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COVID-19 and Firm Response: Evidence from China

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Abstract: *This paper explores the effects of the coronavirus disease (COVID-19) pandemic on firm response. Using a novel COVID-19 sentiment index, our estimation shows that the pandemic significantly reduced the overseas revenue and profits of firms listed on the Chinese A-share market. Moreover, we observe that an increase in loans, and a drop in debt financing cost and trade credit, were prominent during the pandemic. We contend that reduced cash flows, which damaged firm operations; government support, which provided more financing channels; and increased default risks, which placed barriers on trade credit, are the plausible mechanisms through which the COVID-19 pandemic affects firm performance. Profit contraction was more pronounced for firms with a lower ratio of domestic content in exports and state-owned enterprises, while external financing was easier for firms subject to stringent financial constraints despite their lowered trade credit.*

Keywords: COVID-19 pandemic, firm response, external financing

1. Introduction

The unexpected coronavirus disease (COVID-19) pandemic has exerted a devastating influence on the global economy and seriously disturbed social stability. For instance, global trade suffered a significant contraction, and its growth is expected to remain below the pre-pandemic levels (Kiyota, 2022). The decrease in exports is more pronounced in destinations implementing stricter containment policies (de Lucio et al., 2022). In addition to the adverse effects on the macroeconomy, including stagnant economic growth and declining trade volumes, the COVID-19 pandemic has induced uncertainty about future economic growth, leading to fewer investment opportunities and changes in access to loans.

In this regard, the negative influence caused by the pandemic can also be transmitted to the microscopic firm level. He et al. (2022) suggested that the COVID-19 pandemic has harmed corporate revenue and intensified the fluctuation of cash flows, especially for firms with high financial frictions. Likewise, Ardiyono (2022) contended that the COVID-19 pandemic has undermined firms' revenue, pushing them to curtail the number of workers. Despite the existing literature focusing on firm responses to the pandemic, few have comprehensively probed firms' overseas performance and their financing capability during the pandemic.

Indeed, firms' overseas performance, profitability, and access to finance matter to their long-term growth and international competitiveness. Given that the negative influence of COVID-19 on the economy is widespread and long-lasting, we hope to explore how firms – acting as the main body of economic activities – have been affected during the unexpected shock to provide a reference for policymakers and other parties who are concerned about firms' development during uncertainty. In this paper, we explore the perspective of overseas revenue, firm profitability, and firm debt financing.

However, how the pandemic affects the above-mentioned firm response remains inconclusive. With respect to overseas revenue and profits, it is likely that the exports and overseas business reduced due to stringent lockdown policies (Bonadio et al., 2021), undermining firm profitability. In terms of credit financing capability, although the COVID-19 pandemic may lead to tightened credit standards and less financing opportunities,

governments might implement monetary policies or distribute subsidies to provide financial support, thus stimulating firm production and helping firms overcome difficulties during the pandemic (Al-Hadi and Al-Abri, 2022). Therefore, it is likely that firms' access to loans will improve. In terms of trade credit, the substitution hypothesis states that increases in the availability of bank credit are associated with the use of trade credit (Chen, Ma, and Wu, 2019). That is, trade credit is affected by loans and may have experienced a decrease under more relaxed monetary policy and subsidies during the pandemic. Moreover, the default risk hypothesis demonstrates that firms might reduce trade credit to lessen default risks and uncertainty in the presence of adverse shocks (Cuñat, 2007; Luo, 2022). Given the ambiguity of the influence, the issue is essentially empirical.

Therefore, in this study, we probe the relationship between the COVID-19 pandemic and firm performance. We use the COVID-19 sentiment index constructed by Narayan, Iyke, and Sharma (2021) to capture the influence of the pandemic. Based on the frequency of 327 keywords relating to the pandemic published in 45 mainstream newspapers worldwide, the index distinguishes indicators such as the number of deaths and infections, and could enable us to explore the influence of COVID-19 more comprehensively. Our baseline analyses suggest that the pandemic reduced firm overseas revenue and dampened firm profitability. We also observe that firms obtained more loans, lower debt financing costs, and less trade credit. The results are robust when using alternative measures of the COVID-19 pandemic, including industry-quarter fixed effects, along with the pooled ordinary least squares (OLS) method.

Next, we examine the underlying channels through which the COVID-19 pandemic has affected firm profitability and debt financing. We note that strict containment measures during the pandemic have deteriorated production and operation, leading to a decrease in cash flows and eventually reducing overseas revenue, profits, and profitability. With respect to access to loans, we provide evidence that firms experienced an increase in loans and a decrease in debt financing costs through government support. Regarding trade credit, the substitution hypothesis and default risk hypothesis hold. That is, firms undertook less trade credit because of increasing loans and default risks.

Finally, we examine whether the influence of the COVID-19 pandemic on firm response exhibits cross-sectional heterogeneity. We show that the negative effects of the pandemic have been more pronounced for firms with a lower domestic value-added ratio (DVAR) in exports and state-owned enterprises (SOEs), while the increased loans and decreased debt financing costs are more prominent in firms subject to stringent financial constraints.

The contribution of this paper is threefold. First, we enrich the literature that investigates the consequences of the COVID-19 pandemic. In addition to firm profitability and financing during the pandemic, which has been widely studied (Hu and Zhang, 2021; Gopalakrishnan, Jacob, and Mohapatra, 2022; Banerjee, Dhole, and Mishra, 2023), we concentrate on the response of firms' overseas revenue in the context of lockdown policies. Moreover, we not only consider credit reception but also credit supply to investigate the response of firm trade credit more comprehensively during the pandemic.

Second, based on the devastating effects of COVID-19 on firm performance, we take a step further to explore the underlying mechanisms through which the influence works. Most of the literature has focused on the economic consequences of the pandemic (Ardiyono, 2022; He et al., 2022; Kiyota, 2022; Kong et al., 2023), while few studies have explored the potential channels through which the effects work. We provide tentative evidence that firms may obtain more loans and lower debt financing costs through government support during the pandemic. Furthermore, we demonstrate that substitution financing and default risk are potential channels by which the pandemic reduces trade credit.

Third, by studying Chinese firms' responses to the pandemic, our study adds to the literature that explores the impact of COVID-19 in emerging economies (Behera, Gunadi, and Rath, 2023; Iyke and Maheepala, 2022). In addition, we may inspire policymakers in developing countries to take measures to mitigate the adverse effects of the pandemic and alleviate firm pressure. Specifically, relevant departments could provide firms with timely financial support, promoting firms' resilience to unanticipated risks and enabling them to recover from losses incurred because of uncertainty. Moreover, multinational cooperation rather than decoupling should be emphasised in the face of a shock, which would help achieve mutual and win–win development. With respect to investors, they should be aware of potential

losses during a pandemic, and take into account information related to the market and financial condition of firms before making investment decisions.

The remainder of this paper proceeds as follows. Section 2 reviews the literature and develops the research hypotheses. Section 3 introduces the data sources, construction of variables, and empirical strategy. Section 4 presents the empirical results. Section 5 elaborates on the underlying channels and cross-sectional results. Section 6 concludes the study.

2. Literature Review and Hypothesis Development

Many countries have taken strict containment measures (e.g. confinement at home and workplace closures) to protect their populations from the COVID-19 pandemic. de Lucio et al. (2022) stated that containment measures have had significant effects on trade. They found that strict containment measures impose barriers to trade, and the trade flows of countries with stricter containment measures are lower than those with more relaxed measures, especially for exports. Arita et al. (2022) argued that COVID-19 incidence rates, policy restrictions imposed by governments to curb outbreaks, and lockdowns led to a decrease in trade in the agricultural and non-agricultural sectors. On the one hand, business production and operations suffered negative shocks during lockdowns. Li and Lin (2021) argued that the COVID-19 pandemic increased the trade cost between countries and reduced supply in labour, raw materials, and intermediate inputs. On the other hand, consumers had incentives to reduce consumption and increase savings in reaction to the economic uncertainty brought about by the COVID-19 outbreak, which is not conducive to firms' sales growth. Kirik and Ulusoy (2022) found that global spending fell and savings rose with economic lockdown measures and unemployment benefits during the COVID-19 pandemic. Therefore, we propose the following hypothesis:

H1: Firms experience a decrease in overseas revenue and firm profitability during the COVID-19 pandemic.

The Government of China has taken various measures to mitigate the impact of the COVID-19 pandemic and has helped enterprises to persevere throughout the difficulties. It has employed monetary policy tools, including interest rate reductions and non-conventional monetary measures (e.g., central bank guarantees, changes in reserve requirements, macro-prudential policies, easing of lending requirements, and foreign exchange operations), which have been proved to improve access to loans and provide financial support for firms (Al-Hadi

and Al-Abri, 2022). For example, the government requires financial institutions to strengthen financial support for industries and firms seriously affected by the COVID-19 pandemic, including increasing credit support, and increasing non-performing loan ratios (Notice of the General Office of the China Banking and Insurance Regulatory Commission on Further Improving Financial Services for Enterprises in Difficult Industries Affected by the Pandemic (CBIRC Ban Fa (2022) No. 64)). Hoshi, Kawaguchi, and Ueda (2022) noted that the government has conducted concessional loan programmes and provided subsidies and concessional loans for firms to prevent the failure of viable firms and the loss of productive employment relations. Moreover, firms have tended to increase debt financing during COVID-19, motivated by precautionary needs against higher uncertainty and risks, especially firms with high COVID-19 exposure and those located in countries with strict lockdowns (Gopalakrishnan, Jacob, and Mohapatra, 2022). Therefore, firms may experience an increase in access to loans under government support during the COVID-19 pandemic. In this respect, we propose the following hypothesis:

H2: Firms experience an increase in loans and a decrease in debt financing cost during the COVID-19 pandemic.

