratio	0.177	0.161	-0.016	0.78	0.4338
Solvency	18.395	16.770	-1.625	0.11	0.9134
ROA	0.029	0.047	0.018	1.06	0.2915
EPS	0.275	0.434	0.158	1.34	0.1810

Note: (1) *, **, and *** denote significance at the 10%, 5% and 1% level, respectively.

5.2 Main results

Table 3 presents the DID estimation results of Eq. (4.1), which compares SMEs' credit demand in periods before and after the lockdown in Hubei (January 23-April 8, 2019 for the pre-shock period and January 23-April 8, 2020 denotes the post-shock period).

The full sample results, shown in Panel A, suggest that various terms of Hubei SMEs' credit line applications were adversely affected, and the effects are economically and statistically significant. Compared with non-Hubei SMEs, the probability that Hubei SMEs fill a LOC application reduced by more than 50 percentage points under the COVID-19 outbreak. It follows that the number of credit line applications made by Hubei SMEs fell by 75 percentage points relative to that of non-Hubei SMEs. The coefficient in column (3) of Panel A implies that the aggregate credit line applied by Hubei SMEs dropped by 94 percentage points relative to that made by non-Hubei SMEs. The above findings are in line with the existing empirical evidence that firms reduce their credit demand under crisis periods (Ivashina and Scharfstein, 2010; Demirgüç-Kunt *et al.*, 2020). The results also confirm our Hypothesis 1 that SMEs under greater pandemic-induced shock prohibit

Table 3: The effects of COVID-19 on firm's loan demand

Variables	(1) Whether applied	(2) Number of applications	(3) Credit amounts (log)
<i>Panel A: Overall</i>			
Post × Hubei	-0.528** (0.221)	-0.751*** (0.225)	-2.885** (1.202)
Observations	1,185	747	1,185
<i>Panel B: SOEs subsample</i>			
Post × Hubei	-0.127 (0.188)	0.468 (0.537)	-1.149 (1.713)
Observations	64	34	64
<i>Panel C: Non-SOEs subsample</i>			
Post × Hubei	-0.599*** (0.179)	-0.661*** (0.0835)	-3.067*** (0.957)
Observations	1,006	468	1,004
<i>Panel D: With previous application</i>			
Post × Hubei	-0.140 (0.378)	0.0798 (0.303)	-0.0413 (1.654)
Observations	300	335	263
<i>Panel E: Without previous application</i>			
Post × Hubei	-0.568*** (0.120)	-0.452*** (0.103)	-3.674*** (0.869)
Observations	624	110	624
Firm controls	Yes	Yes	Yes
Deal characteristics	No	No	No
Firm fixed effects	Yes	Yes	Yes

Note: (1) Clustered standard errors at industry level. (2) *, **, and *** denote significance at the 10%, 5% and 1% level, respectively.

their credit demand more.¹²

To analyze the effect of debt position on firms' credit demand during the crisis, we focus on

¹²The COVID-19 shock probably hit consumers' demand, as Hubei SMEs' sales decreased in the shock period. Appendix Table I shows the DID estimation result.

firms' LOC after the COVID-19 pandemic outbreak and adopt the pre-shock leverage ratio as a continuous treatment. Specifically, we interact the Hubei SME dummy with the firm's debt to asset ratio by the end of 2019. The results in Appendix Table V show that the firm's pre-shock leverage level is adversely related to the post-shock credit demand. In particular, compared with low-leverage firms, those with a higher leverage ratio before the shock are less likely to fill LOC applications and apply for fewer amounts after the pandemic shock. Our findings are consistent with Iqbal and Kume (2014) that firms with higher average leverage ratios in the pre-crisis periods experience a significant decrease in credit needs during the post-crisis period.

Next, we investigate the heterogeneous impacts in SMEs' credit demand by examining different subsamples: the SOEs and the non-SOEs, and SMEs with and without previous credit applications.

