

Corporate resistance to pandemic: Evidence from China

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Abstract: Based on the quarterly data of A-share listed firms between 2019 and 2020, we find that firms with lower leverage and higher cash holdings before perform better under the COVID-19 pandemic, suggesting that strong liquidity helps firms resist risks. In particular, cash holding affects firm performance through the channel of production. Secondly, we calculate firms' position in the global value chain based on a world input-output table and find that downstream firms perform better under the pandemic. Thirdly, to cope with future uncertainty, cash-holding willingness of firms increases significantly after the pandemic. All findings imply that firms need to improve their financial health to be more resilient toward negative shocks and policy makers need to improve the financial environment to satisfy firms' external financing need.

Keywords: COVID-19; cash holding; global value chain

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1 Introduction

At the beginning of 2020, the sudden spreading of COVID-19 was so rapid that China's economy had to brake suddenly, causing serious impacts and huge losses. As is shown in Figure 1, China's GDP fell by 6.8% in the first quarter of 2020. GDP growth bounced in the second quarter of 2020, but remained negative.

The pandemic has caused a comprehensive collapse of firms' operating revenues and net profits, but its mechanism and magnitude are different from financial crises in previous literature. Zhu et al^[1] conducted two questionnaires on the impact of COVID-19 on small and medium enterprises and found that more than half of the

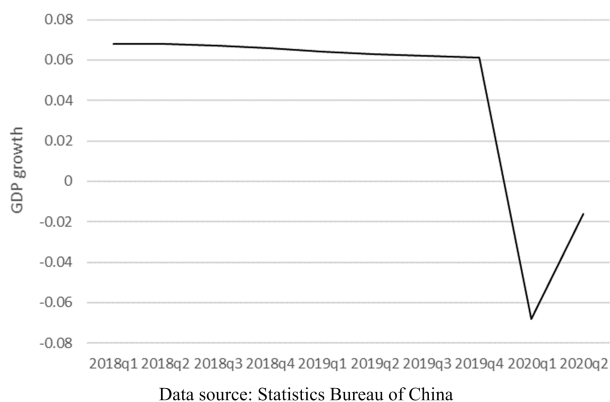


Figure 1. China's GDP quarterly growth from 2018 to 2020.

surveyed firms estimated that their annual operating revenues would drop by more than 20% in 2020. Figure 2 shows that the average revenue of A-share listed firms in China decreased by 15.12% and their net profits decreased by 25.65% in the first quarter of 2020.

This paper aims to explore the characteristics of firms that help them to resist the unprecedented negative shock. Firstly, we focus on the financial situation of firms, as financial health affects firms' performance and growth to a large degree. Do firms with better financial positions behave more resilient toward the pandemic? Does the pandemic stimulate firms' willingness to hold cashes?

With the rapid spread of the pandemic in the world, global economy was affected deeply. Gita Gopinath, the chief economist of the International Monetary Fund, said that the shock to the global economy caused the worst recession since the Great Depression. As China connects with other countries along the global value chain, there has been a secondary shock to China's economy from the rest of world, besides the direct pandemic shock. The global trade dropped sharply, and the global value chain suffered a major setback during the 2008 global financial crisis^[2]. The COVID-19 pandemic with both demand shocks and supply shocks made the trade collapse in 2020 more serious than in 2008. Demand and supply sides were both impacted, and so were the import and export

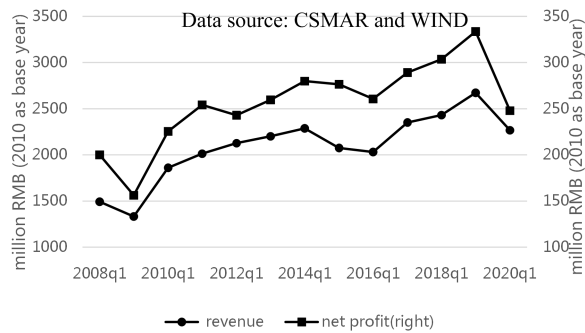


Figure 2. Average revenues and net profits of A-share listed companies from 2008 to 2020.

industry chains. In this circumstance, how do positions of firms in the global value chain affect their performance under the impact of the pandemic? Would the upstream firms or downstream firms perform better?

To answer these questions, we employ the data set of A-share listed companies in China and studies what financial characteristics of firms make them more resilient to the pandemic shock. Moreover, based on the latest world input-output table, we study the impact of firm's position in the global value chain on firm performance during the pandemic. The main findings of this paper are as follows. Firstly, firms with lower leverages and higher cash holdings before the pandemic would perform better under the pandemic, indicating that strong liquidity helps firms resist risks. Secondly, when demand and supply were both impacted, and the import and export industry chains were also affected, the downstream firms would perform better. Thirdly, after the pandemic, the willingness of firms to hold cash increases significantly to cope with the uncertainty in the future. And firms with smaller scales, lower leverage ratios, and lower cash holdings before the pandemic had stronger willingness to hold cashes.