The substitution hypothesis states that trade credit becomes an important means of external financing when firms have difficulties accessing capital markets (e.g. loans) (Petersen and Rajan, 1997). Chen, Ma, and Wu (2019) provided evidence for the substitution hypothesis based on bank interest rate deregulation in China. They found that increases in the availability of bank credit reduce the use of trade credit. Similarly, Al-Hadi and Al-Abri (2022) argued that monetary policy affects trade credit through bank credit, and trade credit is lower in periods of less restrictive bank credit (i.e. the COVID-19 pandemic).

Moreover, the default risk hypothesis states that suppliers regard trade credit as a short-term investment, and firms are exposed to a high credit risk that might lead to huge losses if customers default (Cuñat, 2007; Lai et al., 2022). The cost (high implicit interest rates) of trade credit is the result of insurance and default premiums (Cuñat, 2007). The COVID-19 pandemic represents a low-probability and high-impact systemic risk (Mena, Karatzas, and Hansen, 2022), and firms accelerate the convergency speed towards the target trade credit to avoid risks in the presence of adverse shocks due to the increased systematic uncertainty and

default risk (Luo, 2022). Overall, if the default risk hypothesis holds, we expect that the COVID-19 pandemic would negatively affect firms' trade credit.

H3: Firms experience a decrease in trade credit during the COVID-19 pandemic.

3. Data and Variable Construction

3.1. Data and Sample

Data used in our study are obtained from several sources. First, we use the COVID-19 indices constructed by Narayan, Iyke, and Sharma (2021) to capture the influence of the COVID-19 pandemic. Based on articles reporting on COVID-19 in the 45 most popular newspapers in the world, the indices comprehensively reflect the influence of events related to travel, vaccines, medical issues, COVID-19, and uncertainty during the pandemic. Second, we rely on the China Stock Market and Accounting Research (CSMAR) database for the basic characteristics and financial conditions of firms listed on the Chinese A-share market.[1] Third, we make use of the WIND database to obtain firms' overseas revenue and information concerning government subsidies.[2] Fourth, to identify domestic value-added content in firms' exports, we utilise the Chinese Customs Trade Statistics (CCTS) issued by the General Administration of Customs of China. Further, we depend on the Broad Economic Categories (BEC) classification to distinguish the intermediates in firm imports.

It is worth mentioning that we exclude firms in financial industries and those with missing key variables. Our final sample consists of 24,188 firm observations from the fourth quarter of 2019 to the second quarter of 2021. Furthermore, we winsorize all the continuous variables at 1% and 99% levels to prevent outliers from biasing our estimation.

3.2. Variable Construction

3.2.1. Dependent Variable

Given that we aim to explore how the COVID-19 pandemic affects firm responses, we analyse from the aspects of overseas revenue, profitability, and debt financing capability. Overseas revenue (*Overseas*) is measured as the logarithm of firm overseas revenue plus one.

[1] CSMAR database. https://data.csmar.com/ (accessed 10 May 2022).
[2] WIND database. https://www.wind.com.cn/ (accessed 12 May 2022).

In terms of firm profitability, we use *ROA* (measured as total profits and finance expenses divided by total assets), *ROE* (denoted by the net profits divided by the balance of shareholders' equity), and *Profit* (defined as total profits). With respect to firm borrowing capability, we consider *Loan* (represented by long-term and short-term loans divided by total assets); *Cost* (interest expenses divided by liabilities); *Credit1* (calculated as accounts payable, notes payable, and items received in advance divided by total assets); and *Credit2* (calculated as accounts receivable, notes receivable, and prepaid accounts divided by total assets) as proxies.

3.2.2. Independent Variable

The core independent variable of our interest is the aggregate COVID-19 index (*A_COVID*) put forward by Narayan, Iyke, and Sharma (2021). This index is constructed based on 327 keywords relating to multiple aspects of COVID-19 reported in mainstream newspapers worldwide, and can thus reflect the pandemic sentiment comprehensively. Given that the index was developed on a monthly basis, we use the mean value of the index each quarter as a proxy for the pandemic.

Moreover, we include a series of firm-level control variables in case our findings are driven by firms' intrinsic characteristics and financial position. We incorporate *Size* (natural logarithm of total assets); *LEV* (total debt divided by total assets); *Growth* (revenue growth); *Age* (natural logarithm of the number of years since the establishment date); *Employee* (natural logarithm of the number of employees); *PPE* (net properties, plants, and equipment divided by total assets); *First* (shareholding ratio of the largest shareholder); *Dual* (a dummy variable that equals 1 for firms with CEO duality, and otherwise 0); *Board* (number of members of the board directors); and *RID* (ratio of the number of independent directors to the members of the board directors) in our model.

3.3. Empirical Approach.

We construct the following model to examine the effect of the COVID-19 pandemic on firm response:

$$Response_{i,q} = \beta_0 + \beta_1 A\_COVID_{i,q} + \beta_2 X_{i,q} + \mu_i + v_q + \varepsilon_{i,q} \quad (1)$$

where i indexes firms and q indexes quarters; $A\_COVID_{i,q}$ is a comprehensive measure of COVID-19 constructed by Narayan, Iyke, and Sharma (2021) that captures the COVID-19

pandemic sentiment; $Response_{i,q}$ captures firm response in terms of overseas revenue, profitability, and debt financing capability. $X_{i,q}$ is a vector of control variables that could have an effect on firm response. We include firm (μ_i) and quarter (v_q) fixed effects in the model to capture firm- and time-specific factors. The coefficient of key interest is β_1, which indicates the effect of the COVID-19 pandemic on firm response.

4. Empirical Results

4.1. Descriptive Statistics

Table 1 provides the descriptive statistics of the main variables. The variable *A_COVID* has a mean of 47.3603 and a standard deviation of 10.2289, ranging from 26.5957 to 64.5161, indicating that the aggregate COVID-19 index varies over time. More specifically, the COVID-19 epidemic peaked in the second quarter of 2020. There is a significant amount of dispersion for overseas revenue, ranging from 0 to RMB17.19 billion ($e^{23.5673}$-1). On average, the return on assets (ROA) and return on equity (ROE) of Chinese listed firms are 3.11% and 3.38%, respectively. In terms of access to bank loans, we observe that financing through loans has an average of 12.64% and the cost of debt financing has an average of 1.28%. In terms of trade credit, the trade credit that firms receive and supply takes up 13.47% and 16.17% of assets during the COVID-19 pandemic, respectively. Overall, the level of trade credit is similar to loans.

With respect to the control variables, the average firm size is about RMB4.97 billion ($e^{22.3270}$), firm leverage is 41.56%, revenue growth is 17.26%, firm age is 20.05 years ($e^{2.9982}$), the number of employees is 2154.90($e^{2.9982}$), capital intensity is 19.27%, the ratio of the largest shareholder is 32.70%, board size is 8.33, and the ratio of independent directors is 37.89%.

Table 1: Descriptive Statistics

Variable	N	Mean	Std dev	Min	Q1	Med	Q3	Max
A_COVID	24,226	47.3603	10.2289	26.5957	43.5688	48.1417	52.6327	64.5161
Overseas	13,613	9.7505	9.6539	0.0000	0.0000	13.5265	19.3165	23.5673
Profit	24,226	38.5903	108.9407	-86.7496	1.6158	8.1260	29.0044	779.4403
ROA	24,226	0.0311	0.0460	-0.1538	0.0081	0.0244	0.0502	0.1883
ROE	24,226	0.0338	0.0883	-0.4950	0.0081	0.0309	0.0687	0.2565
Loan	24,226	0.1264	0.1208	0.0000	0.0157	0.0970	0.2059	0.4849
Cost	12,643	1.2842	1.1332	0.0000	0.3916	1.0197	1.8228	5.2186
Credit1	24,226	0.1347	0.1009	0.0043	0.0572	0.1092	0.1887	0.4580
Credit2	24,226	0.1617	0.1166	0.0029	0.0690	0.1419	0.2298	0.5347
Size	24,226	22.3270	1.3167	19.8936	21.3742	22.1340	23.0664	26.4326
LEV	24,226	0.4156	0.1997	0.0574	0.2570	0.4080	0.5600	0.8894
Growth	24,226	0.1726	0.6771	-0.8547	-0.1610	0.0655	0.3229	3.9825
Age	24,226	2.9982	0.2834	2.1972	2.8332	3.0445	3.2189	3.5553
Employee	24,226	7.6755	1.2481	4.7362	6.8134	7.5863	8.4557	11.2079
PPE	24,226	0.1927	0.1475	0.0015	0.0773	0.1618	0.2752	0.6554
First	24,226	0.3270	0.1445	0.0849	0.2157	0.3017	0.4208	0.7211
Dual	24,226	0.3154	0.4647	0.0000	0.0000	0.0000	1.0000	1.0000
Board	24,226	8.3372	1.6169	4.0000	7.0000	9.0000	9.0000	17.0000
RID	24,226	0.3789	0.0538	0.3125	0.3333	0.3636	0.4286	0.5714

COVID-19 = coronavirus disease, Q = quarter.