Panel B and C of Table 3 examine the different responses of the SMEs under COVID-19 for the SOEs and the non-SOEs subsample, respectively. While we see no significant distinctions in the SOEs (Panel B) from Hubei and non-Hubei provinces, the differences among the non-SOEs (Panel C) are worthy noted. Regarding the economic magnitude, the probability of applying a credit line declined by 60 percentage points, the frequency of applications reduced by 66 percentage points, and the credit amounts dropped by 95 percentage points, presenting a similar and even intensified pattern. Our findings are also consistent with Wang *et al.* (2019) that the non-SOEs reduce their credit financing more during a crisis period. It could be that the non-SOEs are facing a higher cost of debt, and thus they cut their credit demand more in the wake of the COVID-induced shock. The empirically results also echo Hypothesis 2.

Finally, we test Hypothesis 3 to see whether SMEs in the more affected areas with prior credit applications would experience lesser contraction. To test it, we split our sample into firms with and without previous credit application records. According to Panel D of Table 3, there are no significant differences in credit demand for Hubei and non-Hubei SMEs with prior applications. However, in Panel E, the demand of Hubei SMEs' without previous requests reduces more relative to non-Hubei SMEs during the shock period. Our three measures of credit demand (whether applied, number of LOC applications, and total credit lines) are all economically and statistically significant. Most prominently, the aggregate credit lines of Hubei SMEs contracted to half of its previous level relative to that of non-Hubei SMEs.

Overall, the results in this section document that in the wake of the COVID-19, SMEs in the most affected area, Hubei, significantly reduce their credit demand. The heterogeneity analysis further shows that the baseline results are mostly driven by the non-SOEs and firms without bank relationships.

5.3 The supply chain spillovers

Amid the COVID-19 threat, nationwide economic activities were more likely to experience stagnations, primarily due to the sudden reduction in logistics. To see the effect of an abrupt rupture in transportation, we replace our treatment variable in Eq. (4.1) with a province's railway freight volume in 2018. Panel A of Table 4 shows the decreased probability of LOC applications and the credit lines applied in areas bearing larger freight volume. Our results indicate that SMEs in provinces with higher logistic capacity contracted their credit demand more, which implies that the interruption in transportations did affect SMEs to a certain degree.

Table 4: The supply chain spillovers

Variables	(1) Whether applied	(2) Number of applications	(3) Credit amounts (log)
<i>Panel A: Channeling through the railway freight volume</i>			
Post \times Railway freight volume (log)	-0.0518* (0.0289)	-0.0539 (0.0845)	-0.307* (0.172)
Observations	1,455	754	1,520
<i>Panel B: With Hubei firms on the supply chain</i>			
Post \times Hubei supply chain	-0.853*** (0.184)	-0.0708 (-0.364)	-5.804*** (1.272)
Observations	965	644	965
<i>Panel C: With Hubei firms as the customers</i>			
Post \times Hubei customers	-1.302*** (0.114)	-2.020*** (0.217)	-8.664*** (0.811)
Observations	294	232	294
<i>Panel D: With Hubei firms as the suppliers</i>			
Post \times Hubei suppliers	-0.580 (0.561)	0.709* (0.400)	-2.799 (3.514)
Observations	422	262	422
Firm controls	Yes	Yes	Yes
Deal characteristics	No	No	No
Firm fixed effects	Yes	Yes	Yes

Note: (1) Clustered standard errors at industry level. (2) *, **, and *** denote significance at the 10%, 5% and 1% level, respectively.

The above result motivates us to examine whether the COVID-19 would spill over to firms along the supply chain, mainly relying on inter-province logistics. Previous studies suggest that shocks may ripple through the supply chain by affecting input supply and demand (Barrot and Sauvagnat, 2016). The COVID-induced shock may also flow from firms in the most affected areas to their suppliers and customers. To test Auxiliary Hypothesis 1, we focus on non-Hubei SMEs and construct a Hubei-related supply chain subsample.¹³ We first replace the treatment variable in Eq. (4.1) with a dummy variable indicating whether the firm is along the Hubei supply chain. Panel B of Table 4 shows a negative and significant impact of the pandemic on the SMEs' credit demand along the Hubei supply chain. Specifically, for non-Hubei SMEs having a supply chain relationship with Hubei firms, the probability of applying for a LOC dropped by 85 percentage points, and the aggregate credit lines declined by almost 100 percentage points relative to firms on non-Hubei supply chains. Our results imply a much striking spillover effect of the COVID-19 through the supply chain network.