The contributions of this paper are as follows. Firstly, we provide supporting evidence in the sample of A-share listed firms that liquidity helps firms resist the unprecedented pandemic shock, adding to the literature on the role of cash holding and firms' strategy toward crises. Secondly, using the latest world input-output data and the measure of upstream degree and downstream degree, we examine the relationship between firms' position in the global value chain under the pandemic, complementing the fast-growing literature on firms' globalization.

The structure of this paper is as follows: Section 2 reviews the literature related to this study and introduces hypotheses. Section 3 displays empirical designs. Section 4 describes the empirical results and robustness tests, and Section 5 draws conclusions.

2 Theory and empirical hypotheses

Cash holding is one of the key indicators of firms' financial health, as it can maintain enough liquidity for firms to invest with future growth opportunities or deal with negative shocks. Bates et al.^[3] find that greater R&D intensity requires firms to hold a greater amount of cash buffer against future shocks. Opler et al.^[4] unveil that firms with strong growth opportunities hold more cashes than other firms. Moreover, firms with more cash holding can provide a cushion against operational volatilities and reduce the likelihood of the financial distress. Ferreira et al.^[5] find that when there is a recession, firms with strong financing constraints are more likely to hold more cash to cope with future uncertainty. Zhu and Lu^[6] suggest that corporate cash holdings are related to monetary policy operations. Under the expanding monetary policy, firms' external financing constraints are reduced, and firms lower their cash holding levels. In contrast, when monetary policy is tight, firms will increase the level of cash holdings. Wan and Rao^[7] study the effect of uncertainty factors on the cash holdings of firms and find that the higher the degree of macro, industry and individual uncertainty firms face, the higher the level of cash holdings will be.

Regarding the resilience of the firm to the pandemic, Ding et al.^[8] examined the relationship between firm characteristics and stock prices, and found that the stock prices of firms with more cashes, lower leverages, and greater profits before 2020 fell less under the impact of the pandemic. Ceng et al.^[9] find that if firms reserve the financial flexibility in advance, their investment expenditure in the early stage of the crisis can be guaranteed, and the new investment can significantly improve the performance of firms after the crisis. Therefore, the financial flexibility before the crisis can effectively enhance their ability to withstand adverse shocks. Holding cashes and retaining the ability to raise debts are two main channels through which firms can maintain financial flexibilities.

Based on the above analysis, we propose the following research hypotheses:

Hypothesis 2.1 Firms with higher cashes and cash equivalent holding ratios and lower leverage ratios have better performance during the pandemic.

Hypothesis 2.2 After the pandemic, firms would be willing to hold more cashes.

After China's accession to WTO in 2001, more Chinese firms start to export or import and participate in the global value chain. Regarding the research on the position of firms in global value chains, Antras et al.^[10] construct indicators of production chain length, upstream degree, and downstream degree to measure the position of a country as a whole and this country's

industries in the global value chain. Wang and Zheng^[11] study the impact of the pandemic on different manufacturing industries in China based on a global perspective and find that low-tech industries with higher export shares, lower inventories, and higher labor intensity would be hit harder, while high-tech industries with higher R&D and innovation capabilities have stronger “pandemic resistance” under the pandemic. These high-tech firms are often in the downstream of the value chain. Based on the above analysis, we propose the following research hypothesis:

Hypothesis 2.3 Firms located in the downstream of the global supply chain perform better.

3 Data and empirical strategy

3.1 Data

We construct the sample from all listed companies on the Shanghai Stock Exchange and Shenzhen Stock Exchange. The financial and operational data of A-share listed companies in the first and second quarters of 2019 and 2020 are obtained from the CSMAR database and WIND database. The screening principles of this paper are as follows: ① we incorporate all companies belonging to manufacturing and service industries according to the 2017 National Economic Classification released by the National Bureau of Statistics. In the finance service industry, we exclude financial companies with international practice to avoid other international shock transmission channels such as the global leverage. ② We exclude companies in *ST and ST status. ③ We exclude companies listed after 2019, namely the new entrants. ④ We exclude companies with missing information of control variables defined in this section. We end up with 2648 companies in the sample. In addition, we obtain the 2014 world input-output tables from the WIOD database. To control the influence of extreme values on the regression results, we censor the sample below 1% and above 99% percentile.

