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Article

International Corporate Cash Holdings and Firm-Level Exposure to COVID-19: Do Cultural Dimensions Matter?

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Abstract: This study investigates the impact of COVID-19 exposure on corporate cash holdings using firm data across sixteen developing and developed economies. The results show that firms reserve more cash when their exposure to COVID-19 increases. We also find a cash burn effect during the COVID-19 pandemic, meaning that the cash holdings are drained when firm exposure to the pandemic exceeds a tipping point. The effect is more pronounced in larger firms and firms with less cash reserve. Further analyses reveal that the cash burn effect tends to be stronger in countries with a high level of individualism and weaker in countries with high levels of risk aversion, masculinity, and long-term orientation. The findings provide fresh insights into the connections among corporate cash holdings, national cultures, and firm-level exposure to COVID-19.



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Keywords: cash burn effect; cash holdings; COVID-19; national culture

1. Introduction

Since January 2020, the world has witnessed the devastating impacts of COVID-19 on all aspects of social and economic life. The pandemic has not only caused a demand shock in economies globally because of a substantial temporary decline in revenues of firms (Fahlenbrach et al. 2020; Goodell 2020) but also makes firms more financially fragile (Falato et al. 2020). To cope with uncertainty shocks, firms tend to hold more cash as a precautionary move (Bates et al. 2009; Panousi and Papanikolaou 2012; Phan et al. 2019), especially during the COVID-19 pandemic (Qin et al. 2020; Hue et al. 2021; Yun 2022). More cash holdings also come from the fact that firms delay investments during periods of heightened uncertainty (Ingersoll and Ross 1992; Julio and Yook 2012; Kang et al. 2014; Gulen and Ion 2016; Kim and Kung 2017) and during the COVID-19 pandemic (Barrero et al. 2020). Vito and Gómez (2020) show that there is a cash burn effect on corporate cash reserve, which means the demand shocks induced by exogenous events, like COVID-19 outbreaks, eventually lead to exhausted cash reserve after a certain period of time depending on how the firm revenues are affected by the event.

Previous studies in the literature examine corporate cash holding behavior from different cultural perspectives. Firms' cash holdings are found to be negatively associated with individualism (Chen et al. 2015), and positively associated with uncertainty avoidance, long-term orientation, and masculinity (Chang and Noorbakhsh 2009; Ramírez and Tadesse 2009; Tran 2020). That means, firms in countries with higher individualism tend to hold less cash in other countries with lower individualism; while firms in countries characterized by a higher degree of risk aversion, longer-term orientation, and higher assertiveness generally hold more cash. Those findings add weight to the argument that national cultural dimensions matter to corporate behavior and decision-making internationally, as suggested by Aggarwal and Goodell (2009), Zheng et al. (2012), and Shao et al. (2013).

This paper aims to investigate the impact of firm exposure to the COVID-19 pandemic on corporate cash holdings. As the pandemic is exerting its unprecedented impact on most economies across the globe, we use an international sample of firms from sixteen American, Asian, European, and Oceanian countries to have better coverage of the investigation on the cash burn effect of the COVID-19 crisis. Following the cash holdings literature, we take into consideration different cultural dimensions, including individualism, uncertainty avoidance, long-term orientation, and masculinity, when analyzing corporate cash holdings decision-making under firm exposure to COVID-19. Natural disasters at the global scale of the COVID-19 pandemic have not been witnessed since the Spanish Flu 1918 (Goodell 2020), thus it provides us with a perfect natural experiment to explore how businesses react to extremely negative demand shocks.

Using a sample of 5926 listed firms from sixteen countries and territories across the globe, we investigate how firm-level exposure to COVID-19 influences firm cash holdings, and how national culture moderates this relationship. The empirical results show a positive relationship between corporate cash holdings and firm-level exposure to COVID-19, suggesting that in an international setting, firms tend to protect themselves from liquidity shocks induced by the COVID-19 crisis by holding more cash. However, we find a nonlinear pattern of this relationship in which the cash reserve eventually depletes if the level of firm exposure to COVID-19 reaches a certain height. We refer to this impact as “the COVID-19 cash burn effect”, which is in line with the findings of Vito and Gómez (2020). The effect is stronger for firms with less cash reserve while being insignificant in small firms.

We adopt four cultural dimensions from Hofstede (2001) and Hofstede and Pedersen (2002) as proxies for national culture: individualism, uncertainty avoidance, long-term orientation, and masculinity. On the one hand, the empirical results show that individualism has a negative incremental impact on the COVID-19 cash burn effect, suggesting that firms from individualistic cultures tend to subject more to liquidity shocks during the COVID-19 crisis. On the other hand, the cash burn effect is weaker for firms in high uncertainty-avoiding, or more long-term oriented, or more masculine cultures. The findings are in line with those of the previous studies in the literature (Chang and Noorbakhsh 2009; Ramírez and Tadesse 2009; Chen et al. 2015; Tran 2020).