Notes: This table reports the summary statistics of our main variables. The dependent variables are *Overseas*, *Profit*, *ROA*, *ROE*, *Loan*, *Cost*, *Credit1,* and *Credit* 2, which comprehensively reflect firm response. The independent variable is COVID, which captures the influence of the COVID-19 pandemic. All variables are defined in Appendix A.

Sources: Narayan, Iyke, and Sharma (2021); and CSMAR and WIND databases.

4.2. Baseline Results

Table 2 presents the results of the effect of the COVID-19 pandemic on firm performance in terms of profitability, loans, and trade credit, as in Equation (1). As shown in panel A, columns (1) and (2) report the estimates on the relation between the COVID-19 pandemic and overseas revenue without and with control variables, respectively. We note that *A_COVID* is significantly and negatively related to *Overseas* in columns (1) and (2), indicating that the COVID-19 pandemic has a negative effect on overseas revenue. Columns (3)–(8) report the estimates on the relation between the COVID-19 pandemic and firm profits, ROA, and ROE. We find that the coefficients of *A_COVID* are all negative and significant, suggesting that firms suffer a loss of profit and a decrease in profitability during the COVID-19 pandemic. More specifically, the coefficients of *A_COVID* in columns (6) and (8) are -0.0002 and -0.0004, respectively, indicating that a one-standard-deviation increase in the aggregate COVID-19 index is associated with a decrease of 6.58% (=0.0002*10.2289/0.0460) of a standard deviation in ROA and a decrease of 4.63% (=0.0004*10.2289/0.0883) of a standard deviation in ROE. Overall, these findings provide evidence that the COVID-19 outbreak leads to a decrease in profitability.

Panel B in Table 2 presents the results of the effect of the COVID-19 pandemic on access to loans. We note that *A_COVID* is significantly and positively associated with *Loan* in columns (1) and (2), implying that firms experience an increase in loans during the COVID-19 pandemic. We further examine the relation between the COVID-19 pandemic and debt financing cost. As shown in columns (3) and (4), the coefficients of *A_COVID* are negative and significant, suggesting that firms experience a decrease in debt financing cost during the COVID-19 pandemic. More specifically, the coefficients of *A_COVID* in columns (2) and (4) are 0.0002 and -0.0026, respectively, indicating that a one-standard-deviation increase in the aggregate COVID-19 index is associated with an increase of 1.69% (=0.0002*10.2289/0.1208) of a standard deviation in loans and a decrease of 2.34% (=0.0026*10.2289/1.1332) of a standard deviation in debt financing cost. The possible explanation is that government support contributes to improve access to loans during the COVID-19 pandemic. For example, the government requires banks to provide loans and lower the loan interest rate for firms affected

by the COVID-19 outbreak to infuse confidence.

Panel C in Table 2 presents the results of the effect of the COVID-19 pandemic on trade credit. As shown in columns (1) and (2), we find that the coefficients of *COVID* are negative and significant, implying that the COVID-19 pandemic has a negative effect on trade credit reception. As shown in columns (3) and (4), the coefficients of *A_COVID* are negative and significant, implying that the COVID-19 pandemic has a negative effect on trade credit supply. More specifically, the coefficients on *A_COVID* in columns (2) and (4) are -0.0009 and -0.0003, respectively, indicating that a one-standard-deviation increase in the aggregate COVID-19 index is associated with a decrease of 9.12% (=0.0009*10.2289/0.1009) of a standard deviation in trade credit reception and a decrease of 2.63% (=0.0003*10.2289/0.1166) of a standard deviation in trade credit supply. These findings provide evidence that trade credit is an alternative source of financing, given that firms experience an increase in loans and a decrease in trade credit.

Table 2: COVID-19 Pandemic and Firm Response

Panel A: The Effect of COVID-19 on Profitability								
Variable	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**
	Overseas		***Profit***		***ROA***		***ROE***	
A_COVID	-0.0262***	-0.0262***	-0.1303***	-0.2449***	-0.0001***	-0.0002***	-0.0002***	-0.0004***
	(-6.0239)	(-5.8623)	(-2.7581)	(-5.3146)	(-4.3043)	(-6.1844)	(-3.3341)	(-5.3677)
Size		1.7100***		42.2205***		0.0280***		0.0651***
		(3.7883)		(9.6356)		(8.9630)		(8.5431)
LEV		-1.3974		-1.1e+02***		-0.0966***		-0.2196***
		(-1.3101)		(-13.1479)		(-11.2163)		(-10.1976)
Growth		-0.2512***		1.8554***		0.0007		0.0044***
		(-3.4079)		(3.1653)		(1.5222)		(4.6359)
Age		8.1695***		157.3321***		0.0506***		0.0748***
		(4.6720)		(10.5350)		(4.4566)		(2.9007)
Employee		-0.4044		-6.3545*		-0.0206***		-0.0463***
		(-1.2850)		(-1.8337)		(-7.9972)		(-7.3674)
PPE		1.4906		-18.6151		-0.0472***		-0.0893***
		(0.8840)		(-1.2927)		(-4.6260)		(-3.7272)
First		2.3729		71.8371***		0.0255*		0.0523*
		(1.1534)		(3.6013)		(1.8884)		(1.6781)
Dual		-0.0262		-1.9423		-0.0005		-0.0024
		(-0.1086)		(-0.9213)		(-0.2852)		(-0.6087)
Board		0.0845		-1.2160		-0.0011		-0.0014
		(0.6815)		(-0.8750)		(-1.3220)		(-0.7444)
RID		-1.5241		-23.8742		-0.0050		0.0176
		(-0.5555)		(-0.8157)		(-0.3216)		(0.5120)
Quarter FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	13,205	13,205	24,188	24,188	24,188	24,188	24,188	24,188
Adj.R^2	0.7361	0.7380	0.7622	0.7683	0.5209	0.5380	0.4028	0.4262

Panel B: The Effect of COVID-19 on Loans				
Variable	**(1)**	**(2)**	**(3)**	**(4)**
	Loan	***Loan***	***Cost***	***Cost***
A_COVID	0.0001***	0.0002***	-0.0034***	-0.0026***
	(4.5871)	(7.9860)	(-6.1297)	(-4.8009)
Size		-0.0019		-0.0564
		(-0.4724)		(-0.8251)
LEV		0.3192***		0.3474*
		(32.4271)		(1.8326)
Growth		-0.0013***		-0.0544***
		(-3.6543)		(-5.1288)
Age		-0.1532***		-1.1832***
		(-14.8059)		(-5.0768)
Employee		0.0010		0.1478***
		(0.5291)		(2.7003)
PPE		0.0714***		1.7275***
		(5.2348)		(6.8355)
First		0.0020		0.6443**
		(0.1662)		(2.0836)
Dual		-0.0004		-0.0539
		(-0.3256)		(-1.5832)
Board		0.0004		-0.0146
		(0.6620)		(-0.9003)
RID		0.0159		-0.1305
		(1.1705)		(-0.3783)
Quarter FE	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes
Observations	24,188	24,188	12,172	12,172
Adj.R^2	0.9256	0.9414	0.7376	0.7428

Panel C: The Effect of COVID-19 on Credit				
Variable	**(1)**	**(2)**	**(3)**	**(4)**
	Credit1	***Credit1***	***Credit2***	***Credit2***
A_COVID	-0.0009***	-0.0009***	-0.0003***	-0.0003***
	(-27.0560)	(-27.0560)	(-10.5730)	(-10.5730)
Size	-0.0022	-0.0022	-0.0157***	-0.0157***
	(-0.7623)	(-0.7623)	(-4.7795)	(-4.7795)
LEV	0.1522***	0.1522***	0.0665***	0.0665***
	(23.1914)	(23.1914)	(9.0901)	(9.0901)
Growth	0.0052***	0.0052***	0.0040***	0.0040***
	(9.4455)	(9.4455)	(9.3576)	(9.3576)
Age	-0.1429***	-0.1429***	-0.0168	-0.0168
	(-13.6349)	(-13.6349)	(-1.6003)	(-1.6003)
Employee	0.0097***	0.0097***	0.0058**	0.0058**
	(3.9497)	(3.9497)	(2.3160)	(2.3160)
PPE	-0.0113	-0.0113	-0.0169	-0.0169
	(-1.0430)	(-1.0430)	(-1.6114)	(-1.6114)
First	0.0105	0.0105	0.0511***	0.0511***
	(0.8289)	(0.8289)	(3.8117)	(3.8117)
Dual	0.0007	0.0007	-0.0015	-0.0015

Panel C: The Effect of COVID-19 on Credit

Variable	(1)	(2)	(3)	(4)
	Credit1	***Credit1***	***Credit2***	***Credit2***
	(0.4264)	(0.4264)	(-1.0354)	(-1.0354)
Board	-0.0002	-0.0002	0.0004	0.0004
	(-0.2920)	(-0.2920)	(0.7387)	(0.7387)
RID	-0.0031	-0.0031	0.0268**	0.0268**
	(-0.2156)	(-0.2156)	(1.9826)	(1.9826)
Quarter FE	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes
Observations	24,188	24,188	24,188	24,188
Adj.R^2	0.8961	0.8961	0.9300	0.9300

COVID-19 = coronavirus disease.

