

## CEO Multiple Crisis Imprints and Firm Cash Holdings

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**Keywords:** Severity and intensity of pandemic imprints, Cash holdings, CEOs' risk preferences

**JEL Classification:** G34, M12, M41

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## **CEO Multiple Crisis Imprints and Firm Cash Holdings**

### **Abstract**

Rather than focus on early-life natural disasters (Bernile *et al.*, 2017), we investigate how crisis imprints throughout a CEO's career affect their behaviours. Using hand-collected data on CEOs' pandemic career experience for China's listed firms, we provide robust evidence that companies led by CEOs who experience SARS tend to have lower cash holdings, consistent with imprinting theory. However, the imprinting effects become insignificant when CEOs experience more severe and multiple pandemics. We document a nonmonotonic relationship between the severity and intensity of CEOs' pandemic imprints throughout their careers and their propensity to adopt aggressive financial strategies. Our study extends Bernile *et al.* (2017) and enriches the literature on CEO imprints by investigating the impact of pandemic experiences at the CEO's career stage rather than early-life on their behaviours.

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## 1. Introduction

Chief executive officer (CEO)'s prior experiences shape their attitudes toward risk-loving, subsequently affecting corporate governance and policies (Bernile *et al.*, 2017). Prior studies provide evidence that CEOs' experiences and backgrounds shape their subsequent decision-making, thereby affecting corporate governance and policies (e.g., Malmendier *et al.*, 2011; Giannetti *et al.*, 2015; Dittmar and Duchin, 2016; Aktas *et al.*, 2019; Li *et al.*, 2023). Upper echelons theory shows that core executives evaluate firms' situations and challenges based on their prior experiences and backgrounds (Hambrick and Mason, 1984; Hambrick, 2007). Furthermore, the imprinting concept indicates that previous experiences imprint on individuals and profoundly impact their subsequent decision-making and behaviour (Marquis and Tilcsik, 2013).<sup>1</sup> Bernile *et al.* (2017) investigate the impact of CEOs' early-life exposure to fatal disasters on corporate risk-taking. They document a nonmonotonic relation between the intensity of early-life disasters and the CEO's aggressive decision. However, little is known about how professional-stage pandemic experiences influence managerial behavior.<sup>2</sup> Drawing upon the imprinting concept, we extend Bernile *et al.* (2017) by investigating whether and how CEO's career-stage pandemic imprints, formed while serving as core executives during major public-health crises, affect corporate cash-holding policies.

Our study differentiates from previous research in the following ways. First, previous studies document that executives' experiences, such as their experiences of natural disasters (Bernile *et al.*, 2017), military experience (Malmendier *et al.*, 2011), childhood disasters (Chen *et al.*, 2021), foreign experience (Wen *et al.*, 2020), academicians position (Li *et al.*, 2023), holding a pilot's licence (Cain and McKeon, 2016), marital status (Roussanov and Savor, 2014), and political stance (Hutton *et al.*, 2014) affect corporate strategies and policies. Pandemics, such as SARS in 2003 and COVID-19 in 2019, have also significantly affected the economy and the lives of human beings. However, it remains unanswered how CEOs' pandemic imprints throughout the career stage affect their behaviours.

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<sup>1</sup> Higgins (2005) documents the imprinting concept related to career as career imprints.

<sup>2</sup> The CEO and founder of Virgin Group, Richard Branson, is an example of CEOs' risk preferences affected by multiple and fatal pandemic career imprints: Richard Branson, who experienced SARS in 2003 and COVID-19 in 2019 in his career, increased financing and actively developed airline business, the primary business of Virgin Group, after experiencing SARS pandemic. However, he intensified efforts to seek financial assistance and extended other business sectors like music, telecommunications, and space exploration after encountering COVID-19.

Diverging from employing CEOs' experiences of natural disasters (Bernile *et al.*, 2017) and childhood disasters (Chen *et al.*, 2021), our study focuses on CEOs' pandemic imprints throughout their careers. Second, unlike career imprints discussed by Higgins (2005), our study examines pandemic career imprints that are defined as CEOs who served as core executives (either chairman, general manager, president, CEO, or chief financial officer (CFO)) during SARS in 2003 and the period of COVID-19. We investigate the severity of pandemic career imprints by comparing the impacts between severe and non-severe pandemic career imprints. Third, we also consider the intensity of pandemic career imprints by looking at the impact of multiple pandemic imprints. We specifically investigate the impact of CEOs' multiple pandemic career imprints (i.e., SARS and COVID-19) on their behaviours and, thus, cash holdings. We particularly focus on corporate cash holdings for the following reasons.