Moreover, we examine the downstream and upstream propagation of the COVID-19 shock separately.¹⁴ Concretely, we split our supply chain relationship sample into the Hubei customer/supplier subsamples, respectively. In Panel C of Table 4, SMEs that have Hubei customers were most adversely affected. On average, those firms are less inclined to initiate credit applications in the wake of COVID-19. The coefficient in Column (3) of Panel C highlights that credit amounts applied by SMEs having Hubei customers nearly reduces to zero. It is noticed that the more substantial impact of the pandemic exhibits in the customer subsample (i.e., firms in other localities that have Hubei customers), compared with the effects on Hubei SMEs shown in the main results. The result indicates that the initial shock on Hubei firms magnifies through the supply chain from downstream (customers) to upstream (suppliers). The result is also in line with the studies documenting the supply-chain externalities due to industry downturns (Benmelech and Bergman, 2011; Carvalho, 2015). A plausible explanation is that customer firms may reduce their demand for suppliers' goods and services under the COVID-19 (Luo, 2019).

Panel D of Table 4 presents a less prominent effect on the supplier subsample, in which firms having Hubei suppliers increased their application frequencies. Simultaneously, we observe no similar patterns in terms of the probability and the amount of borrowing. In this situation, the increase in borrowing frequency implies a drop in the average credit line applied. Downstream SMEs having Hubei suppliers are less affected by the pandemic compared with their upstream peers. Lanier *et al.* (2010) demonstrate that downstream members receive most of the profitability

¹³Specifically, we identify a firm as on the Hubei supply chain if it has at least one Hubei firm in its top 5 suppliers or customers.

¹⁴We define downstream propagation if it affects the supplier of the firm (i.e., the origin is a customer) and upstream propagation if it affects the customer of the firm (i.e., the origin is a supplier).

benefits because of their relatively higher bargaining power. In the wake of COVID-19, the observed stability in credit demand for the downstream SMEs may result from firms' high risk-resistance capability. In other words, the downstream SMEs are more likely to find alternative suppliers in non-Hubei localities, minimizing the pandemic impacts. Overall, our empirical results substantiate Auxiliary Hypothesis 1 that the COVID-19 shock rippled through the supply chain and exerted an intensified strike on the SMEs having Hubei customers.

5.4 Bank-side analysis

In this section, we examine the banks' role during the COVID-19 shock through the lens of several bank-specific deal-level characteristics. Prior studies suggest that lenders' ownership may influence the credit supply. In China, state-owned banks are obliged to maintain employment and social stability through loans (Bailey *et al.*, 2011). Coleman and Feler (2015) presents empirical evidence that government bank lending is politically targeted and play a countercyclical role during crisis periods.

As the COVID-19 pandemic unfolds, the Chinese government has called for financial support from the banking sector to SMEs. We thus hypothesize that during the pandemic, credits from the Chinese state-owned banks, including three policy banks and the six biggest state-owned commercial banks, could incline to SMEs to echo the government call.¹⁵ The state-owned banks may present different behaviors regarding the collateral requirement and the lending rate from other non-state-owned financial institutions. Thus, we split the whole sample into the state-owned and the non-state-owned subsamples on the deal level.

In CSMAR, the deal-level credit application not only has the borrowers' information but also contains lenders' requirements on collaterals. A credit line application is labeled as pledged if it secures with a firm's property or assets. In Table 5, Column (1) of Panel A shows that on average, when SMEs seek credit from state-owned banks, the probability of pledging made by Hubei firms reduced by 11 percentage points relative to firms in other provinces. In other words, Hubei SMEs' access to credit was improved (*i.e.*, the collateral requirement has been lowered), while we observe no such differences in the non-state-owned banks' subsample.

Column (2) of Table 5 shows the results assessing the change in the credit line approving rate. The non-state-owned financial institutions were more likely to reject Hubei SMEs' credit applications, with a magnitude of around seven percentage points during the lockdown period.