Notes: This table presents the results of our baseline estimation. Panels A, B, and C report the influence of the COVID-19 pandemic on firm profitability, loans, and trade credit, respectively. The independent variable is *COVID*, which captures the influence of the COVID-19 pandemic. In panel A, the dependent variables are firm overseas revenue (*Overseas*), net profit (*Profit*), ROA (*ROA*), and ROE (*ROE*) separately. In panel B, the dependent variables are loans (*Loan*), and the debt financing cost of firms (*Cost*), separately. In panel C, the dependent variables are credit reception (*Credit1*) and credit supply (*Credit2*), separately. We include a vector of variables reflecting firm characteristics, including *Size*, *LEV*, *Growth*, *Age*, *Employee*, *PPE*, *First*, *Dual*, *Board*, and *RID*. Definitions of all the variables are presented in Appendix A1. Firm fixed effect and quarter fixed effect are included, and the t-statistics reported in parentheses are based on standard errors clustered at the firm level. Statistical significance at the 1%, 5%, and 10% levels is represented by ***, **, and *, respectively.

Sources: Narayan, Iyke, and Sharma (2021); and CSMAR and WIND databases.

4.3. Robustness Checks

4.3.1. Alternative Measures of the COVID-19 Pandemic

In baseline results, we follow Narayan, Iyke, and Sharma (2021) and employ the aggregate COVID-19 index related to the development of travel, vaccines, medical issues, COVID-19, and uncertainty, to capture the COVID-19 pandemic. In robustness checks, we employ the COVID-19 index and uncertainty index developed by Narayan, Iyke, and Sharma (2021) as the proxy for the COVID-19 pandemic. Panel A of Table 3 employs the COVID-19 index related to the COVID-19 pandemic. As shown in columns (1)–(4), we find that the coefficients on *COVID* remain negative and significant, implying that the COVID-19 pandemic has a negative effect on overseas revenue and profitability. We also find that *COVID* is positively associated with *Loan* in column (5), and negatively associated with *Cost*, *Credit1*, and *Credit2* in columns (6)–(8), suggesting that firms experience more loans, a lower debt financing cost, and lower trade credit. These results are in line with baseline results. Panel B employs the uncertainty index related to the COVID-19 pandemic. Similarly, we find that the COVID-19 pandemic leads to a decrease in profitability and trade credit, and an increase in access to loans. These findings confirm the robustness of the baseline results.

Table 3: Robustness Checks with Alternative Measures of the COVID-19 Pandemic

Panel A: Alternative Measures Using COVID Index								
	Profitability				**Loans**		**Credit**	
Variable	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**
	Overseas	***Profit***	***ROA***	***ROE***	***Loan***	***Cost***	***Credit1***	***Credit2***
COVID	-0.0302***	-0.2733***	-0.0002***	-0.0004***	0.0003***	-0.0027***	-0.0010***	-0.0003***
	(-6.0457)	(-5.3169)	(-6.4044)	(-5.4515)	(8.3416)	(-4.4784)	(-26.7974)	(-10.8255)
Size	1.6949***	42.1030***	0.0279***	0.0649***	-0.0018	-0.0571	-0.0026	-0.0159***
	(3.7561)	(9.6042)	(8.9340)	(8.5243)	(-0.4413)	(-0.8351)	(-0.9038)	(-4.8262)
LEV	-1.4005	-1.1e+02***	-0.0967***	-0.2196***	0.3192***	0.3478*	0.1523***	0.0665***
	(-1.3134)	(-13.1454)	(-11.2177)	(-10.1985)	(32.4255)	(1.8348)	(23.1982)	(9.0919)
Growth	-0.2470***	1.8473***	0.0007	0.0044***	-0.0013***	-0.0548***	0.0052***	0.0040***
	(-3.3487)	(3.1552)	(1.5387)	(4.6397)	(-3.6831)	(-5.1656)	(9.3606)	(9.3680)
Age	7.3369***	147.8323***	0.0434***	0.0612**	-0.1449***	-1.2724***	-0.1777***	-0.0285***
	(4.2653)	(9.7467)	(3.6897)	(2.2846)	(-14.2106)	(-5.4418)	(-16.7249)	(-2.7298)
Employee	-0.4022	-6.3271*	-0.0206***	-0.0462***	0.0010	0.1487***	0.0098***	0.0059**
	(-1.2785)	(-1.8259)	(-7.9942)	(-7.3636)	(0.5251)	(2.7162)	(3.9920)	(2.3247)
PPE	1.4998	-18.5777	-0.0471***	-0.0892***	0.0714***	1.7253***	-0.0112	-0.0168
	(0.8896)	(-1.2902)	(-4.6183)	(-3.7228)	(5.2300)	(6.8261)	(-1.0355)	(-1.6036)
First	2.4002	72.0768***	0.0257*	0.0527*	0.0017	0.6445**	0.0114	0.0514***
	(1.1669)	(3.6138)	(1.9054)	(1.6904)	(0.1431)	(2.0853)	(0.8934)	(3.8374)
Dual	-0.0264	-1.9499	-0.0005	-0.0024	-0.0004	-0.0539	0.0007	-0.0015

Panel A: Alternative Measures Using COVID Index

	Profitability				Loans		Credit	
Variable	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**
	Overseas	***Profit***	***ROA***	***ROE***	***Loan***	***Cost***	***Credit1***	***Credit2***
	(-0.1097)	(-0.9247)	(-0.2889)	(-0.6115)	(-0.3202)	(-1.5845)	(0.4096)	(-1.0423)
Board	0.0854	-1.2091	-0.0010	-0.0014	0.0004	-0.0147	-0.0002	0.0004
	(0.6888)	(-0.8700)	(-1.3105)	(-0.7370)	(0.6454)	(-0.9051)	(-0.2595)	(0.7592)
RID	-1.5129	-23.8069	-0.0049	0.0177	0.0158	-0.1305	-0.0029	0.0269**
	(-0.5514)	(-0.8135)	(-0.3160)	(0.5158)	(1.1633)	(-0.3783)	(-0.2010)	(1.9902)
Quarter FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	13,205	24,188	24,188	24,188	24,188	12,172	24,188	24,188
Adj.R^2	0.7381	0.7683	0.5380	0.4263	0.9415	0.7427	0.8959	0.9300

Panel B: Alternative Measures Using Uncertainty Index

	Profitability				Loans		Credit	
Variable	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**
	Overseas	***Profit***	***ROA***	***ROE***	***Loan***	***Cost***	***Credit1***	***Credit2***
Uncertainty	-0.0269***	-0.2545***	-0.0002***	-0.0004***	0.0002***	-0.0026***	-0.0009***	-0.0003***
	(-5.9246)	(-5.3052)	(-6.4901)	(-5.4701)	(8.7163)	(-4.6948)	(-26.6903)	(-11.0486)
Size	1.7050***	42.0649***	0.0278***	0.0648***	-0.0018	-0.0566	-0.0027	-0.0160***
	(3.7777)	(9.5946)	(8.9203)	(8.5145)	(-0.4295)	(-0.8288)	(-0.9504)	(-4.8398)