First, corporate cash holdings are significantly associated with CEOs' risk preferences (Aktas *et al.*, 2019). Aktas *et al.* (2019) find that overconfident CEOs are more likely to hold less cash. However, Acharya *et al.* (2012) argue that CEOs implementing riskier corporate policies tend to accumulate higher cash holdings optimally. Second, cash holdings can reflect the firms' governance, investment capabilities, and financial strategies (Opler *et al.*, 1999). Denis and Sibilkov (2010) argue that firms with higher financial constraints tend to hold higher cash holdings. Third, cash holdings are relatively homogeneous compared to diverse corporate investments like R&D and capital expenditure (Aktas *et al.*, 2019).

There is a strong tension in the relationship between CEOs' pandemic career imprints and corporate cash holdings. On the one hand, the hubris hypothesis (Roll, 1986) indicates that confident decision-makers are more likely to conduct overinvestment, leading the firms into a risk-loving circumstance. CEOs who successfully survive disasters in their careers become more confident, allowing them to be more aggressive in company decisions. For instance, Bernile *et al.* (2017) infer that CEOs who experienced natural disasters tend to adopt a more aggressive corporate strategy. Chen *et al.* (2021) document that CEOs who encountered childhood disasters may be more aggressive in managing companies and are more accepting of the risks of a stock price crash. Therefore, we predict that CEOs who have pandemic imprints throughout their career stage are more aggressive and, thus, possess lower cash holdings.

On the other hand, the precautionary motive posits that firms with superior investment prospects maintain higher cash holdings, as adverse shocks and financial distress entail greater costs for them (Bates *et al.*, 2009). CEOs who experienced the disasters may be better able to comprehend the substantial costs and financial constraints resulting from these shocks. Consequently, they maintain higher cash holdings. Bishal and Simpson (2022) find that corporate exposure to COVID-19 has a positive impact on cash holdings, suggesting that CEOs adopt more conservative strategies in response to the pandemic. CEOs who have pandemic career imprints may be more conservative and, thus, maintain higher cash holdings.

Similarly, numerous psychological studies have underscored the effects of individuals' prior experiences on their subsequent decision-making. Depending on the quality, severity, and intensity of these experiences, they can yield varying effects on an individual's decision-making and behaviour. For instance, individuals engage in comparing their past experiences with current risks, as suggested by Ben-Zur and Zeidner (2009). This cognitive comparison diminishes the perceived loss associated with taking risks, consequently leading individuals to exhibit a greater propensity for risky decisions (Taylor and Lobel, 1989). On the contrary, Holman and Silver (1998) posit that traumatic experiences are indicative of intensive stress levels persisting long after the events have occurred. Kleim and Ehlers (2009) find a nonmonotonic association between posttraumatic stress growth and posttraumatic stress disorder (PTSD),<sup>3</sup> indicating a nonmonotonic relationship between posttraumatic stress and subsequent behaviour. Therefore, individuals, including CEOs, may exhibit nonmonotonic shifts in risk preferences due to the severity and intensity of past experiences (e.g., pandemic career imprints).

To address these empirical questions, we employ SARS in 2003 and COVID-19 in 2019, which are pandemic disasters in China, as our research setting. The cumulative number of confirmed SARS cases in Guangdong and Beijing in China exceeded 1,500, constituting approximately 19% of total confirmed cases worldwide.<sup>4</sup> Hence, we posit that CEOs who served as core executives in Guangdong and Beijing during the SARS outbreak in 2003 were exposed to severe pandemic career imprints, and those in other jurisdictions have non-severe pandemic

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<sup>3</sup> PTSD can arise when an individual experiences one or more instances of traumatic experiences (e.g., actual death, traumatic natural disasters, and serious injury), exhibiting enduring effects on individuals' mental well-being. PTSD caused by one or more traumatic experiences can thus affect individuals' subsequent behaviour and decision-making.