Our findings contribute to the literature in several ways. It is the first to untangle the impact of firm exposure to COVID-19 on cash holdings internationally. Current studies in the literature regarding the economic impact of COVID-19 mostly focus on the financial markets rather than corporate finance. This study offers a novel perspective on corporate finance during the pandemic using an international sample of firms from sixteen developed and developing countries around the world. Second, it unveils a connection between corporate cash holdings and cultural dimensions under the COVID-19 pandemic. Our findings differ from previous studies in the literature by indicating the moderating role of cultural dimensions on corporate behavior during periods of extreme uncertainty. Third, it provides international evidence of the COVID-19 cash burn effect that is sensitive to the firm-level exposure to COVID-19. Fourth, the findings show that the cash burn effect varies cross-sectionally across different firm sizes, cash holdings, and cultures.

The rest of the paper proceeds as follows: Section 2 presents our rationale for hypotheses development; Section 3 discusses the variables, data, and summary statistics; Section 4 presents the empirical model specifications and the results of our analysis; Section 5 concludes the study.

2. Hypothesis Development

Before the COVID-19 pandemic, the literature documented an enormous volume of studies investigating the impact of uncertainty to corporate decision-making, indicating that corporate management policies and decision-making change during periods of heightened uncertainty (Ingersoll and Ross 1992; Haushalter et al. 2002; Julio and Yook 2012; Gulen and Ion 2016; Kim and Kung 2017; Phan et al. 2019; Fosu and Twumasi 2021; Hoang et al.

2021; Tran et al. 2021; Hoang et al. 2022). The economic impact of the COVID-19 pandemic is well observable worldwide with plummeted financial markets, soaring unemployment rates, an unprecedented sharp fall in real GDP growth, and a huge drop in demands¹. Firms operating in such an uncertain business environment likely experience decreasing revenues and tightened budgets. While the pandemic situation might be different across countries, businesses around the world might adopt similar policies to protect themselves from the COVID-19-induced uncertainty, for example, holding more cash to prevent the shortage of cash due to decreasing revenues (Qin et al. 2020), and going into “hibernation” to reduce the economic costs of doing business (Didier et al. 2021). As such, it is reasonable to hold more cash during the pandemic to reduce the cost of being financially constrained and to protect the working capital of the firm.

However, under the high level of economic disruptions caused by the COVID-19 pandemic, is it possible to keep holding more cash as the firm is more exposed to the COVID-19 crisis? As the firm becomes more vulnerable to COVID-19, the cost of holding cash increases. Specifically, the cost of holding cash includes opportunity cost and the cost of working capital management. As corporate revenues decrease during the demand shocks caused by the pandemic, holding more cash might be viewed as a short-term real option that will eventually be costly in the longer term. Vito and Gómez (2020) estimate that firms would become illiquid between six months and three years under the COVID-19 cash crunch, dependent on different scenarios of sales drop. Because the COVID-19 crisis is likely to persist until a substantial portion of the global population gets vaccinated, it may take a few to several years for the economic activities to recover as before the pandemic. To keep holding a “safe” amount of cash reserve in the longer-term and prevent a COVID-19 cash crunch, it is very likely that most firms would have to resort to the debt market (Vito and Gómez 2020). It is important to note that market frictions increase during the COVID-19 crisis as the risk premium increases (Haddad et al. 2020). Therefore, firms are not able to keep their cash holdings at a high level as their exposure to COVID-19 increases. Based on this understanding, we expect a nonlinear association between corporate cash holdings and firm exposure to the COVID-19 crisis. We refer this to the COVID-19 cash burn effect in which firms start with increased cash holdings as they begin to be exposed to the pandemic, then the cash holdings deplete as their COVID-19 exposure increases. Following this line of argument, our first hypotheses are as follows:

Hypothesis 1a (H1a). *Cash holdings positively associate with firm exposure to COVID-19.*

Hypothesis 1b (H1b). *The relationship between cash holdings and firm exposure to COVID-19 is nonlinear (the COVID-19 cash burn effect).*

It is a known fact that the COVID-19 crisis affects different countries differently. Countries and territories with better responses to the COVID-19 risk likely have fewer COVID-19 cases and deaths, for example, Korea, Japan, and Singapore. In comparison, countries with weak government response to the COVID-19 risk, for instance, the United States and the United Kingdom, experience rocketed numbers of infected cases and deaths by the coronavirus. The differences at the country-level and the perception of risk among countries and societies might be a factor that contributes to the differences in COVID-19 responses.

One of the most fundamental factors to understanding the economics of a country is its culture (Williamson 2000), which is an informal institutional characteristic that influences corporate decision-making (Shao et al. 2013). For examples, culture affects capital structure decisions (Chui et al. 2002), dividend policy (Zheng and Ashraf 2014), foreign direct investment (Guiso et al. 2009), IPO pricing (Costa et al. 2013), corporate mergers (Ahern et al. 2015), syndicated bank loans (Giannetti and Yafeh 2012), and mutual fund performance (Nguyen and Nguyen 2019). Recent studies have demonstrated the moderating role of national culture in the COVID-19 responses of organizations and individuals (Habel et al.

2020; Huynh 2020; Ashraf 2021; Hoang et al. 2022), suggesting that national culture may influence corporate decision-making during the pandemic.

Based on four of the cultural dimensions proposed by Hofstede (2001) and Hofstede and Pedersen (2002) (i.e., individualism, uncertainty avoidance, long-term orientation, and masculinity), several propositions about the moderating impact of national culture on corporate cash holdings during the COVID-19 crisis might be made as follows.