¹⁵China's three policy banks include the Agricultural Development Bank of China (ADBC), China Development Bank (CDB), and the Export-Import Bank of China (EXIM). The six biggest state-owned commercial banks are the Agricultural Bank of China (ABC), Bank of China (BOC), Bank of Communications (BOCOM), China Construction Bank (CCB), Industrial and Commercial Bank of China (ICBC), and the Postal Savings Bank of China (PSBC).

Table 5: Bank-side analysis: evidences from banks

Variables	(1) Whether pledged	(2) Whether signed
<i>Panel A: State-owned banks</i>		
Post × Hubei	-0.113** (0.0543)	0.135* (0.0700)
Observations	298	238
<i>Panel B: Other banks and financial institutions</i>		
Post × Hubei	0.0642 (0.0647)	-0.0653* (0.0386)
Observations	2,359	2,359
Firm controls	Yes	Yes
Deal characteristics	Yes	Yes
Firm fixed effects	Yes	Yes

Note: (1) Clustered standard errors at industry level. (2) *, **, and *** denote significance at the 10%, 5% and 1% level, respectively.

Surprisingly, the state-owned banks increased the signing rate by 14 percentage points for Hubei SMEs. Thus, comparing with non-state-owned financial institutions, state-owned banks generally show a supporting gesture for Hubei SMEs by lowering collateral requirements and ameliorating the credit approving rate. The above findings are in line with Auxiliary Hypothesis 2 that state-owned banks counteract the lending behaviors of non-state-owned banks during a crisis period.

6 Robustness checks

6.1 Alternative measures of the COVID-19 graveness

Throughout our previous analysis, we use the dummy treatment variable, Hubei, to proxy the COVID-induced severeness. To show the robustness of our baseline results, we use the percentage of the pandemic casualties as the continuous treatment proxy, and the modified model is as below:¹⁶

$$Dep_{it} = \beta_0 + \beta_1 Post_t + \beta_2 Post_t \times Casualties_i + \beta_3 Controls_{i,t-1} + \theta_i + \epsilon_{it}, \quad (6.1)$$

¹⁶The proportion of causalities or infections is the ratio of provinces' accumulated causalities or infections to that of China.

where $Casualties_i$ is the share of a province's COVID-19 accumulated casualties to the China's total number of casualties. Note that we also incorporate the other provinces' COVID cases in this specification.

Table 6: Robustness checks: using the casualties ratio as an alternative measure

Variables	(1) Whether applied	(2) Number of applications	(3) Credit amounts (log)
<i>Panel A: Overall</i>			
Post × Casualties ratio	-0.551** (0.211)	-0.753*** (0.236)	-3.047** (1.192)
Observations	1,455	848	1,455
<i>Panel B: SOEs subsample</i>			
Post × Casualties ratio	0.0805 (0.0968)	0.495* (0.261)	0.496 (0.730)
Observations	147	92	147
<i>Panel C: Non-SOEs subsample</i>			
Post × Casualties ratio	-0.637*** (0.197)	-0.719*** (0.0715)	-3.226*** (1.008)
Observations	1,264	635	1,264
<i>Panel D: With previous application</i>			
Post × Casualties ratio	-0.131 (0.366)	-0.145 (0.543)	0.488 (1.487)
Observations	537	888	537
<i>Panel E: Without previous application</i>			
Post × Casualties ratio	-0.409*** (0.0685)	-0.469*** (0.0787)	-2.692*** (0.558)
Observations	873	324	873
Firm controls	Yes	Yes	Yes
Deal characteristics	No	No	No
Firm fixed effects	Yes	Yes	Yes

Note: (1) Clustered standard errors at industry level. (2) *, **, and *** denote significance at the 10%, 5% and 1% level, respectively.

Table 6 summarizes the results of our alternative treatment based on Eq. (6.1). The statistical significances of our baseline results are mostly unaltered, and most of the coefficient estimates

even increase. In Table 7, we further show that the baseline results are also valid if we replace the previous continuous treatment by the percentage of provinces' confirmed cases. Moreover, our bank-side results in Table 8 with the two alternative treatments are quantitatively similar to the previous analysis.