<sup>4</sup> These data come from World Health Organization, <https://www.who.int/publications/m/item/summary-of-probable-sars-cases-with-onset-of-illness-from-1-november-2002-to-31-july-2003> (accessed 03 June 2024).

career imprints. In addition, SARS and COVID-19 exhibit substantial similarities in terms of their epidemiological features and societal impacts.<sup>5</sup> Therefore, we utilize multiple pandemic career imprints (i.e., SARS and COVID-19) to investigate the impact of the intensity of pandemic career imprints on CEOs' risk preferences within the same jurisdictions, which further provides an opportunity to examine the impact of the severity and intensity of pandemic career imprints on CEOs' cash-holding decisions.

We collect individual, firm, and city-level data on China's A-share listed firms from the China Stock Market and Accounting Research (CSMAR) database, resulting in 27,707 firm-year observations. We find that CEOs' pandemic career imprints negatively affect corporate cash holdings; this result is significant at a 1% level. The documented effects are also economically significant. After controlling for the determinants of corporate cash holdings and CEOs' individual characteristics, CEOs' pandemic career imprints are associated with a 13.30% decrease in corporate cash holdings. These results are consistent with the imprinting concept of career imprints on corporate strategies. Therefore, our results capture the significant and economically meaningful deterrent effects of CEOs' pandemic career imprints on corporate cash holdings.

Furthermore, we find nonmonotonic impacts of the severity and intensity of CEOs' pandemic career imprints on corporate cash holdings. Only the coefficient on non-severe SARS career imprints (-0.0457) is negatively significant at the 1% level. By contrast, the results for multiple pandemic career imprints (i.e., SARS and COVID-19) are insignificant. This indicates that the impact of CEOs' pandemic career imprints on corporate cash holdings is significant when the pandemic career imprints are not severe. However, this impact is insignificant when CEOs have severe or multiple pandemic career imprints. Our study therefore documents that the severity and intensity of pandemic career imprints have nonmonotonic impacts on CEOs' risk preferences and, thus, corporate cash holdings.

Heterogeneous analyses indicate that different types of CEOs and firms have distinct results. First, CEOs with pandemic career imprints who have higher educational backgrounds tend to maintain lower cash holdings. Meanwhile, the coefficient on CEOs with lower educational

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<sup>5</sup> They are both coronaviruses, with relatively similar transmission routes and highly similar preventive measures, such as the use of school suspensions, quarantines, and blockades of public transportation. Their outbreaks spread widely in China and globally.

backgrounds is insignificant, indicating that CEOs with higher educational backgrounds are more aggressive when they have pandemic career imprints. Second, male CEOs with pandemic career imprints tend to reduce cash holdings significantly. However, the impact of female CEOs is insignificant, suggesting that male CEOs are more aggressive after establishing pandemic career imprints. Third, the relationship between pandemic career imprints and corporate cash holdings is negative and significant at the 1% level when the firm's financial constraints are low. However, this relationship is insignificant when firms face high financial constraints. This implies that only firms with low financial constraints managed by CEOs with non-severe pandemic career imprints are more aggressive and, thus, inclined to keep lower cash holdings. Fourth, the absolute value of coefficients on pandemic career imprints of non-state-owned enterprises (non-SOEs) is larger than that of state-owned enterprises (SOEs). This indicates that the negative impacts of pandemic career imprints on corporate cash holdings are more pronounced among non-SOEs. In addition, the empirical p-values of these sub-sample tests are all less than 0.01, indicating that our sub-sample tests are all significant.

We address potential endogeneity issues as follows. First, to mitigate the potential endogeneity issue of measurement bias, we redefine CEOs' pandemic career imprints by employing CEOs who served as non-core executives during the pandemic. Second, to address selection bias since non-random mutual selection and other functional misspecification, we employ the propensity score matching (PSM) approach. Specifically, the characteristics of firms managed by CEOs with pandemic career imprints (treatment group) may fundamentally differ from those managed by others (control group). We thus follow Heckman *et al.* (1998) and Drucker and Puri (2005) to employ the PSM approach to match our treatment and control groups for balancing their systematic differences. Third, to mitigate the potential endogeneity stemming from self-selection bias, firms with lower cash holdings may be more likely to hire CEOs with pandemic career imprints. We use the Heckman selection model (Heckman, 1979) to address self-selection bias. Fourth, we adopt a difference-in-differences (DiD) approach to further deal with reverse causality and unobservable variables impacting our estimates. Fifth, our study also exploits the placebo test to ensure that confounding factors or spurious correlations do not drive our estimates. Sixth, we further examine the tests for agency problems to ensure that our results are driven by CEOs' risk preferences instead of agency problems. Our results still hold after considering these potential endogeneities, supporting that our results and findings are robust.