Individualism is defined as the preference in which individuals are expected to take care of only themselves and their immediate families (Hofstede 2001). Therefore, in an individualistic society, people tend to be overly confident and have more risk tolerance (Markus and Kitayama 1991; Van Den Steen 2004; Chen et al. 2015). Because cash holdings are negatively associated with individualism (Chen et al. 2015), the COVID-19 cash burn effect might be stronger for firms in an individualistic culture than those in a collectivistic culture. This proposition forms our Hypothesis 2, as follows:

Hypothesis 2 (H2). *The COVID-19 cash burn effect is stronger for firms in an individualistic culture compared to their counterparts.*

Unlike individualism, uncertainty avoidance indicates how people feel uncomfortable with ambiguity and uncertainty. The COVID-19 crisis induces unprecedented uncertainty at the global scale in many aspects, including economics, international relations, politics, public health, and society. Chang and Noorbakhsh (2009), Ramírez and Tadesse (2009), and Chen et al. (2015) show that uncertainty-avoiding cultures have a positive impact on cash holdings. Managers of firms in a high uncertainty-avoiding culture are likely to hold more cash and thus reduce the impact of the COVID-19 cash burn effect. This argument leads to our Hypothesis 3.

Hypothesis 3 (H3). *The COVID-19 cash burn effect is weaker for firms in high uncertainty-avoiding cultures compared to their counterparts.*

Similarly, Chang and Noorbakhsh (2009) indicate that firms tend to hold more cash and liquid balances in countries with a higher degree of uncertainty avoidance, where people are more culturally masculine and long-term oriented. From there, firms in such cultures might have better preparations for uncertainty shocks by holding more cash than their counterparts. That management choice would become a safeguarding mechanism against liquidity shocks during unpredicted events such as the COVID-19 crisis. As such, we expect the COVID-19 cash burn effect to become less severe for those firms. This understanding forms our Hypotheses H4 and H5, as follows:

Hypothesis 4 (H4). *The COVID-19 cash burn effect is weaker for firms in long-term oriented cultures compared to their counterparts.*

Hypothesis 5 (H5). *The COVID-19 cash burn effect is weaker for firms in highly masculine cultures compared to their counterparts.*

3. Variables, Data, and Summary Statistics

This section may be divided by subheadings. It should provide a concise and precise description of the experimental results, their interpretation, as well as the experimental conclusions that can be drawn.

As suggested by Demir and Ersan (2017) and Phan et al. (2019), to measure corporate cash holdings we use the ratio of cash to the book value of total assets (CASH). For a robustness check, we calculate an alternative cash holdings proxy, the cash to net assets ratio (CASH_NET), where ‘net assets’ is defined as the book value of total assets less cash.

We use the text-based measure of firm exposure to COVID-19 proposed by Hassan et al. (2020)² as the proxy for firm-level exposure to COVID-19 (COVIDEXPOSURE). The

authors construct the measure using a computational linguistic algorithm to identify the text combinations capturing COVID-19 from a firm's transcripts of quarterly earnings conference calls. Earnings conference calls are important investor relationship events where corporate managers disclose information and present their perspectives on their firm's state of affairs. Transcripts of the earnings conference calls also record the questions from conference participants and the responses from the managers that reveal information on how COVID-19 and other extraneous events might affect a firm's financial performance and well-being. To test the nonlinearity of the relationship between firm-level exposure to COVID-19 and cash holdings, we construct a squared specification of COVIDEXPOSURE, namely Sq_COVIDEXPOSURE, and include it in the same regression model as COVIDEXPOSURE. This variable setting helps us to identify whether or not there is a cash burn effect of the COVID-19 pandemic.

To investigate the cash burn effect of COVID-19 while controlling for potential confounding factors, we add the control variables following previous studies in the literature (Chen et al. 2015; Demir and Ersan 2017; Phan et al. 2019). The control variables include firm size (SIZE), profitability (ROA), financial leverage (LEVERAGE), net working capital (NWC), sales growth (SALESGROWTH), dividend (DIVIDEND_DUMMY), capital expenditure (CAPEX), fixed assets (PPE), market-to-book ratio (MTB), and economic policy uncertainty (EPU). Table 1 defines the variables used in our study.

Table 1. Variable description.

Variable	Description
CASH	The ratio of cash to the book value of total assets
CASH_NET	The ratio of cash to noncash assets
COVIDEXPOSURE	The natural logarithm of one plus firm-level exposure to COVID-19 (Hassan et al. 2020)
Sq_COVIDEXPOSURE	The squared specification of COVIDEXPOSURE
COVIDRISK	The natural logarithm of one plus firm-level COVID-19 risk (Hassan et al. 2020)
Sq_COVIDRISK	The squared specification of COVIDRISK
IDV	Individualism index of the country (Hofstede and Pedersen 2002)
UAD	Uncertainty avoidance index of the country (Hofstede and Pedersen 2002)
LTO	Long-term orientation index of the country (Hofstede and Pedersen 2002)
MAS	Masculinity index of the country (Hofstede and Pedersen 2002)
SIZE	The natural logarithm of the book value of total assets
ROA	The ratio of net income to total assets
LEVERAGE	The ratio of total debts to total assets
NWC	The ratio of net working capital to total assets
SALESGROWTH	The ratio of changes in revenues to revenues in the preceding fiscal quarter
DIVIDEND_DUMMY	A dummy variable that equals one if a company pays a common dividend during the quarter, and zero otherwise.
CAPEX	The ratio of capital expenditure to total assets
PPE	The ratio of Property, Plant, and Equipment to total assets
MTB	Market-to-book ratio
EPU	The natural logarithm of the annualized economic policy uncertainty index (Baker et al. 2016)

