

Information Asymmetry and Firm-level Cash Holdings During COVID-19 Pandemic Period

—An Analysis Based on Chinese Listed Companies

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Abstract: Since the COVID-19 occurs from 2020, global economy has a tremendous shrinking in amount and sphere, which brings business objects uncertain financial turbulence. Hence, corporate cash holdings are a concern by managers and investors as it represents the survival ability of companies. This study investigates information asymmetry and corporate cash holdings during COVID-19 pandemic period. After analyzing on large Chinese listed companies sample, we test two opposing hypotheses. According to free cash flow theory, cash flow declines further as the level of information asymmetry rises. However, considering profound event, companies may increase cash holdings for precautionary motive during a long time. As a result, using the difference-in-difference method, this paper finds a positive relationship between information asymmetry and cash holdings, while COVID-19 hurts cash holdings for Chinese listed companies. The robustness test also gains similar results. Overall, the results may support the agency theory and precautionary motives for holding cash.

Keywords: Cash holdings, information asymmetry, COVID-19

1. Introduction

The COVID-19 pandemic outbreak seriously affected the economy and brought severe challenges to companies and individuals. Maliszewska et al. [1] stated that the pandemic dampens the economy through decreased transactions, tourism, and other services. Bartik et al. [2] find that up to 60% of small and medium-sized enterprises are in danger of running out of cash reserves. From the company operating perspective, the demand sharply decreases in service, social contact, and population mobility, leading to a decline in business transactions. It is negative for corporate cash inflow. Meanwhile, the necessary fixed charge (i.e., rent cost, labor expense) leads companies cash out. Hence, cash holdings have had a significant hit during pandemic. From a corporate financing perspective, companies may face hindrances when financing from banks or other institutions. Brown and Rocha [3] find a sharp and dramatic decline in the total amount of equity investment. The investigation shows a 60% annual decline in equity investment in the first quarters of 2019 and 2020. However, information asymmetry works as another key factor impacting firm performance as well, which can be presented by cash holdings.

Information asymmetry is important since it may cause two negative phenomena: adverse selection and moral hazard. Firstly, adverse selection emerges when some parties have more information about firms than outside investors, they may exploit information advantage at the expense of outsiders. Therefore, the function of capital markets may be disturbed. Secondly, the separation of control and ownership may create a moral hazard as it is impossible for shareholders and investors to observe the extent and quality of the top managers' efforts on their behalf [4].

Recently, there have been some works of literature on cash holdings. For example, some literature studies the relationship of determinants on cash holdings. Song and Lee [5] find that precautionary motivation may positively impact on cash holdings after an economic crisis. In addition, Qin et al. [6] find that in the beginning of the pandemic, COVID-19 positively impacts cash holding, while goodwill and goodwill impairment may impair this influence. However, the literature on information asymmetry and cash holdings applied to US data [7], the case of China may be different since the features of Chinese markets. For example, there are more restrictions on dealing and short sales because the regulation of buy and sell cannot happen within one day. In addition, compared with the US market, small investors in the Chinese market are accounted for a larger proportion. Moreover, China serves as this empirical research context since it was the first country to experience a significant COVID-19 epidemic. It may provide important empirical insights into how it impacted other similar nations. As a result, this paper will focus on the relationship between information asymmetry and cash holdings during COVID-19 pandemic period.

In this paper, the research object is the firm-level cash holdings of listed Chinese companies during 2014-2022 from the Chinese stock market and account research (CSMAR). The measurement standard is the impact extent of COVID in industries. By using the Difference-in-Difference (DID) model, total data is separated into four groups:

- High-affected industries companies before COVID-19
- High-affected industries companies during COVID-19
- Low-affected industries companies before COVID-19
- Low-affected industries during COVID-19

This paper finds that COVID-19 has a negative relationship with cash holdings since the precautionary motives on holding cash and cash cycle uncertainty in quarantine policy. Then information asymmetry may positively affect cash holding, which may because of agents' actions on their behalf.

The remainder of this paper is structured as followed. Section 2 introduces main theories, illustrates related literature, and raises hypotheses. Section 3 describes data and explain methodology. Section 4 presents the empirical result and discussion. Finally, section 5 summarizes this study and provides the limitation and further suggestion for future research.