3.2 Regression models

To test the first hypothesis that firms with a higher cash holding ratio and lower leverage ratio have better performances during the pandemic, we employ the regression model (1) to evaluate how firms' characteristics affected their performance in response to the COVID-19 pandemic. We use the revenue growth rate to represent the performance. The regression model (1) is as follows:

$$\begin{aligned} \text{rev_growth}_{i,t} = & \alpha_0 + \beta_1 * \text{firm size}_{i,t-4} + \\ & \beta_2 * \text{leverage}_{i,t-4} + \beta_3 * \text{cce_ta}_{i,t-4} + \\ & \beta_4 * \text{rev_ta}_{i,t-4} + \delta_{j,t} + \varepsilon_{i,t} \end{aligned} \quad (1)$$

where i , j , t and $t-4$ index firm, industry, the first

(second) quarter of 2020 and first (second) quarter of 2019 respectively. The dependent variable, $\text{rev_ratio}_{i,t}$, is the revenue growth rate of the firm i from $t-4$ to t . $\text{firm size}_{i,t-4}$ is the log of total assets, $\text{leverage}_{i,t-4}$ is the ratio of total liabilities over total assets, $\text{cce_ta}_{i,t-4}$ is the ratio of cash and cash equivalent over total assets, and $\text{rev_ta}_{i,t-4}$ is the ratio of revenue over total assets in the first quarter of 2019. The industry-time fixed effects ($\delta_{j,t}$) absorb all time-varying unobserved heterogeneity across industries.

In addition, to test Hypothesis 2.2 that firms would be willing to hold more cash after the pandemic, we employ the following regression model:

$$\begin{aligned} \text{cce_growth}_{i,t} = & \alpha_0 + \varphi_1 * \text{firm size}_{i,t-4} + \\ & \varphi_2 * \text{leverage}_{i,t-4} + \varphi_3 * \text{cce_ta}_{i,t-4} + \\ & \varphi_4 * \text{rev_ta}_{i,t-4} + \varphi_5 * \text{wc_ta}_{i,t-4} + \delta_{j,t} + \varepsilon_{i,t} \end{aligned} \quad (2)$$

where $\text{cce_growth}_{i,t}$ is the growth rate of cash and cash equivalents, $\text{wc_ta}_{i,t-4}$ is the ratio of working capital, namely the difference of current assets and current liabilities over current assets.

To test Hypothesis 2.3 that firms located in the downstream of the global supply chain perform better, we introduce upstream degree U , which represents the step distance between the production and the final demand for an industry and measures the extent to which the goods produced in China are directly sold to final consumers. The larger the upstream degree, the more upstream the industry is in the global value chain.

We calculate the position of China's industries in the global value chain, using the method proposed by Antras and Chor^[12] and data from the world input-output tables for 2014 (the latest available).

$$\begin{aligned} U_p^r = & 1 * \frac{F_p^r}{Y_p^r} + 2 * \frac{\sum_{s=1}^S \sum_{q=1}^Q a_{pq}^{rs} F_q^s}{Y_p^r} + \\ & 3 * \frac{\sum_{s=1}^S \sum_{q=1}^Q \sum_{t=1}^S \sum_{k=1}^Q a_{pq}^{rs} a_{qk}^{st} F_k^t}{Y_p^r} + \dots \end{aligned} \quad (3)$$

where the superscript r is the source country and s is the destination country. The subscript p is the source sector of the product and q is the sector in which the product is used. F_p^r is the value of final output p from the source country r . Y_p^r represents the total output of sector p from country r . a_{ij}^{rs} represents the value of intermediate input required to use country r 's product p to produce one unit product q in country s . The constants 1, 2, 3 represent the numbers of steps in the global value chain. Overall, the upstream degree measures the ratio of direct contribution toward final good in the first term, the contribution toward sector s in country q in the second

term, and so on.

We then use the following regression model to test the Hypothesis 2.3, gauging the effect of the upstream degree on the firm performance under the pandemic shock.

$$\begin{aligned} \text{rev_growth}_{i,t} = & \alpha_0 + \gamma_1 * \text{firm size}_{i,t-4} + \\ & \gamma_2 * \text{leverage}_{i,t-4} + \gamma_3 * \text{cce_ta}_{i,t-4} + \gamma_4 * \text{rev_ta}_{i,t-4} + \\ & \gamma_5 * U_j^c + \gamma_6 * U_j^c * \text{firm size}_{i,t-4} + \\ & \gamma_7 * U_j^c * \text{rev_ta}_{i,t-4} + \delta_{j,t} + \varepsilon_{i,t} \end{aligned} \quad (4)$$

where U_j^c denotes the upstream degree of industry j in China. For convenience, all variable definitions are summarized in Table 1.

Table 1. Definitions of main variables.

	Name	Meaning
Dependent variables	rev_growth	The year-on-year growth rate of revenue
	cce_growth	The year-on-year growth rate of cash and cash equivalents
Independent variables	firm size	Logarithm of total assets (Unit: million RMB)
	leverage	Total liabilities / total assets
	cce_ta	Cash and cash equivalents / total assets
	rev_ta	Revenue / total assets
	nprofit_ta	Net profit / total assets
	wc_ca	(Current assets-current liabilities)/ current assets
	U	Calculation based on the world input-output tables

[Note] This table shows the names and definitions of main variables.

Table 2. Summary statistics.