Our quarterly corporate financial data from the Datastream database cover the period from 2002:Q1 to 2020:Q2. The choice of this study period is to capture the average cash holdings at the firm-level across a longer period of time and avoid the bias arising from short-horizon samples. The study period from 2002:Q1 to 2020:Q2 facilitates better comparison between corporate cash holdings during the COVID-19 year 2020, and corporate cash holdings at different periods and at different levels of economic uncertainty. This is important because the pre-COVID-19 period (2017–2019) witnessed the developments of the trade war between China and the United States, which induced a greater degree of macroeconomic and economic policy uncertainty across the globe. Therefore, a longer time period would be useful to evaluate the impact of the COVID-19 pandemic on corporate cash holdings. To ensure the comparability of firms in our sample, we exclude all financial and utility firms (2-digit SIC 49 and from 60 to 69) following Kahle and Walkling (1996).

The end sample consists of 5926 listed firms and 156,549 firm-year observations from 16 international markets where data for all variables are available: Australia, Canada, China, France, Germany, Hong Kong, India, Italy, Japan, Korea, Russia, Singapore, Spain, Sweden, the United Kingdom, and the United States. To alleviate the potential impact of outliers on the outcomes of data analysis, we winsorize all the financial variables by the top and bottom percentiles.

Table 2 shows the information on the COVID-19 outbreaks based on the date of the first confirmed COVID-19 case, the number of infected cases, the number of deaths due to COVID-19, and the cultural dimension data of the countries and territories (Hofstede 1980, 1993, 2001; Hofstede and Pedersen 2002).

Table 2. COVID-19 outbreak records and the cultural dimensions of countries included in this study.

Country or Territory	COVID-19 (as of 30 June 2020)			Cultural Dimensions			
	First Case Confirmed by WHO on	#Infected Cases	#Death	IDV	UAD	LTO	MAS
Australia	25 January 2020	24,602	104	90	51	21	61
Canada	26 January 2020	103,250	8522	80	48	36	52
China	31 December 2019	85,227	4648	20	30	87	66
France	25 January 2020	156,930	29,730	71	86	63	43
Germany	28 January 2020	194,259	8973	67	65	83	66
Hong Kong	23 January 2020	1206	7	25	29	61	57
India	30 January 2020	566,840	16,893	48	40	51	56
Italy	31 January 2020	240,436	34,744	76	75	61	70
Japan	24 January 2020	18,593	972	46	92	88	95
Korea	20 January 2020	12,800	282	18	85	100	39
Russia	31 January 2020	647,849	9320	39	95	81	36
Singapore	24 January 2020	43,661	26	20	8	72	48
Spain	1 February 2020	249,255	28,394	51	86	48	42
Sweden	1 February 2020	67,667	5310	71	29	53	5
United Kingdom	1 February 2020	283,545	40,341	89	35	51	66
United States	22 January 2020	2,452,048	125,318	91	46	26	62

We focus on four national cultural dimensions of countries and territories in our sample: individualism, uncertainty avoidance, long-term orientation, and masculinity (Hofstede 2001; Hofstede and Pedersen 2002)³. The individualism variable (IDV) shows how confident and optimistic people in society generally are. A high IDV for a country means people in that country tend to be overconfident and usually overoptimistic. The uncertainty avoidance variable (UAD) demonstrates the risk aversion of people in a country. The higher the value of UAD, the more people are likely to avoid risk rather than take risks. The long-term orientation variable (LTO) indicates to what extent long-term outcomes are emphasized. A higher LTO means people are more willing to delay short-term material success for long-term success. The masculinity variable (MAS) demonstrates the preference in society for heroism, assertiveness, and materialism. A high value of MAS indicates a highly masculine society.

The United States is the country with the highest IDV our sample (IDV = 91) closely followed by Australia and the United Kingdom, whereas Korea, Singapore, and China have the lowest IDVs. Singapore is also the country with the lowest uncertainty avoidance (UAD = 8), whereas Japanese and Russians seem to be the most risk-averse (UAD of 92 and 95, respectively). For the long-term orientation index, we again see differences. Some societies, such as Korea, Japan, and China (LTO of 100, 88, and 87, respectively) emphasize long-term objectives more than the rest of the sample. Japan's culture is also the most masculine culture in the sample (MAS = 95), meaning that Japanese are more assertive than other people. From the four indices, it is noticeable that the countries and territories in our sample are culturally different and present a vivid cross-country setting to investigate the

relationship between corporate cash holdings and exposure to COVID-19 from the cultural perspective.

Table 3 summarizes the statistics and pairwise correlation matrix of the variables used in our study.

Table 3. Summary statistics and correlation matrix.