2. Literature Review and Hypotheses

2.1. Related literature

2.1.1. COVID-19 and cash holdings

This section reviews research findings that are related to our hypotheses. One strand of the literature provides evidence on the COVID-19 and cash holdings.

From the macro perspective, research focuses on the stock price in the capital market. Gao and Ren [8] compared the US and China stock markets. They found that COVID-19 imposed a stronger impact on the American stock market in the early stage of the outbreak. Meanwhile, both markets showed a significant leverage effect on the stock price. At the same time, when US stock became

insensitive to the cases dramatically increased, China remained highly sensitive to small cases increase without causing excessive abnormal volatility on the stock market. Shen et al. [9] empirically researched the pandemic's impact on different sections of China. They found that the pandemic hit the high-tech industries, affecting heavily transportation, mining, electric, heating, and environmental industries. However, the manufacturing, information technology, education, and health industries responded positively to the pandemic, boosting stock market confidence.

From the micro perspective, research is dedicated to the reaction of COVID-19 to Chinese companies. Xiong et al. [10] find that firms in vulnerable industries to COVID-19 have a significantly lower cumulative abnormal return, meaning they are more intense to the pandemic. In addition, firms with a stable situation, such as larger scale, better profitability and growth opportunities, higher combined leverage, and fewer fixed assets, are less affected by the pandemic. As for the cash level within the impact of COVID-19, few papers are talking about it. A relevant paper on corporate immunity to the COVID-19 pandemic found that firms with more cash, more unused lines of credit, less debt, and less short-term debt may perform better in COVID-19 [11]. According to their findings, the COVID-19 pandemic significantly positively affects cash holdings, indicating that more businesses are increasing cash holdings to avoid systemic risks.

2.1.2. Information asymmetry and cash holdings

Another strand of the literature focuses on information asymmetry and cash holdings. The market microstructure has extensively analyzed the measurement of information asymmetry about a firm's value, as well as the payoffs of its securities.

In market microstructure, investors are viewed as being informed and uninformed. Since informed investors learn more information on the firm's value, they may gain more unfair profit by sacrificing the profit of uninformed investors.

Easley and O'Hara [12] study the information and the cost of capital, which empirically prove that investors demand a higher return for compensation when stocks have greater private information. Then, by empirical properties of PIN, Easley, Hvidkjaer, and O'Hara [13] provide empirical support for the role of information-based trading in affecting asset returns. They suggest that private information influences price evolution and then affects the risk of asset holding. After that, Agarwal and O'Hara [14] empirically suggest that information risks play an important role in the determination of the capital structure of the firm. In particular, firms with higher extrinsic information risk, measured by PIN, may lead firms to have more debt in the capital structure after intrinsic information asymmetry and other factors known to affect capital structure. The information asymmetry literature always comes from corporate governance and corporate finance. Naqvi et al. [15] suggested that firms engaged in corporate social responsibility with lower information asymmetry. Meanwhile, the findings also suggest that analyst coverage modifies the relationship between corporate social responsibility performance and information asymmetry, which is critical in reducing the firm's level of information asymmetry.

2.2. Hypotheses

Hypothesis 1a: COVID-19 may have a positive effect on cash holding, and information asymmetry may have a negative relationship with cash holdings.

Firstly, according to the study by Huang et al. that a firm with a higher level of information asymmetry has a lower cash holdings value [16]. In other words, cash value declines further as the level of information asymmetry rises. As a result, this empirical evidence supports Jensen's free cash flow hypothesis. As the COVID-19 has less impact on companies with more cash, it may be the catalyst for the relationship between information asymmetry and cash holdings [17].

Hypothesis 1b: COVID-19 may negatively impact on cash holdings, and information asymmetry may have a positive relationship with cash holding.

Since the firms' sensitivity to cash flow risk may increase, especially after an unexpected, profound event (i.e., a financial crisis), the precautionary motive for firms to hold more cash may increase for a long period [5]. Hence, the change in the firm's demand function for cash and sensitivity may also affect COVID-19. As a result, information asymmetry may have a positive relationship with cash holdings.