Table 7: Robustness checks: using the infections ratio as an alternative measure

Variables	(1) Whether applied	(2) Number of applications	(3) Credit amounts (log)
<i>Panel A: Overall</i>			
Post × Infections ratio	-0.639** (0.255)	-0.797*** (0.268)	-3.448** (1.475)
Observations	1,455	848	1,455
<i>Panel B: SOEs subsample</i>			
Post × Infections ratio	0.145 (0.153)	0.672** (0.315)	0.955 (1.192)
Observations	147	92	147
<i>Panel C: Non-SOEs subsample</i>			
Post × Infections ratio	-0.747*** (0.237)	-0.767*** (0.143)	-3.698*** (1.235)
Observations	1,264	635	1,264
<i>Panel D: With previous application</i>			
Post × Infections ratio	-0.106 (0.430)	-0.153 (0.645)	0.979 (1.783)
Observations	537	888	537
<i>Panel E: Without previous application</i>			
Post × Infections ratio	-0.523*** (0.0955)	-0.524*** (0.0974)	-3.404*** (0.731)
Observations	873	324	873
Firm controls	Yes	Yes	Yes
Deal characteristics	No	No	No
Firm fixed effects	Yes	Yes	Yes

Note: : (1) Clustered standard errors at industry level. (2) *, **, and *** denote significance at the 10%, 5% and 1% level, respectively.

Table 8: Robustness checks: using pandemic statistics as alternative treatments

Variables	(1) Whether pledged	(2) Whether signed
<i>Panel A1: Stated-owned banks (1)</i>		
Post × Casualties ratio	-0.167** (0.0807)	-0.0144 (0.0203)
Observations	1,063	1,264
<i>Panel A2: Stated-owned banks (2)</i>		
Post × Infections ratio	-0.210** (0.102)	-0.0301 (0.0274)
Observations	1,063	1,264
<i>Panel B1: Other banks and financial institutions (1)</i>		
Post × Casualties ratio	0.0825 (0.0946)	-0.0909* (0.0469)
Observations	3,036	2,689
<i>Panel B2: Other banks and financial institutions (2)</i>		
Post × Infections ratio	0.0666 (0.117)	-0.104* (0.0576)
Observations	3,036	2,689
Firm controls	Yes	Yes
Deal characteristics	Yes	Yes
Firm fixed effects	Yes	Yes

Note: (1) Clustered standard errors at industry level. (2) *, **, and *** denote significance at the 10%, 5% and 1% level, respectively.

6.2 SMEs' utilized credit

Our baseline analysis shows that Hubei SMEs' credit line deteriorated, and it is intriguing to investigate the impact of the COVID-induced shock on the actual use of credit made by Hubei SMEs. To answer that, we retrieve the bank loan amounts from SMEs' quarterly reports. We construct the dependent variable as the changes in SMEs' bank loan balance in the first quarter divided by the beginning balance to measure the loan increment, following Ivashina and Scharfstein (2010). In Table 9, we re-estimate the main results with binary and continuous treatments. Most of the effects still hold, and the actual use of the credit by Hubei SMEs were still far below their peers in other provinces.

Table 9: Robustness checks: using the received loans as an alternative measure

	Loan increment				
	Overall	SOE	Non-SOE	With previous application	Without previous application
	(1)	(2)	(3)	(4)	(5)
<i>Panel A: Binary treatment</i>					
Post \times Hubei	-0.0201** (0.00868)	-0.00680 (0.00668)	-0.0160 (0.0105)	-0.0186 (0.0172)	-0.0150** (0.00634)
Observations	1,308	73	849	364	828
<i>Panel B: Continuous treatment (1)</i>					
Post \times Casualties ratio	-0.0221** (0.00932)	-0.00442 (0.00404)	-0.00825 (0.00759)	-0.0248 (0.0177)	-0.0159** (0.00604)
Observations	1,487	146	1,297	569	909
<i>Panel C: Continuous treatment (2)</i>					
Post \times Infections ratio	-0.0256** (0.0108)	-0.00377 (0.00565)	-0.00924 (0.00896)	-0.0269 (0.0205)	-0.0195** (0.00754)
Observations	1,487	146	1,297	569	909
Firm controls	Yes	Yes	Yes	Yes	Yes
Deal characteristics	No	No	No	No	No
Firm fixed effects	Yes	Yes	Yes	Yes	Yes

Note: (1) Clustered standard errors at industry level. (2) *, **, and *** denote significance at the 10%, 5% and 1% level, respectively.