Panel A. Summary Statistics of the Variables Used in the Study												
Variable	Observations		Mean		Median		Std Dev.		Min.		Max.	
CASH	156,549		0.201		0.121		0.210		0.001		0.888	
COVIDEXPOSURE	156,549		0.001		0.000		0.032		0.000		2.247	
SIZE	156,549		14.249		14.032		2.344		9.550		22.503	
ROA	156,549		−0.007		0.038		0.189		−0.998		0.279	
LEVERAGE	156,549		0.239		0.210		0.218		0.000		1.006	
NWC	156,549		0.000		0.000		0.026		−0.125		0.114	
SALESGROWTH	156,549		0.022		0.000		0.106		−0.288		0.626	
DIVIDEND_DUMMY	156,549		0.443		0		0.497		0		1	
CAPEX	156,549		0.049		0.032		0.051		0.000		0.284	
PPE	156,549		0.256		0.173		0.234		0.001		0.944	
MTB	156,549		3.036		2.160		5.030		−16.850		28.950	
EPU	156,549		4.815		4.835		0.399		3.953		6.124	
Panel B. Correlation Matrix of the Variables Used in This Study												
Variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
(1) CASH	1.000											
(2) COVID-EXPOSURE	0.000	1.000										
(3) SIZE	−0.359 ***	0.021 ***	1.000									
(4) ROA	−0.288 ***	0.004	0.350 ***	1.000								
(5) LEVER-AGE	−0.343 ***	0.004	0.207 ***	−0.105 ***	1.000							
(6) NWC	−0.033 ***	−0.000	−0.009 ***	0.062 ***	−0.024 ***	1.000						
(7) SALES-GROWTH	0.041 ***	−0.007 ***	−0.016 ***	0.050 ***	−0.021 ***	0.104 ***	1.000					
(8) DIVI-DEND_DUMMY	−0.318 ***	0.014 ***	0.497 ***	0.297 ***	0.089 ***	0.001	−0.051 ***	1.000				
(9) CAPEX	−0.217 ***	−0.012 ***	0.093 ***	0.066 ***	0.091 ***	−0.007 ***	0.033 ***	0.031 ***	1.000			
(10) PPE	−0.409 ***	−0.005 **	0.209 ***	0.082 ***	0.258 ***	−0.016 ***	−0.016 ***	0.174 ***	0.564 ***	1.000		
(11) MTB	0.137 ***	0.009 ***	−0.010 ***	0.043 ***	−0.080 ***	−0.002	0.032 ***	0.005 *	−0.013 ***	−0.089 ***	1.000	
(12) EPU	−0.033 ***	0.067 ***	0.037 ***	−0.025 ***	0.067 ***	−0.021 ***	−0.045 ***	0.029 ***	−0.016 ***	0.066 ***	−0.035 ***	1.000

Notes: ***, **, and * denote statistical significance at 1%, 5%, and 10%, respectively.

Panel A, Table 3, shows that the mean of CASH is 0.201, meaning that on average, cash holdings account for about 20.1% of total assets of firms in our sample during the period from 2002:Q1 to 2020:Q2. If we limit the study periods to the two quarters of 2020, the mean of CASH is 0.182, which is roughly 10% lower than the average level of the whole period. COVIDEXPOSURE has a mean of 0.001, a median value of 0.000, with a maximum value of 2.247 in the second quarter of 2020. This is reasonable given that the first COVID-19 outbreak was at the end of 2019 in China while the following outbreaks are in the first quarter of 2020 in other countries. Panel B, Table 3, reports the pairwise correlation

matrix of variable. All correlation coefficients in the correlation matrix are smaller than 0.6, indicating that there is no pairwise collinearity problem among the variables.

4. Empirical Results and Discussion

4.1. Model Specifications

Our study investigates the relationship between firm-level exposure to COVID-19 and corporate cash holdings and the impact of national culture on that relationship. Given that firms might increase cash holdings during heightened uncertainty (Demir and Ersan 2017; Phan et al. 2019) and taking the cash burn effect of COVID-19 on corporate cash holdings (Vito and Gómez 2020) into consideration, we expect the relationship between corporate cash holdings and firm-level exposure to COVID-19 to be nonlinear. Therefore, the empirical specification of our baseline model is:

$$CASH_{i,t} = \alpha + \beta_1 COVIDEXPOSURE_{i,t} + \beta_2 Sq_COVIDEXPOSURE_{i,t} + \gamma CONTROL_{i,t} + \theta_i + \vartheta_i + \varphi_t + \varepsilon_{i,t} \quad (1)$$

where θ_i , ϑ_i , and φ_t are industry, country, and calendar quarter (from quarter one to quarter four every year) fixed effects to control for heterogeneity at the industry- and country-level, and seasonality in cash holdings. All variable definitions are in Table 1.

$$CASH_{i,t} = \alpha + \beta_1 COVIDEXPOSURE_{i,t} + \beta_2 Sq_COVIDEXPOSURE_{i,t} + \beta_3 COVIDEXPOSURE_{i,t} * CULTURE_i + \beta_4 Sq_COVIDEXPOSURE_{i,t} * CULTURE_i + \gamma CONTROL_{i,t} + \theta_i + \varphi_t + \varepsilon_{i,t} \quad (2)$$

where $CULTURE_i$ is one of four cultural dimensions (IDV, UAD, LTO, or MAS) of the country (territory) i . This model specification is to examine the impact of cultural dimensions on the relationship found in the estimation of Equation (1). Standard errors are clustered by firm-quarter in all regression specifications.