3. Data and empirical methodology

3.1. The sample

This paper sample includes all available listed Chinese companies on the Shanghai and Shenzhen stock exchanges from 2014 to 2022. All data are from the China Stock Market & Accounting Research (CSMAR) database. The following selection principles make data more comparable: (1) delete the companies that have undergone special treatment ST (a special treatment represents a warning for the risk of delisting after a consisting loss in three years) and financially distressed companies; (2) the financial and insurance industry companies are eliminated; (3) companies with data missing and abnormal changes are dismissed. In order to ensure the reliability of the result, total variables winsorize the extreme values data at the 2.5% and 97.5% level since the control variable leverage ratio and R&D ratio has an excessive highly standard deviation.

3.2. Measures of information asymmetry

Since market microstructure attempts to widely estimate the extent of information asymmetry by market liquidity (the liquidity ratio, the illiquidity ratio) and the reversal coefficient, independent variable can be a composite index[18] [19].

$$LR_{it} = \frac{1}{D_{it}} \sum_{k=1}^{D_{it}} \sqrt{\frac{V_{it}(k)}{|r_{it}(k)|}} \quad (1)$$

$$ILL_{it} = \frac{1}{D_{it}} \sum_{k=1}^{D_{it}} \sqrt{\frac{|r_{it}(k)|}{V_{it}(k)}} \quad (2)$$

r_{it} is the return on stock I on day t, $V_{it}(k)$ represents daily turnover, D_{it} represents days for trade.

$$GAM_{it} = |\gamma_{it}| \quad (3)$$

$$r_{it}(k) = r''_{it}(k) + r_{mt}(k) \quad (4)$$

$$r''_{it} = \theta_{it} + \varphi_{it}\gamma_{it}(k-1) + \gamma_{it}V_{it}(k-1)\text{sign}[\gamma''_{it}(k-1)] + \varepsilon_{it}(k) \quad (5)$$

In the formula, $r_{it}(k)$ represents the earning for stock i in k day. Then by principal components analysis, the ASY represents a compound variables of information asymmetry.

Since Easley et al. [13] and Easley & O'Hara [12] point that the probability of informed trading (PIN) is one of the another measurements on information asymmetry, the probability of informed trading (PIN) will work as an alternative variable for robust regression.

The PIN model is developed by Easley, Kiefer, and O'Hara [20]. The likelihood function of the simple model on trade process for a single trading day formula is

$$L(\theta/B, S) = (1 - \alpha)e^{-\epsilon_b \frac{\epsilon_b^B}{B!}} e^{-\epsilon_s \frac{\epsilon_s^S}{S!}} + \alpha\delta e^{-\epsilon_b \frac{\epsilon_b^B}{B!}} e^{-(\mu+\epsilon_s) \frac{(\mu+\epsilon_s)^S}{S!}} + \alpha(1 - \delta)e^{-(\mu+\epsilon_b) \frac{(\mu+\epsilon_b)^B}{B!}} e^{-\epsilon_s \frac{\epsilon_s^S}{S!}} \quad (6)$$

In this model, B represents total buy trades for the day, S represents total sell trades for the day. The information risk is captured by α , and the information events more frequent the number greater. The number of informed traders is captured by μ . The mitigated by the willingness of other traders to hold the stock is captured by ϵ_s . The parameter vector is captured by $\theta = (\alpha, \mu, \epsilon_b, \epsilon_s, \gamma)$. As the likelihood is a mixture of distributions, the trade outcomes are weighted by the probability of ‘good news day’ $\alpha(1 - \delta)$ and ‘bad news day’ ($\alpha\delta$), and a ‘no-news day’ $(1 - \alpha)$.

The likelihood function across I days are given by imposing sufficient independence conditions across trading days.