Our study has four important contributions as follows. First, our study enriches the literature on the impact of executives' experiences and backgrounds on corporate governance and policies (e.g., Malmendier *et al.*, 2011; Giannetti *et al.*, 2015; Aktas *et al.*, 2019; Wen *et al.*, 2020; Chen *et al.*, 2021; Li *et al.*, 2023). Bernile *et al.* (2017) and Chen *et al.* (2021) document that CEOs' early-life experiences significantly affect corporate policies and investment strategies. Malmendier *et al.* (2011) infer that CEOs' military experience affects corporate financial policies. Bernile *et al.* (2017) investigate how CEOs' earlier experiences of natural disasters affect their risk preferences and corporate strategies by employing US county-level natural disaster data. Chen *et al.* (2021) examine the impact of CEOs' early-life disasters on stock price crash risks. We extend Bernile *et al.* (2017) and Chen *et al.* (2021) and add to the literature on CEOs' experiences by investigating the nonmonotonic impacts of the severity and intensity of pandemic imprints at CEOs' career stage rather than early-life on their behaviours.

Second, our study advances the literature on the career imprinting concept. Higgins (2005) argues that a firm's culture (i.e., its structure and strategies) shapes employees' attitudes toward beliefs and values, which are career imprints. Similarly, Dokko *et al.* (2009) infer that firms' culture and socialization cultivate career imprints and lead individuals to establish potentially persistent behaviours regarding how work should be conducted. We provide robust empirical evidence that pandemic career imprints cultivate CEOs' risk preferences by investigating the impact of CEOs' pandemic career imprints on corporate cash holdings. Previous studies have inferred the relationships between corporate cash holdings and corporate governance (Harford *et al.*, 2008; Chen *et al.*, 2020), precautionary motive (Bates *et al.*, 2009), corporate financial constraints (Faulkender and Wang, 2006; Denis and Sibilkov, 2010), and executives' aggressive motivations (Liu and Mauer, 2011). Our study adds to these streams of literature by providing evidence that CEOs' pandemic career imprints negatively affect corporate cash holdings, particularly in the presence of non-severe pandemic and SARS career imprints.

## 2. The SARS pandemic and hypotheses development

### 2.1 The SARS pandemic

SARS first emerged in China's Guangdong Province on November 16, 2002, and escalated into a global health emergency by spring 2003. The causative agent, a novel coronavirus, spreads predominantly through respiratory droplets and manifests clinically as fever, cough, and dyspnea,

with severe cases progressing to respiratory failure and death. While phylogenetically related to COVID-19 within the Coronaviridae family, SARS represents a distinct viral species with different epidemiological characteristics.

The outbreak generated substantial societal and economic disruptions across China. Initial delays in information sharing and public health reporting facilitated early uncontrolled transmission. In response, authorities implemented rigorous containment protocols, including mass quarantine, school closures, travel restrictions, and public awareness campaigns. By July 13, 2003, when the global incidence of new cases stabilized, the epidemic was considered contained. Surveillance data from the Chinese Center for Disease Control and Prevention confirmed 5,327 cases and 349 attributable fatalities in mainland China.

Economic analysis reveals a sharp but transient impact from the epidemic. Second-quarter GDP growth in 2003 fell to 9.1%, down from 11.1% in the first quarter, reflecting the outbreak's peak effect. A rapid recovery ensued in the latter half of the year, with growth returning to approximately 10% in both the third and fourth quarters. Annual GDP growth reached 10.04% in 2003, closely aligning with the 9.13% (2002) and 10.11% (2004) rates observed in adjacent years. This pattern indicates that although SARS produced significant short-term socioeconomic disruption, its long-term macroeconomic impact remained limited. The transient nature of SARS' economic consequences contrasts sharply with the sustained global damage wrought by the COVID-19 pandemic, underscoring fundamental differences in scale, duration, and structural impact between the two coronavirus outbreaks.