To ensure the findings do not suffer biases arising from the autocorrelation problem, we use the Newey–West estimator to re-estimate Equation (1). Moreover, as COVID-19 is one of the most serious contagious diseases ever, cash holdings decision-making of firms might depend on COVID-19-related health news that reaches all countries simultaneously. Therefore, there might be a potential cross-sectional dependence of the residuals in the empirical models of COVID-19 studies. Following Driscoll and Kraay (1998) and Hoechle (2007), we employ the Driscoll–Kraay estimator to re-estimate the Equation (1) to eliminate the potential bias caused by the cross-sectional dependence issue.

4.2. The Relationship between Firm-Level Exposure to COVID-19 and Cash Holdings

Column 1, Table 4, reports the regression results of Equation (1). We alternatively exclude the fixed effects to see whether the analysis outcomes are sensitive to heterogeneity; those results are in Table 4, columns 2 and 3, from excluding only the calendar quarter fixed effect to excluding all fixed effects.

In all regression specifications, we find a positive coefficient of COVIDEXPOSURE and a negative coefficient of $Sq_COVIDEXPOSURE$ on CASH; both are statistically significant at the 1% level. The results show a nonlinear relationship between firm-level exposure to COVID-19 and corporate cash holdings. This suggests that firms tend to hold more cash when they are more exposed to COVID-19, but if the degree of exposure exceeds a tipping point where firms are directly exposed to the demand shock caused by COVID-19, there is a strong cash burn effect of COVID-19 on cash holdings. We refer to this active cash management strategy as a safeguard mechanism against unavoidable demand shocks during the pandemic. Another possible reason for this finding comes from the corporate investment perspective. Since firms tend to delay corporate investment during heightened uncertainty in the business environment (Kang et al. 2014; Gulen and Ion 2016), their cash holdings increase because of their unwillingness to invest during COVID-19. As a result,

cash holdings increase either actively or passively and, when the demand shock during COVID-19 comes, eventually, the firm's cash reserves are drained by the cash burn effect of COVID-19, which agrees with the argument of [Vito and Gómez \(2020\)](#). The estimates of the Newey–West and Driscoll–Kraay estimators are in Table 4, columns 4 and 5, respectively. Generally, the results are consistent with those reported in columns 1–3, confirming the validity of our econometric approach. In general, the empirical findings support our Hypotheses H1a and H1b.

Table 4. Baseline regression.

	(1)	(2)	(3)	(4)	(5)
Variable	Baseline Regression	Baseline Regression without Quarter Fixed Effect	Baseline Regression without Fixed Effects	Newey–West Regression	Driscoll–Kraay Regression
COVIDEXPOSURE	0.065 *** (6.657)	0.081 ** (2.493)	0.107 *** (3.464)	0.107 *** (3.410)	0.066 *** (7.779)
Sq_COVIDEXPOSURE	−0.034 *** (−5.552)	−0.052 * (−1.785)	−0.072 *** (−2.773)	−0.072 *** (−2.843)	−0.035 *** (−5.526)
SIZE	−0.039 *** (−16.243)	−0.018 *** (−12.249)	−0.010 *** (−47.061)	−0.010 *** (−25.620)	−0.039 *** (−44.730)
ROA	0.038 *** (4.819)	−0.170 *** (−12.805)	−0.246 *** (−68.757)	−0.246 *** (−39.929)	0.038 *** (6.032)
LEVERAGE	−0.093 *** (−10.384)	−0.206 *** (−18.863)	−0.244 *** (−95.234)	−0.244 *** (−51.445)	−0.093 *** (−29.644)
NWC	−0.194 *** (−16.984)	−0.251 *** (−10.043)	−0.274 *** (−14.641)	−0.274 *** (−14.681)	−0.194 *** (−16.081)
SALESGROWTH	−0.020 *** (−4.963)	0.039 *** (4.835)	0.066 *** (13.379)	0.066 *** (14.208)	−0.018 *** (−4.931)
DIVIDEND_DUMMY	−0.001 (−0.536)	−0.035 *** (−8.538)	−0.053 *** (−58.514)	−0.053 *** (−31.881)	−0.001 (−1.227)
CAPEX	−0.096 *** (−4.613)	0.080 ** (2.620)	0.116 *** (13.377)	0.116 *** (7.718)	−0.096 *** (−5.125)
PPE	−0.391 *** (−18.727)	−0.276 *** (−22.105)	−0.262 *** (−129.311)	−0.262 *** (−71.354)	−0.392 *** (−15.949)
MTB	0.000 * (1.827)	0.003 *** (9.930)	0.004 *** (37.235)	0.004 *** (21.728)	0.000 ** (2.346)
EPU	0.001 (0.361)	−0.000 (−0.011)	0.005 *** (4.478)	0.005 *** (2.692)	0.001 (0.374)
Constant	0.883 *** (25.440)	0.575 *** (23.701)	0.443 *** (73.541)	0.443 *** (42.825)	0.884 *** (59.644)
Industry fixed effect	Yes	Yes	No	No	No
Country fixed effect	Yes	Yes	No	No	No
Quarter fixed effect	Yes	No	No	No	No
Observations	156,549	156,549	156,549	156,549	156,549
Adjusted R-squared	0.856	0.449	0.359		

Notes: This table reports the estimated coefficients for Equation (1). Robust t-statistics are reported in parentheses. Standard errors are double-clustered by firm and quarter-year. ***, **, and * denote statistical significance at 1%, 5%, and 10%, respectively.