Panel B: Alternative Measures Using Uncertainty Index

	Profitability				Loans		Credit	
Variable	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**
	Overseas	***Profit***	***ROA***	***ROE***	***Loan***	***Cost***	***Credit1***	***Credit2***
LEV	-1.3985	-1.1e+02***	-0.0966***	-0.2196***	0.3192***	0.3475*	0.1524***	0.0665***
	(-1.3112)	(-13.1388)	(-11.2164)	(-10.1982)	(32.4356)	(1.8333)	(23.2249)	(9.0995)
Growth	-0.2498***	1.8018***	0.0006	0.0043***	-0.0013***	-0.0545***	0.0050***	0.0039***
	(-3.3879)	(3.0909)	(1.4824)	(4.5969)	(-3.5969)	(-5.1405)	(9.1144)	(9.2649)
Age	7.8985***	147.4197***	0.0432***	0.0607**	-0.1446***	-1.2142***	-0.1792***	-0.0290***
	(4.5449)	(9.7016)	(3.6675)	(2.2658)	(-14.1913)	(-5.2078)	(-16.8524)	(-2.7765)
Employee	-0.4037	-6.3611*	-0.0207***	-0.0463***	0.0011	0.1481***	0.0097***	0.0058**
	(-1.2831)	(-1.8345)	(-8.0044)	(-7.3709)	(0.5467)	(2.7057)	(3.9320)	(2.3048)
PPE	1.4938	-18.4149	-0.0469***	-0.0889***	0.0712***	1.7268***	-0.0106	-0.0166
	(0.8859)	(-1.2787)	(-4.5988)	(-3.7081)	(5.2198)	(6.8323)	(-0.9804)	(-1.5820)
First	2.3820	72.1760***	0.0259*	0.0529*	0.0016	0.6444**	0.0117	0.0515***
	(1.1579)	(3.6171)	(1.9137)	(1.6965)	(0.1322)	(2.0843)	(0.9211)	(3.8473)
Dual	-0.0263	-1.9552	-0.0005	-0.0024	-0.0004	-0.0539	0.0006	-0.0016
	(-0.1089)	(-0.9271)	(-0.2917)	(-0.6137)	(-0.3161)	(-1.5837)	(0.3978)	(-1.0470)
Board	0.0848	-1.1989	-0.0010	-0.0014	0.0004	-0.0146	-0.0001	0.0004
	(0.6840)	(-0.8625)	(-1.2954)	(-0.7258)	(0.6260)	(-0.9019)	(-0.2038)	(0.7840)
RID	-1.5203	-23.7164	-0.0048	0.0179	0.0157	-0.1304	-0.0026	0.0270**
	(-0.5542)	(-0.8104)	(-0.3092)	(0.5212)	(1.1555)	(-0.3783)	(-0.1787)	(1.9992)

Panel B: Alternative Measures Using Uncertainty Index

Variable	Profitability				Loans		Credit	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Overseas	***Profit***	***ROA***	***ROE***	***Loan***	***Cost***	***Credit1***	***Credit2***
Quarter FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	13,205	24,188	24,188	24,188	24,188	12,172	24,188	24,188
Adj.R^2	0.7380	0.7683	0.5382	0.4264	0.9415	0.7427	0.8962	0.9301

Notes: This table presents the results of our robustness analyses. Panels A and B show the results when we use the COVID-19 index and uncertainty index as alternative independent variables, separately. Panel C reports the results when we also include industry-quarter fixed effects. The dependent variables are firm overseas revenue (*Overseas*), net profit (*Profit*), ROA (*ROA*), ROE (*ROE*), loans (*Loan*), debt financing cost (*Cost*), credit reception (*Credit1*), and credit supply (*Credit2*), respectively. We include a vector of variables reflecting firm characteristics, including *Size*, *LEV*, *Growth*, *Age*, *Employee*, *PPE*, *First*, *Dual*, *Board*, and *RID*. Definitions of all the variables are presented in Appendix A. Firm fixed effect and quarter fixed effect are included, and the t-statistics reported in parentheses are based on standard errors clustered at the firm level. Statistical significance at the 1%, 5%, and 10% levels are represented by ***, **, and *, respectively.
Sources: Narayan, Iyke, and Sharma (2021); and CSMAR and WIND databases.

4.3.2. Including Industry-Quarter Fixed Effects

In the baseline results, we include firm and quarter fixed effects to capture firm- and time-specific factors as in Equation (1). Given that the type of industry (e.g. industries related to healthcare) might affect the relation between the COVID-19 pandemic and firm response, we further control for industry-quarter fixed effects. Specifically, we use the fixed effect model including quarter, firm, and industry-quarter fixed effects, and pooled OLS method including quarter, industry, and industry-quarter fixed effects in robustness checks. As presented in panels A and B of Table 4, the coefficients of *A_COVID* are all statistically unchanged and consistent with baseline results. Overall, the baseline results are robust and less likely to be driven by industry-specific factors.

Table 4: Robustness Checks, Including Industry-Quarter Fixed Effects

Panel A: Fixed Effect Model, Including Industry-Quarter Fixed Effects								
	Profitability				**Loans**		**Credit**	
Variable	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**
	Overseas	***Profit***	***ROA***	***ROE***	***Loan***	***Cost***	***Credit1***	***Credit2***
A_COVID	-0.0290***	-0.2237***	-0.0002***	-0.0004***	0.0002***	-0.0025***	-0.0009***	-0.0003***
	(-6.5931)	(-4.9375)	(-6.4018)	(-5.4107)	(8.0375)	(-4.5953)	(-27.7030)	(-10.5450)
Size	1.5327***	44.4336***	0.0275***	0.0649***	-0.0019	-0.0387	-0.0011	-0.0157***
	(3.3987)	(10.0776)	(8.8679)	(8.6228)	(-0.4701)	(-0.6031)	(-0.4022)	(-4.8206)
LEV	-2.0568*	-1.1e+02***	-0.0986***	-0.2222***	0.3197***	0.3662*	0.1541***	0.0639***
	(-1.9435)	(-12.8271)	(-11.5734)	(-10.3878)	(32.5822)	(1.9555)	(23.5714)	(8.7689)
Growth	-0.0020	0.6267	0.0014***	0.0052***	-0.0015***	-0.0618***	0.0036***	0.0040***
	(-0.0269)	(1.1441)	(3.1131)	(5.1023)	(-3.8651)	(-5.5979)	(7.0351)	(8.9750)
Age	10.1517***	136.2928***	0.0520***	0.0695***	-0.1542***	-1.3494***	-0.1555***	-0.0137
	(5.8444)	(9.2272)	(4.6118)	(2.7126)	(-14.7235)	(-5.8389)	(-14.7812)	(-1.3033)
Employee	-0.1616	-7.6226**	-0.0197***	-0.0447***	0.0010	0.1418***	0.0089***	0.0061**
	(-0.5343)	(-2.2392)	(-7.7173)	(-7.1297)	(0.5368)	(2.6133)	(3.6674)	(2.4242)
PPE	0.8076	-14.5157	-0.0487***	-0.0907***	0.0705***	1.6478***	-0.0037	-0.0149
	(0.4788)	(-0.9944)	(-4.7775)	(-3.8047)	(5.2660)	(6.5702)	(-0.3417)	(-1.4247)
First	1.7163	69.7093***	0.0269**	0.0530*	0.0029	0.7148**	0.0077	0.0530***
	(0.8307)	(3.4616)	(1.9721)	(1.6891)	(0.2448)	(2.3589)	(0.6173)	(3.9527)
Dual	-0.0085	-1.9454	-0.0004	-0.0023	-0.0006	-0.0469	0.0004	-0.0014

Panel A: Fixed Effect Model, Including Industry-Quarter Fixed Effects

Variable	Profitability				Loans		Credit	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Overseas	***Profit***	***ROA***	***ROE***	***Loan***	***Cost***	***Credit1***	***Credit2***
	(-0.0353)	(-0.9448)	(-0.2434)	(-0.5881)	(-0.4342)	(-1.3795)	(0.2845)	(-0.9568)
Board	0.0763	-1.1726	-0.0011	-0.0014	0.0004	-0.0154	-0.0001	0.0004
	(0.6268)	(-0.8902)	(-1.3684)	(-0.7692)	(0.6126)	(-0.9752)	(-0.1012)	(0.7833)
RID	-1.9834	-20.2387	-0.0075	0.0145	0.0165	-0.1968	-0.0005	0.0255*
	(-0.7297)	(-0.7100)	(-0.4809)	(0.4210)	(1.2244)	(-0.5827)	(-0.0356)	(1.8994)
Quarter FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Ind-quarter FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	13,205	24,186	24,186	24,186	24,186	12,171	24,186	24,186
Adj.R^2	0.7476	0.7777	0.5454	0.4327	0.9415	0.7493	0.9000	0.9305

Panel B: Pooled OLS Model Including Industry-Quarter Fixed Effects

Variable	Profitability				Loans		Credit	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Overseas	***Profit***	***ROA***	***ROE***	***Loan***	***Cost***	***Credit1***	***Credit2***
A_COVID	-0.0176**	-0.1616**	-0.0001***	-0.0002**	0.0002**	-0.0012**	-0.0009***	-0.0003***
	(-2.4219)	(-1.9882)	(-2.6741)	(-2.4481)	(2.4323)	(-2.4406)	(-14.0044)	(-3.9233)
Size	0.6088***	48.9737***	0.0042***	0.0093***	0.0140***	0.1500***	-0.0190***	-0.0304***