7 Conclusions and policy implications

The financing problems of SMEs in emerging markets have been the focus of a vast literature. However, little empirical research has investigated the pandemic impact on SMEs' financing. Combining the data on Chinese SMEs' line of credit (LOC) applications with the pandemic statistics, this paper makes a first step in studying how SMEs change their credit demand under the COVID-19 outbreak.

We find that relative to non-Hubei firms, Hubei SMEs' credit demand was adversely affected in terms of the probability and the frequency of filling applications, and the aggregate credit line applied. Specifically, the non-SOEs and firms without prior relationships with banks were more depressed by the COVID-19 than their counterparts. We further find that SMEs' credit demand reduction was more pronounced in provinces with higher logistics capacity, which was directly affected by the lockdown policies. Meanwhile, we provide evidence that the pandemic-induced shock spilled over into the upstream and the downstream of the supply chain. Compared with the downstream customers, the upstream suppliers hold weaker bargaining power because of their reliance on market demand, and therefore were particularly affected in times of the pandemic.

Furthermore, we show that state-owned banks generally presented a responsive gesture under government advocations and counteracted the lending reduction of other financial institutions. More specifically, when SMEs applied for credits from state-owned banks, they were less likely to be asked for collaterals and were more likely to be approved in the wake of the COVID-19.

Overall, the empirical evidence suggests that the pandemic-induced shock severely affects SMEs' credit demand, and the observed governments' support through state-owned banks may not adequately remedy the problem. Our findings may serve as a reference for SMEs' financing situation under the COVID-19, especially in emerging markets. It is worth noting that what we investigate is only the short-term effect. As the COVID-19 is still unfolding, whether those SMEs may recover from this financing depress in the long run is an important topic for future research.

Looking ahead, to dampen the impacts of the pandemic on SMEs, government and policymakers must design sufficient financing policy interventions. While SMEs face liquidity constraints in covering the fixed expenses such as wages and operating costs, they are less likely to seek external financing due to their lack of sufficient collaterals (Abraham and Schmukler, 2017). The Chinese government so far has been focusing on reducing the cost for SMEs after the pandemic outbreak (Cusmano *et al.*, 2020). Our demand-side results call for more direct policies such as zero-interest loans, subsidies, and grants as adopted by several other countries (e.g., Belgium, Chile, Japan, United Kingdom, United States). According to our study, the measures should target the subgroups such as the non-SOEs, firms that heavily rely on supply chains, and SMEs without stable bank

relationships.

Conflict of interest

The authors declare that they have no conflict of interest.

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Appendix Table I: The effect of COVID-19 on firm's output

Variables	(1) Output (log)
Post \times Hubei	-0.206* (0.113)
Observations	2,243
Firm controls	Yes
Deal characteristics	No
Firm fixed effects	Yes

Note: (1) Clustered standard errors at industry level. (2) *, **, and *** denote significance at the 10%, 5% and 1% level, respectively.