$$V = L(\theta/M) = \prod_{i=1}^I L(\theta / B_i, S_i) \quad (7)$$

In the function (B_i, S_i) is trade date for day $i=1, 2, \dots, I$ and $M=(B_1, S_1), \dots (B_i, S_i)$
 The formula for the value of probability of informed trading (PIN) is the following:

$$PIN = \frac{\alpha\mu}{\alpha\mu + \epsilon_s + \epsilon_b} \quad (8)$$

3.3. Empirical methodology

As the logic of DID is best explained within two groups and two periods, this research divides Chinese listed companies into two groups by the high or low effect on industry when the pandemic happened. Thus, there are four groups: high-effect industry before COVID, high-effect industry after COVID, low-effect industry after COVID, and low-effect industry after COVID. The divide in the industry is followed by Fu and Shen [21], which record tourism, film and TV entertainment, catering retail, and transportation as the most affected industries in China. Since the COVID-19 breakout in 2020, the catering industry suffered an 80% drop in revenue in the first quarter. In addition, Maliszewska et al. [1] asserted that the pandemic impacts the economy in several ways. Firstly. It impacts the increase in transaction costs. Secondly, it sharply decreases in the travel industry, which represents tourism. Thirdly, it declines the demand for services as the requirements of social distance. Hence, this research defines entertainment, catering retail, tourism, and transportation as high-effect industries. The least industries are reviewed as the low-effect industry.

In mathematical perspective, the difference-in-difference is

$$(Treated_{post} - Treated_{pre}) - (Control_{post} - Control_{pre}) = Diff - in - Diff \text{ estimate} \quad (9)$$

Hence, the formula for difference-in-differenced model is

$$Y = \beta_0 + \beta_1 * Treated + \beta_2 * Period + \beta_3 * Treated * Period \quad (10)$$

Treated is a dummy variable, the treated group (high-effect industry) is 1 and the control group (low-effect industry) is 0. Meanwhile, period is a dummy variable; before pandemic it is 0 and post pandemic it is 1. Treated*period is a dummy variable indicating the observed in the treatment group and intervention.

Therefore, to examine the relationship between the level of cash holdings and information asymmetry, this study estimates the following regression model

$$Cashholding_{it} = \beta_0 + \beta_1 ASY_{it} * Treated_{it} * Period_{it} + \beta_2 Treated_{it} + \beta_3 Period_{it} + \beta_4 Treated_{it} * Period_{it} + \beta_5 ASY_{it} + \beta_6 SIZE + \beta_7 FCF_{it} + \beta_8 WC_{it} + \beta_9 LEV_{it} + \beta_{10} BETA_{it} + \beta_{11} BI_{it} + \beta_{12} NROA_{it} + \beta_{13} R\&D_{it} + \epsilon_{it} \quad (11)$$

Prior study indicates that characteristics of firms may affect the level of cash holding. As a result, this study set the following variables to reduce interference. Those are: SIZE is enterprise-scale, measured by the natural logarithm of total assets. WC is the net working capital ratio to net assets. LEV is firm leverage ratio. BETA is the systematic risk of the market model. BI is the ratio of independent directors on the board to total directors. NROA is the total assets net profit margin. R&D is the ratio of research and development to sales. In addition, this study control industry and annual-fixed effects.

4. Empirical Results

4.1. Descriptive Statistics

Table 1 provides descriptive statistics for the sample, which based on the financial data from 2014-2022. The dependent variable, cash holdings, has a mean of 42.9% and a median of 32.8%, which indicates the average cash holding level is low. In addition, the cash holdings level of enterprises is considerably different as the maximum value is 145.5% and the minimum value is 4.1%. It has already taken the logarithm to reduce the skewness of cash holdings. The dependent variable's mean for the information asymmetry variable is -11.90%, and the median is 0.2%. The standard deviation (0.492) shows a huge difference among different companies. The mean and medium of firm size (the logarithm of total assets) are 9.678 and 9.59, respectively, and the standard deviation is 0.564, indicating most companies are large. In terms of financial ratio, the free cash flow to total asset ratio is low for most companies as the 75th percent is 4.8%, and the average is -0.7%. The leverage ratio is reasonable for 1.284 on average and 1.066 on medium. The mean for working capital to asset is 0.261; the net profit margin of total assets is 0.058, and R&D to sales is 4.495. Concerning the non-financial variables, the ratio of independent to total directors on the board is about 0.387, and the average systematic risk for the sample is 1.118.

Table 1: Descriptive Statistics.