Variables	N	Mean	Median	Std. Dev.	Min	Max
firm size	10592	8.506	8.352	1.316	5.348	13.320
leverage	10592	0.410	0.403	0.195	0.045	0.998
cce_ta	10592	0.132	0.105	0.103	0.006	0.700
wc_ca	10592	0.360	0.412	0.396	-1.989	0.951
rev_ta	10590	0.141	0.118	0.107	0.004	0.676
nprofit_ta	10592	0.001	0.008	0.016	-0.087	0.073
rev_growth	5295	-0.049	-0.101	0.458	-0.814	2.593
cce_growth	5296	0.329	0.095	0.999	-0.829	6.096
U	10540	2.839	2.838	0.829	1.000	4.432

[Note] This table presents the summary statistics of the key variables used in our analyses.

3.3 Summary statistics

Table 2 provides summary statistics for main variables. The mean and median of rev_growth are negative, and cce_growth are consistently positive.

Preliminarily, it indicates that the overall income was hit hard by the COVID-19 pandemic and the willingness of enterprises to hold cashes was enhanced. The large dispersion of revenues and the cash growth rate indicates that the impact of the pandemic shock on firms is heterogeneous. Besides variables used in regressions, we also report the summary statistics of the profit ratio (the ratio of net profit over total assets) that is used as a performance indicator.

4 Empirical results

4.1 Preliminary analysis

COVID-19 pandemic brought a huge blow to real economy. Table 3 shows that in the first two quarters of 2020, and the average operating revenue decreased by 12% and the net profit decreased by 22%, in comparison with the first two quarters of 2019. At the same time, the average holding ratio of cash and cash equivalents increased by 2% over the same period of last year. The median values of rev_ta, nprofit_ta and cce_ta have similar trends.

We further find that the decline of the firm performance in the first half of 2020 was mainly due to the unprecedented shock in the first quarter. Since the outbreak of the COVID-19 pandemic, the Chinese government has proposed a series of effective policies to prevent the spread of the epidemic as well as to stabilize economy. As a result, in the second quarter of 2020, firms in various industries steadily advanced the resumption of production with the policy support of the government. Overall, China's economy was recovering, and the financial performance of firms in the second quarter was significantly better than that of the first quarter. As shown in Table 4 and Table 5, both revenues and net profits collapsed in the first quarter of 2020, but there were no statistically significant differences in revenue and profit growth between the second quarter of 2020 and that of 2019. On the contrary, there were no significant differences in holding ratios of cashes and cash equivalents between the first quarter of 2020 and that of 2019, but the differences are statistically significant between the second quarter of 2020 and that of 2019. The results validate Hypothesis 2.2.

Table 3. Comparison for the first two quarters of 2019 and 2020.

Variables	2019H1			2020H1			Mean-diff	<i>t</i> statistic	Median-diff	<i>P</i> value
	<i>N</i>	Mean	Median	<i>N</i>	Mean	Median				
rev_ta	2648	0.303	0.249	2648	0.268	0.225	-0.035***	5.340	-0.024***	0.000
nprofit_ta	2648	0.023	0.019	2648	0.018	0.014	-0.005***	6.146	-0.005***	0.000
cce_ta	2648	0.130	0.103	2648	0.133	0.107	0.003	-1.314	0.004*	0.054

[Note] This table shows the differences and *t*-statistics for the mean values and the differences and *p* value for the median values of key financial indicators for the first two quarters of 2019 and 2020. ***, **, * denote significance levels at 1%, 5% and 10% respectively.

Table 4. Comparison for the first quarter of 2019 and 2020.

Variables	2019Q1			2020Q1			Mean-diff	<i>t</i> statistic	Median-diff	<i>P</i> value
	<i>N</i>	Mean	Median	<i>N</i>	Mean	Median				
rev_ta	2648	0.142	0.118	2647	0.113	0.093	-0.029***	10.665	0.025***	0.000
nprofit_ta	2648	0.010	0.008	2648	0.004	0.003	-0.006*	14.824	-0.005***	0.000
cce_ta	2647	0.132	0.105	2647	0.132	0.107	0.000	-0.079	0.002	0.527

[Note] This table shows the differences and *t*-statistics for the mean values and the differences and *p* value for the median values of key financial indicators for the first quarter of 2019 and 2020. ***, **, * denote significance levels at 1%, 5% and 10% respectively.

Table 5. Comparison for the second quarter of 2019 and 2020.

Variables	2019Q2			2020Q2			Mean-diff	<i>t</i> statistic	Median-diff	<i>p</i> value
	<i>N</i>	Mean	Median	<i>N</i>	Mean	Median				
rev_ta	2648	0.157	0.132	2647	0.153	0.132	-0.004	1.215	0.000	0.815
nprofit_ta	2648	0.013	0.011	2648	0.013	0.011	0.000	0.615	0.000	0.510
cce_ta	2648	0.129	0.101	2648	0.134	0.107	0.005*	-1.775	0.002**	0.028

[Note] This table shows the differences and *t*-statistics for the mean values and the differences and *p* value for the median values of key financial indicators for the second quarter of 2019 and 2020. ***, **, * denote significance levels at 1%, 5% and 10% respectively.