Panel B: Pooled OLS Model Including Industry-Quarter Fixed Effects								
	Profitability				**Loans**		**Credit**	
Variable	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**
	Overseas	***Profit***	***ROA***	***ROE***	***Loan***	***Cost***	***Credit1***	***Credit2***
	(5.8894)	(41.7780)	(10.9793)	(10.9774)	(16.9649)	(7.7146)	(-26.3138)	(-33.1773)
LEV	0.9068**	-97.0462***	-0.0662***	-0.1215***	0.4195***	1.9328***	0.2550***	0.1602***
	(2.0785)	(-27.0108)	(-34.3574)	(-22.2131)	(105.4002)	(23.4906)	(72.0049)	(37.5282)
Growth	-1.1216***	2.4070***	0.0005	0.0050***	-0.0066***	-0.1335***	0.0035***	0.0048***
	(-11.2497)	(2.8389)	(0.8233)	(3.9999)	(-6.7432)	(-9.0976)	(3.8956)	(4.1002)
Age	-1.2898***	-17.3429***	-0.0066***	-0.0103***	-0.0070***	0.0495	-0.0062***	-0.0046*
	(-4.8533)	(-7.7459)	(-6.5127)	(-5.3142)	(-3.6305)	(1.0631)	(-3.4003)	(-1.9324)
Employee	1.1502***	7.1131***	0.0041***	0.0097***	-0.0162***	-0.2303***	0.0207***	0.0150***
	(11.4968)	(8.6931)	(11.1655)	(12.1839)	(-20.3216)	(-11.8579)	(29.1412)	(16.1104)
PPE	-0.4572	-15.3604***	-0.0159***	-0.0277***	0.1518***	1.6115***	-0.0990***	-0.2318***
	(-0.7779)	(-3.0460)	(-7.2243)	(-5.9936)	(32.1741)	(15.1892)	(-24.9996)	(-48.1670)
First	-3.1496***	30.6508***	0.0235***	0.0471***	-0.0566***	-1.0052***	0.0506***	-0.0217***
	(-5.9629)	(7.1716)	(12.8041)	(12.6249)	(-14.7156)	(-10.8087)	(13.8034)	(-4.8726)
Dual	0.6058***	8.2473***	0.0016***	0.0020	0.0069***	0.0674**	-0.0083***	-0.0078***
	(3.7633)	(7.0133)	(2.6591)	(1.6437)	(5.9334)	(2.4262)	(-7.6887)	(-5.4376)
Board	-0.1836***	1.9181***	-0.0001	-0.0000	-0.0022***	-0.0207**	-0.0001	-0.0008*
	(-3.1600)	(3.1997)	(-0.5353)	(-0.0920)	(-4.8791)	(-2.0032)	(-0.3291)	(-1.7310)
RID	3.9906**	126.0251***	-0.0032	-0.0081	-0.0678***	-0.2637	-0.0097	-0.0174

Panel B: Pooled OLS Model Including Industry-Quarter Fixed Effects

Variable	Profitability				Loans		Credit	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Overseas	***Profit***	***ROA***	***ROE***	***Loan***	***Cost***	***Credit1***	***Credit2***
	(2.4119)	(8.0057)	(-0.5293)	(-0.6543)	(-5.4446)	(-0.9614)	(-0.8602)	(-1.2287)
Quarter FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Ind-quarter FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	13,613	24,224	24,224	24,224	24,224	12,642	24,224	24,224
Adj.R^2	0.260	0.401	0.221	0.140	0.542	0.367	0.428	0.303

OLS = ordinary least squares.

Notes: This table presents the results of our robustness analyses, including the industry-quarter fixed effect. Panel A reports the results of the fixed effect model including quarter, firm, and industry-quarter fixed effects, whereas panel B shows the results of the pooled OLS method including quarter, industry, and industry-quarter fixed effects. The dependent variables are firm overseas revenue (*Overseas*), net profit (*Profit*), ROA (*ROA*), ROE (*ROE*), loans (*Loan*), debt financing cost (*Cost*), credit reception (*Credit1*), and credit supply (*Credit2*), respectively. We include a vector of variables reflecting firm characteristics, including *Size*, *LEV*, *Growth*, *Age*, *Employee*, *PPE*, *First*, *Dual*, *Board*, and *RID*. Definitions of all the variables are presented in Appendix A. The t-statistics reported in parentheses are based on standard errors clustered at the firm level. Statistical significance at the 1%, 5%, and 10% levels are represented by ***, **, and *, respectively.
Sources: Narayan, Iyke, and Sharma (2021); and CSMAR and WIND databases.

5. Further Tests

In this section, we first examine the underlying mechanisms by which the COVID-19 pandemic affects firm profitability from the perspectives of cash flow, access to loans in terms of government support, and trade credit in terms of substitution financing and default risk. Considering the heterogenous nature of our sample firms, we then perform a series of cross-sectional tests to observe whether the influences of COVID-19 vary for firms of different ownership property (i.e. SOEs and non-SOEs), firms with different domestic value-added content in exports, and firms subject to different levels of financial constraints.

5.1. Underlying Mechanisms

5.1.1. Cash Flow

As the section on hypothesis 1 in Section 2 states, strict containment measures during the pandemic imposed barriers to trade and business in terms of decreased supply capacity (Li and Lin, 2021) and consumption (Kirik and Ulusoy, 2022). He et al. (2022) and Luo (2022) argued that the pandemic directly hit real business activities and strained cash flows in the supply chain, especially for firms with high financial frictions or ex-ante operational risks. We argue that the decreased cash is an underlying channel by which the COVID-19 pandemic reduces overseas revenue, profits, and profitability. That is, we expect the negative effect of the COVID-19 pandemic on profitability to be more pronounced for firms with low cash flows.

We introduce the interaction term of the aggregate COVID-19 index and low cash flows into the model to examine the underlying mechanisms. We define a dummy variable *Low_cashflow* that equals 1 if the firm's cash flows are in the bottom 50% of the industry, and 0 otherwise. As reported in panel A of Table 5, we note that the coefficients on *A_COVID*Low_cashflow* are negative and significant in columns (1)–(4), indicating that firms with low cash flows have lower overseas revenue, profits, ROA, and ROE during the COVID-19 pandemic compared to those with high cash flows. These results are in line with our expectations, providing evidence that the COVID-19 pandemic deteriorates business operations, thereby impairing firm profitability.

Table 5: Mechanism Analyses

Panel A: Potential Mechanism on Profitability

Variable	(1)	(2)	(3)	(4)
	Overseas	***Profit***	***ROA***	***ROE***
*A_COVID*Low_cashflow*	-0.0154**	-0.2671***	-0.0001**	-0.0004***
	(-2.0473)	(-3.7718)	(-2.1067)	(-4.1037)
A_COVID	-0.0185***	-0.1118**	-0.0001***	-0.0001
	(-3.2496)	(-2.1366)	(-4.1834)	(-1.4414)
Low_cashflow	0.6332*	8.4853**	0.0002	0.0175***
	(1.7925)	(2.4052)	(0.1147)	(3.0899)
Size	1.8072***	45.2109***	0.0305***	0.0682***
	(3.9017)	(10.1587)	(15.7175)	(8.9263)
LEV	-1.1539	-1.0e+02***	-0.0902***	-0.2123***
	(-1.0616)	(-12.3282)	(-18.4291)	(-9.7138)
Growth	-0.2480***	2.0142***	0.0008**	0.0045***
	(-3.3638)	(3.4396)	(2.3302)	(4.7954)
Age	8.0528***	152.4295***	0.0467***	0.0695***
	(4.5981)	(10.2257)	(5.1252)	(2.6897)
Employee	-0.4075	-6.5822*	-0.0209***	-0.0464***
	(-1.2980)	(-1.8984)	(-13.7278)	(-7.4305)
PPE	1.4138	-23.2337	-0.0518***	-0.0932***
	(0.8394)	(-1.6166)	(-6.6204)	(-3.8817)
First	2.2780	70.2668***	0.0246**	0.0502
	(1.1091)	(3.5370)	(2.4544)	(1.6102)
Dual	-0.0245	-1.9430	-0.0005	-0.0024
	(-0.1017)	(-0.9248)	(-0.4123)	(-0.5998)
Board	0.0862	-1.2148	-0.0011*	-0.0014
	(0.6947)	(-0.8757)	(-1.8396)	(-0.7385)
RID	-1.4760	-23.8831	-0.0052	0.0178
	(-0.5382)	(-0.8172)	(-0.3960)	(0.5192)
Quarter FE	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes
Observations	13,205	24,188	24,188	24,188
Adj.R^2	0.7381	0.7686	0.5391	0.4271

Panel B: Potential Mechanism on Loans and Credit				
Variable	**(1)**	**(2)**	**(3)**	**(4)**
	Loan	***Cost***	***Credit1***	***Credit2***
*A_COVID*High_subsidies*	0.0001*	-0.0020**		
	(1.7171)	(-2.3939)		
*A_COVID*Low_trust*			-0.0001**	-0.0001***
			(-2.4997)	(-2.5773)
A_COVID	0.0002***	-0.0016**	-0.0008***	-0.0002***
	(5.9116)	(-2.2706)	(-20.6782)	(-6.2479)
High_subsidies	-0.0039**	0.1174***		
	(-2.0457)	(2.7321)		
Low_trust			-0.0121	0.0000
			(-1.5192)	(0.0065)
Size	-0.0017	-0.0513	-0.0021	-0.0157***
	(-0.9115)	(-1.0351)	(-1.0742)	(-8.3119)
LEV	0.3209***	0.3890***	0.1523***	0.0665***
	(68.0577)	(3.1932)	(30.2514)	(13.9248)
Growth	-0.0013***	-0.0576***	0.0052***	0.0040***
	(-3.8280)	(-5.7310)	(14.1488)	(11.4108)
Age	-0.1495***	-1.2995***	-0.1433***	-0.0169*
	(-16.9093)	(-5.8608)	(-15.0773)	(-1.8761)
Employee	0.0019	0.1367***	0.0098***	0.0059***
	(1.2731)	(3.4291)	(6.1599)	(3.8980)
PPE	0.0764***	1.6930***	-0.0110	-0.0167**
	(10.2982)	(8.5211)	(-1.3535)	(-2.1616)
First	0.0040	0.5762**	0.0106	0.0510***
	(0.4112)	(2.3843)	(1.0105)	(5.1424)
Dual	-0.0005	-0.0639**	0.0007	-0.0016
	(-0.3906)	(-2.0843)	(0.4953)	(-1.2305)
Board	0.0004	-0.0142	-0.0002	0.0004
	(0.7846)	(-1.0045)	(-0.3104)	(0.7107)
RID	0.0159	-0.0305	-0.0026	0.0269**
	(1.2756)	(-0.0957)	(-0.1902)	(2.0818)
Quarter FE	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes
Observations	23,449	12,017	24,186	24,186
Adj.R^2	0.9414	0.7472	0.8961	0.9300