To test the sensitivity of the findings, we use alternative measures of cash holdings and a firm's exposure to COVID-19, the cash-to-net assets ratio (CASH_NET), and the measurement of firm-level risk associated with COVID-19 (COVIDRISK) constructed by [Hassan et al. \(2020\)](#). To exclude the potential impact of previous pandemics on cash holdings, we exclude from the sample the periods of the severe acute respiratory syndrome (SARS) and the influenza A virus subtype H1N1 (H1N1) outbreaks (2003:Q1–2003:Q2 and 2009:Q1–2010:Q3) and reperform the regression. Similarly, we remove the firm-quarter observations during the global financial crisis period 2008–2010 to mitigate the impact of

an economic recession on the analysis outcomes. The results of the regressions using these subsamples and alternative measures are reported in Table 5, columns 1–4.

Table 5. Robustness test results.

Variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Cash to Net Assets as the Dependent Variables	COVIDRISK (Hassan et al. 2020) as the Explanatory Variable	Excluding SARS and H1N1 Periods	Excluding GFC Period	Firms with More Cash Holdings	Firms with Less Cash Holdings	Larger Firms	Smaller Firms
COVIDEXPOSURE	0.244 ** (2.563)		0.062 *** (6.302)	0.059 *** (6.062)	0.017 *** (3.572)	0.072 *** (4.292)	0.049 *** (3.228)	0.075 (1.526)
Sq_COVIDEXPOSURE	−0.128 * (−1.831)		−0.031 *** (−5.233)	−0.030 *** (−5.241)	−0.012 *** (−5.976)	−0.031 *** (−3.201)	−0.033 *** (−3.175)	−0.022 (−0.842)
COVIDRISK		0.112 *** (3.647)						
Sq_COVIDRISK		−0.141 *** (−4.178)						
Constant	3.032 *** (13.443)	0.882 *** (25.409)	0.882 *** (25.018)	0.887 *** (24.503)	0.132 *** (10.686)	1.133 *** (22.891)	0.677 *** (12.746)	1.021 *** (19.250)
Control variables	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry fixed effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country fixed effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Quarter fixed effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	156,549	156,549	139,540	127,675	78,246	78,165	78,389	78,109
Adjusted R-squared	0.772	0.856	0.858	0.861	0.588	0.800	0.830	0.854

Notes: This table reports the regression results of the sensitivity tests. Robust t-statistics are reported in parentheses. Standard errors are double-clustered by firm and quarter-year. ***, **, and * denote statistical significance at 1%, 5%, and 10%, respectively.

We observe that the coefficient of COVIDEXPOSURE is positive and the coefficient of Sq_COVIDEXPOSURE remains negative in columns 1–4; both are statistically significant. This indicates that our findings are not sensitive to alternative measures of cash holdings and firm-level exposure to COVID-19. Finally, we classify firms by the level of cash holdings and size to capture the effect of COVID-19 exposure on different firm groups, since firms of different sizes and levels of cash reserve may react differently to the uncertainty of extraneous events. We find that the coefficients of COVIDEXPOSURE and Sq_COVIDEXPOSURE are larger for firms with a lower level of cash holdings relative to those for firms with larger cash reserve (0.072 and −0.031 compared with 0.017 and −0.012, respectively) though remaining significant at the 1% level for both cash holding firm groups (Table 5, columns 5–6). This shows that the cash burn effect of COVID-19 is weaker in firms with more cash reserves. We document that the coefficients of the firm-level exposure variables are statistically significant for large firms (0.049 and −0.033) and insignificant for small firms (0.075 and −0.022) (Table 5, columns 7–8), suggesting that the nonlinear relationship between cash holdings and COVID-19 exposure shows only for larger firms. This is consistent with small businesses going into hibernation with the bare minimum cash necessary to avoid bankruptcy during the pandemic (Didier et al. 2021). Therefore, small firms' cash holdings pattern is not likely to be associated with the cash burn effect of COVID-19. This finding is also in line with larger firms face higher bankruptcy risk during the COVID-19 crisis, but it seems not to be the case of smaller firms (Wang et al. 2020). This suggests the flexibility of smaller firms to adapt to the extremely negative shock caused by the pandemic.

4.3. The Role of Cultural Dimensions to the Cash Burn Effect

To examine if different cultural dimensions impact the cash burn effect arising from COVID-19, we perform our analyses using Equation (2) with the four cultural dimensions in Section 2. Table 6 reports the estimates from Equation (2).

Table 6. The role of national culture dimensions.