4.2 The impact of firm characteristics on firm performance

4.2.1 Benchmark results

After the preliminary analysis, we formally test three hypotheses. The regression results for equation (1) are presented in Table 6. The coefficients of firm size in column (I), leverage in column (II), and rev_ta in column (IV) are significantly negative, and the coefficient of cce_ta in column (III) is significantly positive, indicating that the pre-epidemic firm size, leverage, and operating revenue are negatively related to the growth rate of operating revenue after the pandemic shock, and the pre-epidemic cash and cash equivalent holdings are positively related to the revenue growth after the pandemic shock. In other words, the smaller the firm's scale before the pandemic, the lower the percentage of operating revenues, the lower the leverage ratio, and the higher the cash and cash equivalents holding ratios, the better the firm performs. The possible reasons are as follows. Firstly, the COVID-19 pandemic delivered a heavy blow to both supply and

demand sides, and small firms were affected to a limited extent because of their limited businesses. Secondly, firms with low leverages, less debt pressure and less interest expenses are more financially healthy and thus able to maintain stable performance during the pandemic. Meanwhile, firms with higher holding ratio of cash and cash equivalent have higher financial flexibility to withstand shocks, which is consistent with the findings of Ceng et al^[13]. The above results validate Hypothesis 2.1.

4.2.2 The channel through which cash holding affects firm performance

We have confirmed that cash holding has a positive effect on the firm's resistance to the COVID-19 pandemic. Then we explore through which channel cash affects the firm's revenue growth rate. We postulate that cash holding affects firms' investment and production, which in turn affects revenue. To test this channel, we construct two indicators, invest_ta and prod_ta, to measure the level of investment and production respectively. invest_ta is calculated as the

ratio of investment over total assets, where the investment is the sum of debt investments, long-term equity investments, investments in other equity instruments, investment properties, fixed assets, and construction in progress. And *prod_ta* is calculated as the sum of inventory and operating income divided by total assets.

We first divide our sample of companies equally into two groups according to the median cash holding (*cce_ta*) in the first two quarters of 2019, and test whether there is a significant difference between firms with high cash holdings and those with low cash holdings in production and investment in the first two quarters of 2020. As is shown in Table 7, the firms with higher cash holdings have higher production and higher investment levels in 2020.

To further investigate the effect of cash holdings on the level of investment and production, we construct two indicators, *invest_growth* and *prod_growth*, to represent the year-on-year growth rate of investment and

production. Then we examine whether firms with high cash holdings in 2019 will have higher investment or production growth. We replace *rev_growth* in equation (1) with *invest_growth*, and the regression results are not significant. It indicates that the level of cash holdings has little effect on the growth rate of investment. A possible explanation is that the essential strategy for companies is to survive the COVID-19 pandemic, not to invest for future.

Then we replace *rev_growth* in equation (I) with *prod_growth*, and the regression results are shown in Table 8. The coefficients of *cce_ta* in column (III) and column (V) are positive. It suggests that high cash holdings have a positive effect on the growth rate of production. Therefore, we can conclude that cash affects revenue mainly by influencing the production of the firm. This means that firms with high cash holdings can afford to buy raw materials to secure production and increase revenues.

Table 6. The impact of firm characteristics on revenue growth rate.

Variables	rev_growth				
	(I)	(II)	(III)	(IV)	(V)
firm size	-0.022*** (-4.14)				-0.022*** (-3.76)
leverage		-0.064* (-1.88)			0.063 (1.54)
cce_ta			0.241*** (3.94)		0.252*** (3.93)
rev_ta				-0.195*** (-2.95)	-0.210*** (-3.13)
Fixed effects	Yes	Yes	Yes	Yes	Yes
No. of Ob.	5,295	5,295	5,294	5,295	5,294
R ²	0.086	0.084	0.086	0.085	0.090

[Note] This table shows how pre-epidemic characteristics shape revenue growth rate in response to the COVID-19 pandemic during the first quarter of 2020. *t*-statistics are reported in parentheses. ***, **, * denote significance levels at 1%, 5% and 10% respectively.

Table 7. Comparison for the high and low cash holdings firms.

Variables	<i>N</i> (Low <i>cce_ta</i>)	Mean (Low <i>cce_ta</i>)	<i>N</i> (High <i>cce_ta</i>)	Mean (High <i>cce_ta</i>)	Mean-diff	<i>t</i> -statistic
invest_ta	2752	0.045	2752	0.060	0.015*	-1.676
prod_ta	2752	1.230	2752	1.680	0.449***	-3.525

[Note] This table shows the difference of production levels and investment levels between companies with high cash holdings and low cash holdings. ***, **, * denote significance levels at 1%, 5% and 10% respectively.