Notes: This table presents the results of our mechanism analyses. Panel A reports the results of the mechanism analysis related to firm profitability, whereas panel B shows the results of the mechanism analysis related to firm loans and trade credit. The dependent variables are firm overseas revenue (*Overseas*), net profit (*Profit*), ROA (*ROA*), ROE (*ROE*), loans (*Loan*), debt financing cost (*Cost*), credit reception (*Credit1*), and credit supply (*Credit2*), respectively. We include a vector of variables reflecting firm characteristics, including *Size*, *LEV*, *Growth*, *Age*, *Employee*, *PPE*, *First*, *Dual*, *Board*, and *RID*. Definitions of all the variables are presented in Appendix A. Firm fixed effect and quarter fixed effect are included, and the t-statistics reported in parentheses are based on standard errors clustered at the firm level. Statistical significance at the 1%, 5%, and 10% levels are represented by ***, **, and *, respectively.

Sources: Narayan, Iyke, and Sharma (2021), Falk et al. (2018); and CSMAR and WIND databases.

5.1.2. Government Support

The government employed monetary policy tools (Al-Hadi and Al-Abri, 2022) as well as concessional loan programmes and subsidies (Hoshi, Kawaguchi, and Ueda, 2022) to provide financial support for firms and help them overcome difficulties. We argue that the government support is an underlying channel through which firms experience an increase in access to loans during the COVID-19 pandemic. Therefore, we expect the positive effect of the COVID-19 pandemic on loans to be more pronounced for firms with high government subsidies.

We introduce the interaction term of the aggregate COVID-19 index and high government subsidies into the model to examine the underlying mechanisms. We define a dummy variable *A_COVID*High_subsidies* that equals 1 if the government subsidies obtained by the enterprise are in the top 50% of the industry, and 0 otherwise. As reported in columns (1) and (2) of panel B in Table 5, we observe that *A_COVID*High_subsidies* is positively related to *Loan* and negatively related to *Cost*, suggesting that firms with more government supports have more loans and a lower debt financing cost during the COVID-19 pandemic. These results are in line with our expectations, providing evidence that government support during the COVID-19 pandemic leads to improvement in access to loans.

5.1.3. Substitution Hypothesis and Default Risk Hypothesis

The substitution hypothesis states that trade credit is an important means of external financing (Petersen and Rajan, 1997) and the availability of bank credit is negatively associated with trade credit (Chen, Ma, and Wu, 2019). In the previous section, we found that the COVID-19 pandemic leads to an increase in access to loans and a decrease in trade credit, supporting the substitution hypothesis that more loans are associated with lower trade credit.

Moreover, the default risk hypothesis states that the trade credit of suppliers is exposed to a high credit risk, and firms suffer huge losses if customers default (Cuñat, 2007). We argue that the increased default risk is an underlying channel by which the COVID-19 pandemic reduces trade credit. The existing studies have shown that low social

trust exacerbates adverse selection and moral hazard, which increases credit costs and default risks (Cohen and Dienhart, 2013; Ho et al., 2020). If the default risk hypothesis holds, we expect the negative effect of the COVID-19 pandemic on trade credit to be more pronounced for firms located in regions with low social trust.

We introduce the interaction term of the aggregate COVID-19 index and low social trust into the model to examine the underlying mechanisms. We define a dummy variable *A_COVID*Low_trust* that equals 1 if the firm is located in the province in the bottom 50% of low social trust, and 0 otherwise. As reported in columns (3) and (4) of panel B in Table 5, we find that *A_COVID*Low_trust* is negatively associated with *Credit1* and *Credit2*, suggesting that firms located in regions with low social trust receive and supply a lower trade credit during the COVID-19 pandemic. These results are in line with our expectations, providing evidence that the COVID-19 pandemic increases default risks, thereby reducing trade credit. Overall, the substitution hypothesis and default risk hypothesis hold, through which firms experience a decrease in trade credit during the COVID-19 pandemic.

5.2. Cross-Sectional Analyses

5.2.1. Domestic Value-Added Ratio

In the context of the global value chain, production is completed in a system of value-added sources and destinations, where producers purchase inputs and add value that will be incorporated in the cost of the next stage of production (Koopman, Wang, and Wei, 2014). Indeed, domestic value added in exports can effectively reflect the real gains in production (Johnson and Noguera, 2012). Therefore, firms have endeavoured to increase their DVAR in exports to obtain higher profits. Typically, those with a higher DVAR in exports rely less on imports, and are more competitive in the global market. In this subsection, we thus categorise firms based on the ratio of domestic content in firm exports to evaluate the heterogeneous impacts of the pandemic, where the DVAR is measured following Upward, Wang, and Zheng (2013).

We define a dummy variable *DVAR* that equals 1 if the firm DVAR was below the median level before the COVID-19 pandemic, and 0 otherwise. We then introduce the interaction term of *DVAR* and *A_COVID* into our model, and the results are exhibited in columns (1) and (2) of panel A in Table 6. With all control variables included, this shows

that firms with lower domestic content in exports experience a more significant drop in ROA and ROE, indicating that less productive firms that depend more on imports were more inclined to suffer more from the shock of COVID-19 pandemic.

Table 6: Cross-Sectional Analyses

Panel A: Cross-Sectional Analyses of DVAR and Ownership Property				
Variable	**(1)**	**(2)**	**(3)**	**(4)**
	ROA	***ROE***	***ROA***	***ROE***
*A_COVID*DVAR*	-0.0005***	-0.0010***		
	(-3.8648)	(-3.6100)		
*A_COVID*SOE*			-0.0002***	-0.0004***
			(-3.5547)	(-4.2804)
A_COVID	-0.0001**	-0.0003**	-0.0001***	-0.0002***
	(-2.5607)	(-2.4484)	(-4.5887)	(-2.7401)
Size	0.0322***	0.0834***	0.0291***	0.0677***
	(6.6583)	(6.6864)	(15.0757)	(8.7087)
LEV	-0.1506***	-0.3647***	-0.0965***	-0.2139***
	(-10.0228)	(-9.1351)	(-19.5918)	(-9.6821)
Growth	0.0005	0.0045***	0.0006*	0.0042***
	(0.6005)	(2.6566)	(1.6670)	(4.3688)
Age	0.0611***	0.0932**	0.0427***	0.0586**
	(3.3381)	(2.1497)	(4.6102)	(2.2399)
Employee	-0.0229***	-0.0522***	-0.0202***	-0.0458***
	(-5.7709)	(-5.1484)	(-13.1262)	(-7.2142)
PPE	-0.0640***	-0.1162**	-0.0476***	-0.0897***
	(-3.2964)	(-2.2568)	(-6.0720)	(-3.7025)
First	0.0398**	0.0773*	0.0281***	0.0555*
	(2.0227)	(1.8975)	(2.7595)	(1.7151)
Dual	-0.0024	-0.0035	-0.0001	-0.0019
	(-0.7576)	(-0.4664)	(-0.0822)	(-0.4647)
Board	-0.0007	-0.0014	-0.0010*	-0.0011
	(-0.5682)	(-0.5196)	(-1.7191)	(-0.5910)
RID	0.0009	0.0324	-0.0037	0.0219
	(0.0363)	(0.6237)	(-0.2795)	(0.6197)
Quarter FE	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes
Observations	10,746	10,746	23,479	23,479
Adj.R^2	0.5661	0.4930	0.5434	0.4308

Panel B: Cross-Sectional Analyses of Financial Constraint				
Variable	**(1)**	**(2)**	**(3)**	**(4)**
	Loan	***Cost***	***Credit1***	***Credit2***
*A_COVID*high_KZ*	0.0001**	-0.0115***	-0.0000	-0.0001**
	(1.9933)	(-14.3644)	(-0.0527)	(-2.0548)
A_COVID	0.0002***	0.0036***	-0.0009***	-0.0002***
	(6.2571)	(5.2660)	(-20.6327)	(-7.1744)