Appendix Table II: Variable Definitions

Variables	Definitions	Sources
<i>Panel A: Dependent variables</i>		
Output (log)	The logarithm of cash receipts from sales of goods or services.	CSMAR
Whether applied	A dummy variable equals to one if the firm made a credit application and zero otherwise.	CSMAR
Number of applications	The logarithm of total number of credit applications made by a firm.	CSMAR
Aggregate credit amounts (log)	The logarithm of the aggregate credit amounts applied by the firm.	CSMAR
Railway freight volume (log)	The logarithm of the railway freight volume in each province.	CNRDS
Whether pledged	A dummy variable equals to one if the credit application is pledged with collaterals and zero otherwise.	CSMAR
Whether signed	A dummy variable equals to one if the credit application is approved by the bank and zero otherwise.	CSMAR
Loan increment	The difference between firm's bank loan balance at the start and end of the first quarter divided by the bank loan balance at the start of the year.	CSMAR
<i>Panel B: Treatment variables</i>		
Hubei	A dummy variable equals to one if the firm is located in Hubei province and zero otherwise.	CSMAR
Casualties ratio	The ratio of province's accumulated fatalities to that of China.	CSMAR
Infections ratio	The ratio of province's accumulated infections to that of China.	CSMAR
Hubei supply chain	A dummy variable equals to one if the firm has Hubei firms in its supply chain and zero otherwise.	CNRDS
Hubei suppliers	A dummy variable equals to one if the firm has Hubei firms as the supplier and zero otherwise.	CNRDS
Hubei customers	A dummy variable equals to one if the firm has Hubei firms as the customer and zero otherwise.	CNRDS
Pre-shock leverage	The debt to asset ratio by the end of 2019.	CNRDS
<i>Panel C: Classification variables</i>		
Post	A dummy variable equals to one if the credit application is made during the lockdown period in 2020 and zero if	CSMAR

Appendix Table III: Number of firms by province

Provinces	Num. of firms	Percent	Casualties %	Infections %
Guangdong	832	24.81	0.24	1.85
Zhejiang	442	13.18	0.03	1.52
Jiangsu	402	11.99	0.00	0.78
Beijing	314	9.36	0.24	0.71
Shandong	196	5.84	0.21	0.94
Shanghai	156	4.65	0.21	0.65
Fujian	134	4	0.03	0.42
Sichuan	116	3.46	0.09	0.67
Hunan	108	3.22	0.12	1.23
Anhui	82	2.44	0.18	1.19
Henan	80	2.39	0.66	1.53
Hubei	74	2.21	96.14	81.53
Liaoning	54	1.61	0.06	0.17
Hebei	44	1.31	0.18	0.39
Jiangxi	36	1.07	0.03	1.13
Tianjin	34	1.01	0.09	0.22
Xinjiang	34	1.01	0.09	0.09
Shaanxi	30	0.89	0.09	0.20
Yunnan	26	0.78	0.06	0.22
Chongqing	24	0.72	0.18	0.70
Guizhou	20	0.6	0.06	0.18
Jilin	18	0.54	0.03	0.12
Gansu	18	0.54	0.06	0.17
Guangxi	16	0.48	0.06	0.31
Tibet	14	0.42	0.00	0.00
Shanxi	12	0.36	0.00	0.31
Hainan	12	0.36	0.18	0.20
Heilongjiang	12	0.36	0.39	0.68
Inner Mongolia	10	0.3	0.03	0.15
Ningxia	2	0.06	0.00	0.09
Qinghai	2	0.06	0.00	0.02

Source: Authors' calculations based on CSMAR firm data.

Appendix Table IV: Number of firms by industry

Industries	Num. of firms	Percent
Manufacturing	2,448	72.99
Telecom/Network/Computer Services/Software	394	11.75
Construction	78	2.33
Research/Technical Service/Geology	66	1.97
Leasing/Business Services	62	1.85
Wholesale/Retail	58	1.73
Water Conservancy/Environment/Public Utilities	46	1.37
Culture/Sports/Entertainment	46	1.37
Agriculture/Fishing/Forestry	40	1.19
Transportation/Logistic	32	0.95
Real Estate	22	0.66
Mining	20	0.6
Utilities/Energy	20	0.6
Health Care/Social Security/Social Welfare	14	0.42
Education	4	0.12
Hospitality/Tourism	2	0.06
Other Services	2	0.06

Source: Authors' calculations based on CSMAR firm data.

Appendix Table V: Debt position analysis

Variables	(1) Whether applied	(2) Number of applications	(3) Credit amounts (log)
Hubei \times Pre-shock leverage	-12.69** (6.076)	-0.125 (0.835)	-6.236* (3.173)
Observations	287	219	1,189
Firm controls	Yes	Yes	Yes
Deal characteristics	No	No	No
Firm fixed effects	Yes	Yes	Yes

Note: (1) Clustered standard errors at industry level. (2) *, **, and *** denote significance at the 10%, 5% and 1% level, respectively.