	N	Mean	Median	SD	Min	P25	P75	Max
Cash holdings	20372	0.429	0.328	0.336	0.041	0.182	0.577	1.455
ASY	20372	-0.119	0.002	0.492	-1.595	-0.333	0.228	0.536
SIZE	20372	9.678	9.590	0.564	7.712	9.278	9.982	12.437
FCF	20372	-0.007	0.010	0.300	-16.700	-0.029	0.048	14.100
WC	20372	0.261	0.260	0.230	-0.739	0.102	0.420	0.960
LEV	20372	1.284	1.066	0.640	0.737	0.987	1.280	4.152
BETA	20372	1.118	1.127	0.351	-0.078	0.903	1.323	2.889
BI	20372	0.387	0.375	0.076	0.188	0.332	0.429	0.800
NROA	20372	0.058	0.047	0.051	-0.019	0.023	0.079	0.969
R&D	20372	4.495	3.680	3.814	0.110	1.745	5.740	15.020

The correlation matrix of variables in table five indicates a very weak positive correlation between cash holdings and information asymmetry, as the coefficient of 0.013 is statistically significant at a significant level of 10%. However, it does not mean these two variables have a cause-and-effect relationship. In addition, firm size, free cash flow, and leverage ratio have a weak negative correlation

between cash holdings as the coefficient are -0.017, -0.026, and -0.26. They are significant with a p-value of less than 1%. Although the working capital ratio, independent board ratio, net profit margin of total assets, and R&D ratio are positive and significantly correlated with cash holdings, the relationship for the latter three is very weak. Finally, as all coefficient in the correlation matrix is less than 0.7, there is no multicollinearity among any variables.

Table 2: Pairwise Correlations.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
(1)Cash holdings	1.000									
(2)ASY	0.013*	1.000								
(3)SIZE	-0.017***	-0.550***	1.000							
(4)FCF	-0.026***	-0.019***	0.049***	1.000						
(5)WC	0.647***	0.118***	-0.446**	-0.038***	1.000					
(6)LEV	-0.260***	0.029***	0.183***	0.005	-0.432***	1.000				
(7)BETA	0.050***	-0.146***	-0.161***	-0.019***	0.083***	-0.015**	1.000			
(8)BI	0.017**	-0.001	0.076***	-0.006	0.071***	0.031***	0.011*	1.000		
(9)NROA	0.206***	-0.206***	0.086***	0.026***	0.312***	-0.375***	-0.006	0.046***	1.000	
(10)R&D	0.224***	-0.033***	-0.313***	-0.044***	0.360***	-0.170***	0.186***	0.068***	0.128*	1.000

*** p<0.01, ** p<0.05, * p<0.1

Table 3: Variance Inflation Factors of Variables.

Variable	VIF	1/VIF
ASY	1.83	0.547065
SIZE	2.14	0.466513
WC	1.62	0.617155
LEV	1.34	0.748507
NROA	1.31	0.766273
R&D	1.26	0.790744
BETA	1.14	0.875395
BI	1.01	0.994941
FCF	1.01	0.994941
Mean VIF	1.41	

In order to accurately examine if the variables have a multicollinearity issue, variance inflation factors (VIF) are used as explanatory variables. The VIF suggests the strength of the linear relationship between the variables. A general rule is that if VIF is smaller than 10, multicollinearity is less likely [22]. Table 3 presents the VIF of independent variables and control variables. The maximum VIF is 2.14, and the minimum is 1.01. Therefore, in this model, there is no multicollinearity problem.

Table 4 is a two-sample t-test, which presents the difference in mean before COVID-19 (period=0) and during COVID-19 (period=1). The separation of period comes from the outbreak of covid. 2014 to 2019 represents before covid, and 2020 to 2021 represents during covid. The difference of mean in cash holding is -0.073 at a significant level of 1%, representing companies adding cash holding

during the covid period. At the same time, in post COVID-19 period the information asymmetry also became more severe since the absolute value increased from 0.105 to 0.147 at a 1% significance level. In addition, the symmetric risk of the market has a most obvious decrease from 1.204 to 0.952 during covid-19, indicating the total market return falls. Apart from the free cash flow ratio, leverage ratio, beta risk, and the mean of other control variables increased during the pandemic.