Panel B: Cross-Sectional Analyses of Financial Constraint				
Variable	**(1)**	**(2)**	**(3)**	**(4)**
	Loan	***Cost***	***Credit1***	***Credit2***
Size	-0.0019	-0.0207	-0.0014	-0.0148***
	(-0.4563)	(-0.3004)	(-0.4743)	(-7.5713)
LEV	0.3186***	0.2692	0.1502***	0.0656***
	(32.5519)	(1.4085)	(22.2582)	(13.1399)
Growth	-0.0015***	-0.0490***	0.0055***	0.0039***
	(-3.7895)	(-4.5634)	(9.3255)	(10.7028)
Age	-0.1629***	-1.1522***	-0.1515***	-0.0270***
	(-15.1830)	(-4.9500)	(-14.0247)	(-2.8670)
Employee	0.0006	0.1071**	0.0095***	0.0050***
	(0.3264)	(1.9731)	(3.8041)	(3.2630)
PPE	0.0701***	1.7534***	-0.0126	-0.0172**
	(4.8322)	(6.8460)	(-1.1084)	(-2.1278)
First	-0.0008	0.4234	0.0106	0.0499***
	(-0.0633)	(1.4466)	(0.8211)	(4.9264)
Dual	-0.0010	-0.0498	0.0006	-0.0011
	(-0.7283)	(-1.4692)	(0.3627)	(-0.8842)
Board	0.0004	-0.0155	-0.0001	0.0005
	(0.5645)	(-0.9690)	(-0.2082)	(0.8185)
RID	0.0167	-0.1304	-0.0025	0.0304**
	(1.2198)	(-0.3810)	(-0.1692)	(2.3055)
Quarter FE	YES	YES	YES	YES
Firm FE	YES	YES	YES	YES
Observations	22225	11734	22225	22225
Adj.R^2	0.9398	0.7494	0.8924	0.9298

Notes: This table presents the results of our cross-sectional analyses. Panel A reports the results of cross-sectional analysis related to the firm domestic value-added ratio (DVAR) and ownership property, whereas panel B exhibits the results of cross-sectional analysis related to financial constraints. The dependent variables in panel A are ROA (*ROA*) and ROE (*ROE*). The dependent variables in panel B are loans (*Loan*), debt financing cost (*Cost*), credit reception (*Credit1*), and credit supply (*Credit2*), respectively. We include a vector of variables reflecting firm characteristics, including *Size*, *LEV*, *Growth*, *Age*, *Employee*, *PPE*, *First*, *Dual*, *Board*, and *RID*. Definitions of all the variables are presented in Appendix A. Firm fixed effect and quarter fixed effect are included, and the t-statistics reported in parentheses are based on standard errors clustered at the firm level. Statistical significance at the 1%, 5%, and 10% level are represented by ***, **, and *, respectively.

Sources: Narayan, Iyke, and Sharma (2021); Kaplan and Zingales (1997); and BEC, CCTS, CSMAR, and WIND databases.

5.2.2. Ownership Property

In China, SOEs can function as an instrument that enforces government policies. In face of the unanticipated COVID-19 pandemic, it is likely that SOEs shoulder more responsibilities, including stabilising social order and creating employment. If this is the case, we conjecture that SOEs and non-SOES differ in their profitability during the

pandemic. To validate the hypothesis, we define a dummy variable *SOE*, which equals 1 for SOEs, and 0 otherwise.

As presented in columns (3) and (4) of panel A in Table 6, we observe that the negative impacts of the pandemic are more pronounced for SOEs, verifying our hypothesis that SOEs are more inclined to undertake the goals of the government, which caused a more violent decrease in firm profits.

5.2.3. Financial Constraint

The previous section demonstrated that the government improved access to loans (e.g. easing lending requirements and reducing interest rates) and provided financial support for firms during the pandemic (Al-Hadi and Al-Abri, 2022), especially for those dealing with the crisis and some poorly performing firms to prevent the failure of viable firms (Hoshi, Kawaguchi, and Ueda, 2022). We expect the positive effect of the pandemic on access to loans to be more salient for firms with a high level of financial constraints.

We employ the Kaplan–Zingales (KZ) index as the proxy for financial constraints. We define a dummy variable *high_KZ* that equals 1 if the KZ index was above the median level before the COVID-19 pandemic, and 0 otherwise. As reported in columns (1) and (2) of panel B in Table 6, we note that *A_COVID*High_KZ* is positively related to *Loan* and negatively related to *Cost*, indicating that firms with a high level of financial constraints have better access to loans, which is consistent with our expectations.

We further explore the heterogenous effect of financial constraints on the relation between the pandemic and trade credit. We expect the negative effect of the pandemic on trade credit to be more salient for firms with a higher level of financial constraints for the following two reasons. First, the substitution hypothesis states that increases in the availability of bank credit reduce the use of trade credit (Chen, Ma, and Wu, 2019). Therefore, firms with a high level of financial constraints obtain more bank loans and undertake less trade credit. Second, the default risk hypothesis states that firms suffer huge losses if customers default (Cuñat, 2007; Luo, 2022). Due to the limited resources, firms with a high level of financial constraints are associated with a default risk, and would thus receive and supply less trade credit. As reported in columns (3) and (4) of panel B in Table 6, we note that the negative impacts of the pandemic on trade credit are more salient for firms with a high level of financial constraints, which is consistent with our expectations.

6. Conclusion

In this study, we have investigated the effects of the COVID-19 pandemic on firm performance, including overseas revenue, profitability, and external financing. Using the COVID-19 sentiment index as a proxy for the pandemic, we find that firms listed on the Chinese A-share market experienced a dramatic drop in overseas revenue and profits. In terms of external financing, we show that the loans increased in response to the shock, while the debt financing cost and trade credit decreased. We believe that the decrease in firm cash flows, which inhibits firm operations; the government support, which provides firms with more financing channels; and the increase in default risks, which place barriers on trade credit, are the potential mechanisms at work. Further, our cross-sectional analyses show that firms with a lower DVAR in exports and SOEs were more vulnerable in the profit contraction led by the pandemic. Moreover, the impact of the pandemic on external financing is more prominent for firms subject to tighter financial constraints. That is, they experienced better access to loans (the increase in loans and the decrease in debt financing costs) but lower trade credit compared to firms with a lower level of financial constraints during the pandemic.

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Appendix A

Definition of Variables

Variable	Definition	Source
A_COVID	The aggregate COVID-19 index based on 327 keywords relating to multiple aspects of COVID-19 (i.e. travel, vaccine, medical, COVID-19, and uncertainty) reported in mainstream newspapers worldwide	Narayan, Iyke, and Sharma (2021)
COVID	The COVID-19 index	Narayan, Iyke, and Sharma (2021)
Uncertainty	The uncertainty index	Narayan, Iyke, and Sharma (2021)
Overseas	The logarithm of firm overseas revenue plus one	WIND
Profit	Total profits per RMB10 million	CSMAR
ROA	Return on assets equal to net profits divided by total assets	CSMAR
ROE	Return on equity equal to net profits divided by balance of shareholders' equity	CSMAR
Loan	Long-term loan and short-term loan divided by total assets	CSMAR
Cost	Interest expenses divided by liabilities multiplied by 100	CSMAR
Credit1	Accounts payable, notes payable, and items received in advance divided by total assets	CSMAR
Credit2	Accounts receivable, notes receivable, and prepaid accounts divided by total assets	CSMAR
Size	The natural logarithm of total assets	CSMAR
LEV	Total debt divided by total assets	CSMAR
Growth	Revenue growth	CSMAR
Age	The natural logarithm of the number of years since the establishment date	CSMAR
Employee	The natural logarithm of the number of employees	CSMAR
PPE	Net properties, plants, and equipment divided by total assets	CSMAR
First	The shareholding ratio of the largest shareholder	CSMAR
Dual	A dummy variable that equals 1 for firms with CEO duality, and 0 otherwise	CSMAR
Board	The number of members of the board directors	CSMAR

RID	The ratio of the number of independent directors to the number of members of the board directors	CSMAR
Low_cashflow	A dummy variable that equals 1 if the firm's cash flows are in the bottom 50% of the industry, and 0 otherwise	CSMAR
High_subsidies	A dummy variable that equals 1 if the government subsidies obtained by the enterprise are in the top 50% of the industry, and 0 otherwise	WIND
Low_trust	A dummy variable that equals 1 if the firm is located in the province in the bottom 50% of low social trust, and 0 otherwise	Falk et al. (2018)
DVAR	A dummy variable that equals 1 if the firm DVAR was below the median level before the COVID-19 pandemic, and 0 otherwise	CCTS and BEC
SOE	A dummy variable that equals 1 for SOEs, and 0 otherwise	CSMAR
high_KZ	A dummy variable that equals 1 if the KZ index was above the median level before the COVID-19 pandemic, and 0 otherwise	CSMAR; Kaplan and Zingales (1997)

BEC = Broad Economic Categories, CCTS = Chinese Customs Trade Statistics, CEO = chief executive officer, COVID-19 = coronavirus disease, CSMAR = China Stock Market and Accounting Research, DVAR = domestic value-added ratio, KZ = Kaplan–Zingales, SOE = state-owned enterprise, WIND = Wind Information Co. Ltd.

Sources: Narayan, Iyke, and Sharma (2021); Falk et al. (2018); Kaplan and Zingales (1997); and BEC, CCTS, CSMAR, and WIND databases.

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