## 2.2 Hypotheses development

Upper echelons theory indicates that core executives evaluate firms' challenges through the lens of their own values and prior experiences (Hambrick and Mason, 1984; Hambrick, 2007). This is an empirical question regarding whether and how CEOs' earlier experiences affect their risk preferences and, thus, corporate policies. Previous studies have investigated the impact of CEOs' different career experiences on subsequent decision-making. For instance, Xuan (2009) shows that CEOs allocate more funding to departments in which they have not worked before. Greenwood and Hanson (2015) examine investment strategies in the shipping sector and infer that managers overestimate the likelihood of near-term requirement shocks. Cláudia *et al.* (2019) demonstrate that CEOs' career experiences lead firms to invest in more innovation and have

transferrable skills when innovation initiatives fail. Fich and Nguyen (2020) reveal that CEOs with supply-chain knowledge in the target sector undertake acquisitions with more synergies, improving post-transaction accounting performance and fewer goodwill write-downs. Islam and Zein (2020) argue that CEOs who possess prior innovation experience are associated with producing higher-quality innovation outcomes.

The imprinting concept infers that individuals form imprints adapted to the environment and have lasting and profound impacts on their subsequent decision-making and behaviours (Marquis and Tilcsik, 2013). CEOs' earlier experiences can also have career imprints (Higgins, 2005), affecting their decision-making and governance strategies in the firms they manage (Chen *et al.*, 2023). For instance, Callen *et al.* (2014) provide evidence that individuals who have experienced traumatic disasters consistently alter their risk preferences. Cronqvist *et al.* (2015) infer that investors who encounter catastrophic and significant macroeconomic disasters are more oriented toward value investing. Bernile *et al.* (2017) use US county-level natural disaster data (i.e., earthquakes, hurricanes, and floods) to infer how CEOs' earlier experiences with natural disasters affect their risk preferences and financial strategies. They find that CEOs with natural disaster experiences without extremely negative results manage their firms more aggressively. However, CEOs manage their firms more conservatively if they suffer from extremely negative results (Bernile *et al.*, 2017). Wen *et al.* (2020) document that executives' foreign experience negatively affects firms' tax avoidance strategies. Chen *et al.* (2021) infer that CEOs who have experienced childhood disasters become more aggressive and, therefore, are more inclined to accept the stock price crash risks. Luo *et al.* (2022) find that executives who have experienced stock market crashes are more value-oriented in their subsequent investment decision-making.

Therefore, disasters may provoke CEOs more aggressively by boosting their confidence in handling dangerous circumstances. Aktas *et al.* (2019) find that CEO overconfidence positively impacts firms' cash holdings, which is in line with the hubris hypothesis (Roll, 1986). Numerous studies demonstrate that people who have experienced fatal disasters, such as natural catastrophes and violent wars, become more aggressive (Eckel *et al.*, 2009; Voors *et al.*, 2012; Page *et al.*, 2014; Hanaoka *et al.*, 2018; Chen *et al.*, 2021).

SARS in 2003 was a viral pandemic disaster that caused painful memories for humans and the economy. SARS was unanticipated and may have affected CEOs who have experienced these

pandemics. Bernile *et al.* (2017) argue that CEOs with early-life exposure to fatal natural disasters that did not result in severe consequences tend to demonstrate more risk-taking behaviors. This pattern finds parallel in the Chinese context: although SARS exerted substantial short-term pressures on China's economy, the rapid V-shaped recovery and limited long-term damage observed in Chinese enterprises may have led CEOs who experienced the outbreak to attribute their firms' resilience to their own strategic competence. Such attribution is likely to reinforce managerial overconfidence and subsequently translate into more aggressive corporate policies in Chinese firms. This encourages them to believe that future dangers are easier to tackle than SARS. Furthermore, since these CEOs are core executives in firms during the pandemic, they might recognize that they have a solid comprehension of how to get through it and absolutely will. Consequently, these CEOs appear more ambitious and aggressive. Therefore, CEOs involved in SARS in their careers, which can leave pandemic career imprints, may exhibit more aggressiveness and keep lower corporate cash holdings. Accordingly, we propose the following hypothesis:

**H1:** *CEOs with pandemic imprints throughout their careers tend to have lower corporate cash holdings.*

Based on the trade-off theory, firms maintain cash reserves for precautionary motives, especially when confronting financing constraints or significant operational volatility. However, substantial cash holdings may also reflect agency problems and lead to inefficient capital allocation. This study captures a theoretical tension regarding CEOs with pandemic experience: while such experiences could heighten risk awareness and increase cash holdings through precautionary channels, the distinctive context of SARS, characterized by its transient impact and rapid economic recovery, might instead foster CEO overconfidence and prompt more aggressive cash management strategies. Thus, the net effect of CEOs' pandemic experience on corporate cash policies remains an open empirical question.