Table 4: T-test for All Variables Before COVID-19 and During COVID-19

	Whole mean	Period=0 mean	Period=1 mean	Difference In mean	P-value
Cashholdings	0.429	0.404	0.477	-0.073	0.000***
ASY	-0.119	-0.105	-0.147	0.042	0.000***
SIZE	9.678	9.669	9.697	-0.028	0.001***
FCF	-0.007	-0.005	-0.011	0.006	0.188
WC	0.261	0.244	0.293	-0.048	0.000***
LEV	1.284	1.316	1.221	0.095	0.000***
BETA	1.118	1.204	0.952	0.252	0.000***
BI	0.387	0.385	0.389	-0.004	0.000***
NROA	0.058	0.055	0.064	-0.010	0.000***
R&D	4.495	4.258	4.954	-0.695	0.000***
N	20372	13435	6937		

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

4.2. Regression Result

Table 5 presents the results of reduced valuation regression in Eq.(11), which is split to difference in mean before COVID-19 (period=0) and during COVID-19 (period=1). The separation of period comes from the outbreak of the pandemic.

Taking moderating effect, control variables, and industry fixed effect into consideration, the coefficient of information asymmetry is 0.011 at a 5% significance level, t value is 2.366. These figures indicate a positive relationship between information asymmetry and cash holdings. As this research applies DID in regression, treated*period represents the impact of COVID-19. In the fifth column, the coefficient of treated*period is -0.064 at a 1% significant level. From economy perspective, it means when every unit on the impact of COVID-19 increases, cash holdings will decrease by 0.064 units. These figures indicate that COVID-19 harms companies' cash holdings. Furthermore, the R-squared is 0.475. The result supports hypothesis 1b.

Due to tight financial markets during the financial crisis, external financing becomes too expensive and difficult to obtain. Therefore, driven by precautionary motives, firms tend to increase cash holdings to avoid raising external capital such as bank loans, bond offerings, and equity offerings. Song and Lee's finding also proves that a big event, such as a financial crisis, can permanently shift the demand function of cash to empirical research on the East Asian market [5]. It may also explain why cash holdings have a negative relationship with covid-19. Firms may reserve cash to hedge for the uncertainty risk in future cash shortfalls since there is no certain prediction on when the covid-19 disappear. However, although firms attempt to hold the cash from precautionary motives, cash holdings still decrease with little inflow and fix a huge amount of outflow in the cash conversion cycle. This finding was also proved by Fu and Shen [21], which suggests that covid-19 significantly negatively impacts the performance of listed Chinese companies by decreasing investment scales and reducing the total revenue. The limitation of production and consumption may affect the Chinese market.

Table 5: The Empirical Result for Information Asymmetry and Cash Holdings During COVID-19 Pandemic.

	(1)	(2)	(3)	(4)	(5)
	Cash	Cash	Cash	Cash	Cash
	holdings	holdings	holdings	holdings	holdings
ASY	0.009*		0.012**	0.018***	0.011**
	(1.786)		(2.538)	(3.626)	(2.366)
Treated		0.049***	0.050***	0.057***	0.017
		(3.783)	(3.849)	(5.711)	(1.083)
Period		0.079***	0.080***	0.032***	0.034***
		(15.734)	(15.838)	(7.811)	(8.542)
Treated*Period		-0.149***	-0.150***	-0.071***	-0.064***
		(-5.963)	(-5.972)	(-3.723)	(-3.459)
ASY*Treated*Period			0.023	0.070**	0.084**
			(0.514)	(2.055)	(2.526)
SIZE				0.097***	0.073***
				(20.754)	(15.553)
FCF				-0.005	-0.004
				(-0.797)	(-0.685)
WC				1.045***	1.006***
				(106.381)	(102.653)
LEV				0.015***	0.019***
				(4.558)	(6.276)
BETA				0.031***	0.022***
				(5.387)	(4.007)
BI				-0.098***	-0.101***
				(-4.226)	(-4.491)
NROA				0.062	0.209***
				(1.572)	(5.430)
R&D				0.002***	-0.001***
				(3.043)	(-1.113)
CONSTANTS	0.430***	0.402***	0.403***	-0.821***	-0.574***
	(177.484)	(135.619)	(134.277)	(-16.440)	(-11.494)
N	20372	20372	20372	20372	20371
R-square	0.000	0.012	0.012	0.440	0.475
Industry FE	NO	NO	NO	NO	YES

t statistics in parentheses
* p<0.10, ** p<0.05, *** p<0.01

In addition, information asymmetry increases with the level of cash holding, proving agency theory indicates that information asymmetry may affect both inside management and outside investors. Although the finding is different from Chung et al [7], it proves Jensen's (1986) theory that investors may find it hard to obtain the inside information and may fail to supervise the agents' actions, which aggravates the free cash flow issue. Managers may have incentives in obtain benefits by using controlling rights. They may also be incentivized to window wash the earnings by holding cash. Hence, when it is difficult for external investors hard to monitor management, agents may seek to maximize their interest [16].