Table 8. The impact of firm characteristics on production growth rate.

Variables	prod_growth				
	(I)	(II)	(III)	(IV)	(V)
firm size	-0.001 (-0.21)				-0.005 (-0.87)
leverage		0.037 (1.17)			0.069* (1.85)
cce_ta			0.106* (1.88)		0.132** (2.23)
rev_ta				0.071 (1.17)	0.048 (0.77)
Fixed effects	Yes	Yes	Yes	Yes	Yes
No. of Ob.	5,357	5,357	5,356	5,357	5,356
R^2	0.032	0.032	0.033	0.032	0.034

[Note] This table shows how pre-epidemic characteristics shape product on growth rate in response to the COVID-19 pandemic during the first quarter of 2020. t -statistics are reported in parentheses. ***, **, * denote significance levels at 1%, 5% and 10% respectively.

4.3 The relationship between pre-epidemic firm characteristics and cash holdings in 2020

The results in Tables 3, 4, and 5 support Hypothesis 2.2 that firms tend to hold more cashes after the pandemic. This section further studies the relationship between pre-epidemic firm characteristics and cash holdings in 2020.

Under the COVID-19 pandemic, the central bank has implemented an accommodative monetary policy to help reduce financing costs, through lowering interest rate on the open market as well as refinancing and rediscounting. It provided moderate liquidity for firms and reduced the financing constraints brought by the COVID-19 pandemic. According to the data released by the People's Bank of China^①, at the end of January, the central bank arranged 300 billion yuan of special refinancing. In February and April, it increased 500 billion yuan and 1 trillion yuan of refinancing and rediscounting respectively. In January, the full-scale 0.5 percentage point reduction in reserve requirement ratios (RRR) released 800 billion yuan. And in March, the central bank implemented a targeted reduction in RRR for financial inclusion, releasing 550 billion yuan of long-term funds.

According to Zhu and Lu^[6], when the monetary policy tends to be loose and the external financing constraints are reduced, firms will reduce their cash holdings. But why do the average cash holdings of sample firms increase in the first half of 2020 under the expanding monetary policy? One of the possible reasons is that the expanding monetary policy makes it easier for firms to raise funds and they have plenty of cashes on hand. Another possible reason is that due to the impact of the COVID-19 pandemic, demand has been greatly

frustrated and has not fully recovered in the first half of 2020. Therefore, firms lack good investment opportunities and had to keep high liquidity. At the same time, to cope with future uncertainty, firms are more willing to hold more cashes for a rainy day.

To further verify what pre-epidemic characteristics of firms make them more willing to hold cashes, we make a regression according to equation (2), and the regression results are shown in Table 9. In column (VI), the coefficients of the firm size, leverage, cce_ta are significantly negative at the level of 1%, while wc_ca is negative at the level of 10%, and rev_ta is significantly positive at the level of 1%. These indicate that firms with small scales, low leverages, low proportion of cash and cash equivalents, high operating incomes and low working capital before the pandemic have a higher growth rate of cashes and cash equivalents.

4.4 The impact of upstream degree on firm performance

To study the impact of the upstream degree of the industry in the global value chain on the performance of firms under the epidemic situation, we introduce 2 interchange items, $U \times \text{firm size}$ and $U \times \text{rev_ta}$. Because the upstream degree value of all firms in an industry are identical, we control the fixed effect of time but not industry. The regression results are shown in Table 10. The coefficient of $U \times \text{firm size}$ in column (II) is -0.012, statistically significant at the 5% level, and the coefficient of $U \times \text{leverage}$ in column (III) is -0.146, statistically significant at 1% level.

① Access address: <http://www.pbc.gov.cn/goutongjiaoliu/113456/113469/4021012/index.html>

Table 9. The impact of financial indicators on the growth rate of cash and cash equivalents.

Variables	cce_growth					
	(I)	(II)	(III)	(IV)	(V)	(VI)
firm size	-0.049*** (-4.23)					-0.058*** (-4.49)
leverage		-0.017 (-0.23)				-0.411*** (-3.66)
cce_ta			-2.295*** (-17.15)			-2.499*** (-17.53)
rev_ta				0.193 (1.29)		0.521*** (3.53)
wc_ca					-0.121*** (-3.59)	-0.088* (-1.91)
Fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
No. of Ob.	5,296	5,296	5,295	5,296	5,296	5,295
R ²	0.028	0.024	0.076	0.025	0.027	0.087

[Note] This table shows how pre-epidemic characteristics of firms shape their growth rate of cash and cash equivalents in response to the COVID-19 pandemic during the first quarter of 2020. *t*-statistics are reported in parentheses. ***, **, * denote significance levels at 1%, 5% and 10% respectively.

Table 10. The impact of upstream degree on revenue growth rate.