### 3. Research design and data

#### 3.1 Model Specification

To examine the impacts of CEOs' pandemic career imprints on corporate cash holdings, we employ the following regression models:

$$\text{Cash Holdings}_{i,t} = \alpha + \beta \text{CEO Pandemic}_{i,t} + \gamma X_{i,t} + \text{Industry FE} + \text{Year FE} + \varepsilon_{i,t} \quad (1)$$

$$\begin{aligned} \text{Cash Holdings}_{i,t} = & \alpha + \beta_1 \text{CEO Pandemic}^{\text{Severe}}_{i,t} + \beta_2 \text{CEO Pandemic}^{\text{Non-Severe}}_{i,t} \quad (2) \\ & + \gamma X_{i,t} + \text{Industry FE} + \text{Year FE} + \varepsilon_{i,t} \end{aligned}$$

where the subscripts  $i$  and  $t$  represent the firm and year, respectively. Corporate cash holdings are proxied by  $\text{Cash Holdings}_{i,t}$ ; the more aggressive CEOs tend to reserve lower cash holdings (Bernile *et al.*, 2017). Specifically, we adopt four measures for the dependent variable, using  $\text{Cash1}$  in the regression in the baseline models and the remaining three ( $\text{Cash2}$ ,  $\text{Cash3}$ , and  $\text{Cash4}$ ) for the robustness test. We define  $\text{Cash1}$  as the ratio of the sum of cash and marketable securities to non-cash assets,<sup>6</sup> following Opler *et al.* (1999), Harford *et al.* (2008), Liu and Mauer (2011), Feng and Rao (2018), and Zhang and Zhou (2022). The treatment variable  $\text{CEO Pandemic}_{i,t}$  denotes CEOs' pandemic career imprints.  $\text{CEO Pandemic}^{\text{Severe}}_{i,t}$  refers to severe pandemic career imprints and  $\text{CEO Pandemic}^{\text{Non-Severe}}_{i,t}$  indicates non-severe pandemic career imprints.

The vector of  $X_{i,t}$  denotes the set of control variables, comprising the following variables based on previous studies (Chen *et al.*, 2012; Dudley and Zhang, 2016; Jayakody *et al.*, 2023): the firm's total assets ( $\text{Size}$ ), leverage ( $\text{Leverage}$ ), profitability and return on assets ( $\text{ROA}$ ), cash flow from operating activities ( $\text{Cash Flow}$ ), sales growth ( $\text{Growth}$ ), capital expenditure ratio ( $\text{Capital Expenditure}$ ), net working capital ratio ( $\text{Net Working Capital}$ ), book-to-market ratio ( $\text{Book-to-Market}$ ), whether cash dividends are paid ( $\text{Cash Dividends}$ ), whether the company is a state-owned enterprise ( $\text{SOE}$ ), management shareholding ratio ( $\text{Manager Shareholding}$ ), board size ( $\text{Board Size}$ ), and the proportion of independent directors ( $\text{Indep Director}$ ). We also control for CEOs' characteristics, including age ( $\text{CEO Age}$ ), gender ( $\text{CEO Gender}$ ), and education ( $\text{CEO Degree}$ ).  $\text{IndustryFE}$  and  $\text{YearFE}$  denote the industry- and year-fixed effects,<sup>7</sup> respectively. Table A1 in the Appendix provides detailed variable definitions.

The variable of interest is  $\text{CEO Pandemic}$  ( $\text{CEO Pandemic}^{\text{Severe}}$  and  $\text{CEO Pandemic}^{\text{Non-severe}}$ ), indicating whether firms are managed by CEOs with pandemic career imprints. We, therefore, are interested in the coefficient  $\beta$  ( $\beta_1$  and  $\beta_2$ ), capturing the impact of CEOs' pandemic career

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<sup>6</sup> Non-cash assets are equivalent to total assets minus the sum of cash and marketable securities.

<sup>7</sup> One may argue that firms hit by the pandemic have experienced significant economic losses can result in a negative, long-lasting effect on cash. To deal with this issue, we control year fixed effect in our regressions which captures such global factors.

imprints on corporate cash holdings. We cluster standard errors by firms and winsorize all continuous variables at 1<sup>st</sup> and 99<sup>th</sup> percentiles to eliminate the effects of outliers on our results.