5. Robustness Test

Table 6: Robustness Test

	(1)	(2)	(3)	(4)	(5)
	Cash	Cash	Cash	Cash	Cash
	holdings	holdings	holdings	holdings	holdings
PIN	2.493*** (22.426)		2.375*** (21.004)	0.511*** (5.398)	0.486*** (5.248)
PIN*Treated*Period			0.842 (1.006)	1.958*** (3.073)	1.166* (1.867)
Treated		0.049*** (3.784)	0.075*** (5.823)	0.061*** (6.059)	0.015 (0.960)
Period		0.079*** (15.740)	0.069*** (13.822)	0.028*** (6.908)	0.031*** (7.789)
Treated*Period		-0.888*** (-4.574)	-0.330* (-1.702)	-0.520*** (-3.524)	-0.334** (-2.308)
SIZE				0.093*** (24.173)	0.072*** (18.731)
FCF				-0.004 (-0.719)	-0.004 (-0.621)
WC				1.042*** (106.278)	1.005*** (102.660)
LEV				0.016*** (4.970)	0.021*** (6.653)
BETA				0.023*** (4.213)	0.017*** (3.179)
NROA				0.011 (0.283)	0.172*** (4.619)
BI				-0.102*** (-4.401)	-0.103*** (4.586)
R&D				0.001** (2.067)	-0.001* (-1.811)
CONSTANTS	-0.175*** (-6.477)	0.402*** (135.665)	-0.172*** (-6.261)	-0.892*** (-17.169)	-0.670*** (-13.091)
N	20372	20372	20372	20372	20371
R-square	0.024	0.013	0.034	0.440	0.475
Industry FE	NO	NO	NO	NO	YES

t statistics in parentheses

* p<0.10, ** p<0.05, *** p<0.01

This regression performs an analysis using an alternative independent variable. PIN is an alternative independent variable which replaces ASY to check the robustness of the main regression conclusion. In the last column of table 6, within the fixed effect, mediation effect, and control variables, the coefficient of PIN is 0.486 at a 1% significant level. The positive coefficient indicates that there is a positive relationship between information asymmetry and cash holdings, which is the same with the conclusion of the main regression. In addition, with the control variable, fixed effect, the coefficient

is -0.334 at a 5% significant level. These suggest there is a negative relationship between covid-19 and cash holdings. Hence, the conclusion on the robustness check is similar to the main result.

6. Conclusion

This paper investigates the relationship between information asymmetry and cash holdings in the covid-19 context based on Chinese listed companies. Using the sample firms over 2014 to 2022, this research finds a positive relationship between information asymmetry and cash holdings and a negative relationship between COVID-19 and cash holdings. The uncertain COVID-19 from 2020 leads firms rearrange short and long-time plan, which increase the unexpected decision makings and unintended consequence. The precautionary motive and impossible motoring on agents from outside may work on the increase in holding cash when firms become more conservative in investing and cash holding policies. However, compared to investing in other opportunities, the cost of cash holdings is lower than the return earned on cash holdings. In addition, the robustness regression presents similar result to the main regression result.

This research provides new evidence on the relationship between cash holdings and information asymmetry during the COVID-19 period in Chinese market with robustness regression results, which enriches the conclusion on literature. Then, the outcome may help policymakers, entrepreneurs, and other business professionals working on the direction of development of the Chinese stock market, which in turn may benefit the smooth operation of companies.

However, the possible limitation is in the selection of the control variable. This study selects variables on corporate structure and financial characteristics. Nevertheless, it doesn't consider variables on corporate internal and external supervisory mechanisms, environment, and other factors. Hence, further research could account for such variables, which may conduct more comprehensive research.

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