Variables	rev_growth		
	(I)	(II)	(III)
firm size	-0.022*** (-3.88)	0.012 (0.70)	-0.021*** (-3.72)
leverage	0.118*** (2.96)	0.117*** (2.95)	0.520*** (4.50)
cce_ta	0.220*** (3.41)	0.219*** (3.40)	0.221*** (3.42)
rev_ta	-0.225*** (-3.75)	-0.215*** (-3.56)	-0.209*** (-3.47)
<i>U</i>	0.020*** (2.60)	0.123** (2.44)	0.077*** (4.48)
<i>U</i> ×firm size		-0.012** (-2.06)	
<i>U</i> ×leverage			-0.146*** (-3.70)
Fixed effects	Yes	Yes	Yes
No. of Ob.	5,268	5,268	5,268
R ²	0.022	0.023	0.024

[Note] This table shows how the upstream degree of the industry in the global value chain shape revenue growth rate in response to the COVID-19 pandemic during the first quarter of 2020. *t*-statistics are reported in parentheses. ***, **, * denote significance levels at 1%, 5% and 10% respectively.

Table 11. The impact of downstream degree on revenue growth rate.

Variables	rev_growth		
	(I)	(II)	(III)
firm size	-0.021*** (-3.70)	-0.034*** (-4.06)	-0.022*** (-3.83)
leverage	0.095** (2.38)	0.090** (2.24)	-0.051 (-0.86)
cce_ta	0.175*** (2.73)	0.174*** (2.71)	0.169*** (2.63)
rev_ta	-0.148** (-2.46)	-0.135** (-2.25)	-0.129** (-2.15)
<i>F/GO</i>	0.080*** (2.85)	-0.281 (-1.63)	-0.103* (-1.70)
<i>F/GO</i> ×firm size		0.043** (2.12)	
<i>F/GO</i> ×leverage			0.451*** (3.38)
Fixed effects	Yes	Yes	Yes
No. of Ob.	5,268	5,268	5,268
R ²	0.022	0.023	0.024

[Note] This table shows how the downstream degree of the industry in the global value chain shape revenue growth rate in response to the COVID-19 pandemic during the first quarter of 2020. *t*-statistics are reported in parentheses. ***, **, * denote significance levels at 1%, 5% and 10% respectively.

It shows that the higher the upstream degree of a firm, the greater the negative impact on the revenue growth rate from the firm's large scales and high leverages. That is to say, upstream firms were hit harder by the pandemic, and the downstream firms performed better. The possible reason is that the reduction of downstream orders will also be further transmitted to the upstream through the global value chain, making the upstream enterprises bear a double blow. Another possible reason is that the downstream firms have more bargaining power through their direct market access to consumers and thus making their upstream suppliers endure more shocks. The above results validate Hypothesis 2.3.

4.5 Robustness check

In addition, there is a simpler way put forward by Antras et al.^[10] to measure GVC positioning: the share of a country-industry's output that is sold directly to final consumers, and this measure was denoted by F/GO , which is a measure of the downstream degree. Note that a higher value of this ratio, the more downstream the industry is in the global value chain.

The formula is as follows:

$$F/GO_p^r = \frac{F_p^r}{Y_p^r} \quad (5)$$

where Y_p^r represents the total use of output of industry r

from country p , and F_p^r represents the total final use of the output originating from industry r in country p . We replace U in equation (4) with F/GO , and the regression results are shown in Table 11. The result is consistent with the benchmark that firms in downstream industries are more resilient to the pandemic shock.

One may have the concern that large firms play an important role in results at the mean level in Table 9. In order to test the robustness of the results in Table 9, we added the quantile regression results. As is shown in Table 12, firms with lower leverage ratios and lower cash growth before the pandemic tend to hold more cash across all quantiles.

Furthermore, to check whether the results in Table 9 are robust with different values of firm characteristics such as the firm size, leverage, cash holding, revenue, and working capital, we divide the sample into two subsamples based on the median of the firm size and run the regression within each subsample according to equation (2) separately. For leverage, cce_ta , rev_ta and wc_ca , we repeat the above steps. The regression results are displayed in Table 13. All results show that firms with smaller scales, lower leverage ratios and lower cash holdings before the pandemic have stronger willingness to hold cashes.

Table 12. Quantile regression results of the growth rate of cash.