### 3.2 Measures of CEOs' pandemic career imprints

We define the CEOs' pandemic career imprints (*CEO Pandemic*) as the CEOs who served as core executives (either chairman, general manager, president, CEO, or CFO) in A-share listed firms during the 2003 SARS pandemic. We assume that CEOs who served as core executives during this period have career imprints of the SARS pandemic, which can significantly impact their subsequent risk preferences and, thus, influence their decision-making. We choose CEOs who served as core executives in 2003 as the treatment group and set the indicator variable *CEO Pandemic* to one when CEOs have the SARS pandemic career imprint, and zero otherwise.

### 3.3 Data and sample

First, we manually construct individual-level datasets of all executives of all A-share listed firms on the Shanghai and Shenzhen Stock Exchanges.<sup>8</sup> We use these datasets to determine whether CEOs were core executives until the end of the statistical year during the SARS pandemic. Our study combines data on core executives' individual information from the CSMAR database, including their personal characteristics. Second, we retrieve firm-level data regarding the corporate financial information of all A-share listed companies on the Shanghai and Shenzhen Stock Exchanges between 2004 and 2022 from the CSMAR database. We select 2004 as the initial year rather than 2003, as SARS was not eliminated until the middle of 2003. Therefore, we define the imprinting effects of SARS on CEOs since 2004. Third, we collect city-level data on the cumulative number of confirmed SARS cases in 2003 by province and city. These data are obtained from the National Health Commission, which publishes data on all SARS cases in China until August 2003.

Our initial sample comprises all A-share listed firms, resulting in 51,792 firm-year observations from 2004 to 2022. Our sample starts in 2004 because SARS was not eliminated until the middle of 2003. We end the sample in 2022 because the COVID-19 pandemic concluded in that year; this reduces the number of missing values in our sample as much as possible. Table 1 presents the sample-selection strategies. We employ four filters to obtain the

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<sup>8</sup> We employ this order to collect executives' date in our datasets: *CEO>President >General Manager>General Manager(agency)*.

final sample. First, we remove 1,430 firm-year observations without CEOs' characteristics. Second, we exclude 3,175 firm-year observations because these companies have been delisted in the statistical year, and financial firms have different financial structures and regulations. Third, we eliminate 16,274 firm-year observations without crucial data to compute the control variables.

[Please Insert Table 1 Here]

## 4. Empirical results

### 4.1 Descriptive statistics

Table 2 presents the summary of statistics for our sample. The mean of *Cash1* equals 0.303 with a standard deviation of 0.343, indicating the substantial variation in corporate cash holdings across diverse firm-year observations. In addition, the data distribution of *Cash1* are consistent with previous studies (e.g., Jebran *et al.*, 2019; Chen *et al.*, 2021). The mean of *CEO Pandemic* indicates that approximately 18.6% of firm-year observations in our sample are managed by CEOs with pandemic career imprints. Other firm characteristics are consistent with previous studies (e.g., Wen *et al.*, 2020; Chang *et al.*, 2021; Lin *et al.*, 2023). The average leverage ratio (*Leverage*) in our sample is 42.8%, the average return on assets (*ROA*) is 3.6%, and the average operating cash flow ratio (*Cash Flow*) is 4.8%. In addition, most CEOs in our sample are male, with an average education level between a bachelor's degree and a master's degree.

[Please Insert Table 2 Here]

Table 3 presents a univariate comparison based on a subsample of CEOs with or without pandemic career imprints. The number of firms in the treatment group, managed by CEOs with pandemic career imprints, is 5,741, while the number of firms in the control group is 25,199. Notably, the treatment firms are inclined to maintain lower cash holdings, which is initially consistent with *H1a*. In addition, other variables, such as the leverage ratio (*Leverage*) and net working capital ratio (*Net Working Capital*) differ considerably based on mean and median difference tests. Firms managed by CEOs with pandemic career imprints have higher leverage ratios than those managed by CEOs without such imprints. The net working capital ratios are negative at the mean and median levels for firms managed by CEOs with pandemic career imprints. In addition, Table 3 shows that the treatment firms pay a lower proportion of cash

dividends. These results preliminarily indicate that firms managed by CEOs with pandemic career imprints are more inclined to adopt riskier and aggressive corporate strategies.