Variable	(1) Baseline Regression without Country Fixed Effect	(2) Interact with IDV	(3) Interact with UAD	(4) Interact with LTO	(5) Interact with MAS
COVIDEXPOSURE	0.065 *** (6.657)	−0.029 *** (−3.617)	0.136 *** (5.908)	0.109 *** (4.750)	0.253 *** (6.593)
Sq_COVIDEXPOSURE	−0.034 *** (−5.552)	0.066 * (1.785)	−0.079 *** (−4.245)	−0.073 *** (−6.518)	−0.176 *** (−3.817)
COVIDEXPOSURE × IDV		0.001 *** (9.729)			
Sq_COVIDEXPOSURE × IDV		−0.001 *** (−3.026)			
COVIDEXPOSURE × UAD			−0.001 *** (−3.821)		
Sq_COVIDEXPOSURE × UAD			0.001 * (1.988)		
COVIDEXPOSURE × LTO				−0.001 *** (−5.546)	
Sq_COVIDEXPOSURE × LTO				0.001 *** (4.079)	
COVIDEXPOSURE × MAS					−0.003 *** (−5.558)
Sq_COVIDEXPOSURE × MAS					0.002 *** (3.143)
Constant	0.883 *** (25.440)	0.884 *** (25.445)	0.884 *** (25.445)	0.884 *** (25.446)	0.884 *** (25.446)
Control variables	Yes	Yes	Yes	Yes	Yes
Industry fixed effect	Yes	Yes	Yes	Yes	Yes
Quarter fixed effect	Yes	Yes	Yes	Yes	Yes
Observations	156,549	156,549	156,549	156,549	156,549
Adjusted R-squared	0.856	0.856	0.856	0.856	0.856

Notes: This table reports the estimated coefficients for Equation (2). Robust t-statistics are reported in parentheses. Standard errors are double-clustered by firm and quarter-year. ***, **, and * denote statistical significance at 1%, 5%, and 10%, respectively.

On the one hand, we find that the coefficient of the interaction term $Sq_COVIDEXPOSURE \times IDV$ is negative and significant at the 1% level (Table 6, Column 2), implying that the cash burn effect is stronger for firms in highly individualistic cultures. This is consistent with the conclusion that people in highly individualistic cultures tend to be overly confident about the precision of their predictions (Markus and Kitayama 1991; Van Den Steen 2004; Chen et al. 2015). Therefore, the senior management of firms in high-IDV countries might underestimate the exposure of their firms to COVID-19, leading to smaller cash reserve for protection against liquidity shocks during a pandemic, resulting in a stronger cash burn effect. This finding supports our Hypothesis 2.

Conversely, the coefficients of the interaction terms $Sq_COVIDEXPOSURE \times UAD$, $Sq_COVIDEXPOSURE \times LTO$, and $Sq_COVIDEXPOSURE \times MAS$ are positive and statistically significant. This implies that the cash burn effect of COVID-19 is weaker in countries and territories with a higher degree of uncertainty avoidance, long-term orientation, and masculinity. This is understandable, since people in an uncertainty-avoiding, masculine society with a long-term vision will likely have better preparations for uncertainty shocks. Therefore, uncertainty avoidance, long-term orientation, and masculinity have a moderating effect on the relationship between cash holdings and firm-level exposure to COVID-19. The empirical findings corroborate our argument and support our Hypotheses H3, H4, and H5.

The empirical findings suggest that cultural dimensions matter in how corporate management reacts to the unprecedented COVID-19 pandemic in terms of cash holding behavior.

5. Conclusions

This paper investigates the impact of COVID-19 on corporate cash holdings using data on 5926 listed firms across sixteen developed and developing countries. Our results show that firms reserve more cash when their exposure to COVID-19 increases. We find a negative nonlinear relationship between corporate cash holdings and COVID-19 exposure, meaning that the cash reserve will be drained when the exposure exceeds a tipping point. This finding confirms the cash burn effect during the COVID-19 pandemic.

We also find that the COVID-19 cash burn effect tends to be stronger in countries with a high level of individualism. Interestingly, the effect is likely to be weaker in countries with high levels of risk aversion, masculinity, and long-term vision. This study is the first to reveal that there is a cash burn effect for corporate cash holdings during an infectious disease outbreak of COVID-19 and that cultural dimensions have a moderating impact on the effect. We also find that the cash burn effect is more pronounced in larger firms and firms with less cash reserves, suggesting that the impact of the COVID-19 crisis on corporate activities varies cross-sectionally across our sample. Therefore, the findings have implications for future research to explore the impact of the coronavirus outbreaks on corporate decision-making. Our study provides grounds for better understanding the cash holding behavior of firms facing similar future infectious outbreaks. The studies also have implications for working capital management and risk management of firms in individualistic cultures during the COVID-19 crisis. Corporate managers of such firms should understand their psychological characteristics and the impact of individualism on their firms' liquidity risk. As such, good working capital management and liquidity risk management frameworks should take cultural aspects into consideration, especially during periods of heightened uncertainty.

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Notes

- ¹ See <https://www.bbc.com/news/business-51706225> (accessed on 29 December 2021).
- ² The firm-level COVID-19 exposure data are obtainable from website <https://www.firmlevelrisk.com/> (accessed on 29 December 2021).
- ³ Hofstede (1980, pp. 21–23) defines culture as “the collective programming of the mind which distinguishes the members of one group from another”, which is passed from generation to generation, and which is changing all the time because each generation adds something of its own before passing it on. For more details on culture dimensions and the data of the four culture dimensions, please refer to the website <https://www.hofstede-insights.com> (accessed on 29 December 2021).

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