Variables	cce_growth				
	(I) Q. 05	(II) Q. 25	(III) Q. 50	(IV) Q. 75	(V) Q. 90
firm size	0.022 *	0.034 ***	0.015 **	-0.038 ***	-0.133 ***
	(1.96)	(4.20)	(2.45)	(-3.25)	(-5.03)
leverage	-0.207 ***	-0.249 ***	-0.303 ***	-0.464 ***	-0.948 ***
	(-2.84)	(-3.50)	(-4.94)	(-4.50)	(-3.10)
cce_ta	-0.521 ***	-0.716 ***	-1.203 ***	-1.993 ***	-3.265 ***
	(-4.95)	(-7.50)	(-16.50)	(-18.75)	(-20.41)
rev_ta	0.869 ***	0.747 ***	0.685 ***	0.652 ***	0.363
	(9.44)	(10.33)	(9.72)	(4.58)	(1.57)
wc_ca	0.056 *	0.072 ***	0.076 ***	-0.033	-0.559 **
	(1.73)	(3.39)	(2.84)	(-0.59)	(-2.24)
No. of Ob.	5,295	5,295	5,295	5,295	5,295
R^2	0.0324	0.0236	0.0270	0.0502	0.0780

[Note] This table shows quantile regression results on how pre-epidemic firm characteristics affect the growth rate of cash during the first quarter of 2020. t -statistics are reported in parentheses. ***, **, * denote significance levels at 1%, 5% and 10% respectively.

Table 13. Robustness check of the impact of financial indicators on the growth rate of cash and cash equivalents.

Variables	cce_growth									
	Low wc_ca	High firm size	Low firm size	High leverage	Low leverage	High cce_ta	Low cce_ta	High rev_ta	Low rev_ta	High wc_ca
firm size			-1.743*** (-5.77)	-2.089*** (-5.07)	-1.647*** (-7.96)	-1.645*** (-3.53)	-0.033** (-2.01)	-0.084*** (-4.17)	-0.067*** (-3.50)	-0.051*** (-2.82)
leverage	-2.966*** (-3.82)	-4.622*** (-5.53)			-0.056 (-0.11)	-5.548*** (-4.43)	-0.257* (-1.70)	-0.452*** (-2.71)	-0.507*** (-3.08)	-0.046 (-0.29)
cce_ta	-8.145*** (-13.83)	-7.590*** (-15.07)	-9.320*** (-12.80)	-6.863*** (-15.60)			-2.629*** (-13.83)	-2.436*** (-11.41)	-2.239*** (-14.48)	-3.860*** (-12.60)
rev_ta	0.235 (0.46)	0.596 (0.98)	0.094 (0.17)	0.864 (1.46)	0.952*** (3.35)	2.017** (2.31)			0.526** (2.36)	0.586*** (2.85)
wc_ca	-0.522** (-2.16)	-1.498*** (-4.27)	-0.371 (-1.50)	-1.106*** (-3.67)	-0.936*** (-4.20)	-1.446*** (-4.43)	0.071 (1.12)	-0.178*** (-2.64)		
Fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
No. of Ob.	2,604	2,606	2,518	2,520	2,252	2,250	2,646	2,644	2,648	2,647
R ²	0.814	0.764	0.795	0.773	0.848	0.759	0.102	0.102	0.105	0.101

[Note] This table shows robustness check results of the impact of financial indicators on the growth rate of cash and cash equivalents with the firm character changing, such as the firm size, leverage level, cash holding level, revenue and working capital value. *t*-statistics are reported in parentheses. ***, **, * denote significance levels at 1%, 5% and 10% respectively.

5 Conclusions

What characteristics of firms can help them perform better under the COVID-19 shock? How do positions of firms in the global value chain affect their performance under the impact of the pandemic? What happens to corporate cash holdings after the COVID-19 shock? To answer the above questions, we construct a sample of A-share listed companies and employ the latest world input-output data and find that: ① The firms which were lower in leverage and higher in cash holdings before the pandemic would perform better under the pandemic, namely, strong liquidity before the COVID-19 pandemic help firms resist risks. In particular, cash holding affects firm performance through production. ② When demand and supply were both impacted, and the import and export industry chains were also affected, the shrinking demand in the downstream market will further increase the business risk of upstream firms through the multiplier effect, and the downstream firms would perform better. ③ After the pandemic, the willingness of firms to hold cash increases significantly to cope with the uncertainty in the future. Cash and cash equivalents holdings increased by 2% in the first half of 2020 compared to the same period last year. And the firms with smaller scales, lower leverage ratios and lower cash holdings before the pandemic had stronger

willingness to hold cashes.

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Conflict of interest

The authors declare no conflict of interest.

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企业的“抗疫”能力:来自中国的证据

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摘要: 基于 2019 和 2020 年 A 股上市公司数据,我们发现之前杠杆率较低、现金持有量较高的企业在新冠疫情下会有较好的表现,这表明流动性有助于企业抵御风险,并验证了现金持有量这一渠道通过影响生产进而影响企业表现。其次,我们根据世界投入产出表计算企业在全产业链的位置,并发现下游企业在新冠疫情下表现更好。第三,我们发现为了应对未来的不确定性,新冠疫情下企业的现金持有意愿明显增强。研究结果表明,企业需要改善财务健康状况以提高对负面冲击的抵御能力,而政策制定者需要改善金融环境以满足企业的外部资金需求。

关键词: COVID-19; 现金持有; 全球价值链