[Please Insert Table 3 Here]

#### 4.2 Baseline results

The results of the baseline regression model are presented in Table 4. Our results are statistically significant. We find that, when control variables and fixed effects are excluded from Column (1), the estimated coefficient on *CEO Pandemic* (-0.1047) is negative and significant at the 1% level. Columns (2) to (5) control for year- and industry-fixed effects, respectively. When we consider the firm-level control variables in Column (3), the coefficient on *CEO Pandemic* (-0.0394) remains negative and significant at the 1% level. In addition, we control for CEOs' individual-level variables in Column (4), the coefficient on *CEO Pandemic* (-0.0411) is also negative and significant at the 1% level. Therefore, the estimated coefficients on *CEO Pandemic* are all negative and significant at the 1% level. The empirical results demonstrate that CEOs with SARS exposure exhibit a more aggressive managerial style, resulting in lower corporate cash holdings. This finding provides strong support for our research hypothesis (*H1*) that CEOs with pandemic imprints tend to reduce corporate cash holding.

We also show that these impacts are also economically significant. We find that a one standard deviation increase in the CEOs' pandemic career imprints is associated with 4.48% decrease in corporate cash holdings relative to the sample mean.<sup>9</sup> These results provide evidence that the negative effects of CEOs' pandemic career imprints on corporate cash holdings are statistically and economically significant. Among control variables, corporate leverage (*Leverage*), firm capital expenditure rate (*Capital Expenditure*), net working capital ratio (*Net Working Capital*), and book-to-market ratio (*Book-to-Market*) are negatively related to cash holdings. In contrast, corporate return on assets (*ROA*) and operating cash flow ratio (*Cash Flow*) are positively related to cash holdings, acknowledging prior findings (Aktas *et al.*, 2019; Jebran *et al.*, 2019; Chang *et al.*, 2021; Lin *et al.*, 2023).

Existing research indicates that exposure to natural disasters exerts a nonlinear influence on individual behavior: when such experiences do not lead to severe consequences, individuals tend

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<sup>9</sup> The coefficient on *CEO Pandemic* (-0.0396)  $\times$  the standard deviation of *CEO Pandemic* (0.343)  $\times$  100% / the mean of *Cash1* (0.303) = 4.48%

to adopt more risk-taking behaviors; conversely, exposure with severe outcomes leads to more conservative conduct. Building on this theoretical foundation, this study proposes that CEOs' pandemic experiences may similarly exert a nonlinear impact on corporate cash holdings. The significant variation in the severity of the 2003 SARS outbreak across Chinese provinces provides a suitable quasi-natural experiment for testing this conjecture. So, we further categorize CEOs' pandemic career imprints into severe ( $CEO\ Pandemic^{Severe}$ ) and non-severe imprints ( $CEO\ Pandemic^{Non-Severe}$ ) based on the cumulative number of confirmed cases in each jurisdiction during SARS in 2003. The cumulative number of confirmed SARS cases in Guangdong and Beijing in 2003 exceeded 1,500. However, those in other jurisdictions are all lower than 500. Table A2 in Appendix details the cumulative number of confirmed SARS cases across diverse jurisdictions. Therefore, we define CEOs who served as core executives in Guangdong and Beijing in 2003 are defined as having a severe pandemic career imprint, with  $CEO\ Pandemic^{Severe}$  equals one, and zero otherwise. CEOs who served as core executives in other jurisdictions in 2003 are defined as having a non-severe pandemic career imprint, with  $CEO\ Pandemic^{Non-Severe}$  equals one, and zero otherwise.

Column (5) shows that only the estimated coefficient on  $CEO\ Pandemic^{Non-Severe}$  (-0.0396) is negative and significant after distinguishing between severe and non-severe pandemic career imprints. This finding indicates that pandemic career imprints affect CEOs' risk preferences only when the imprints are non-severe. We therefore document a nonmonotonic relationship between the severity of CEOs' pandemic career imprints and corporate cash holdings.

[Please Insert Table 4 Here]

### **4.3 Robustness tests**

To mitigate potential endogeneity concerns and better establish a causal relationship between CEOs' pandemic experience and corporate cash holdings, this study employs a series of endogeneity tests.

#### **4.3.1 Propensity score matching**

To mitigate the concern that corporate cash holdings are driven by firm characteristics and other confounding factors rather than CEOs' pandemic career imprints, we use the PSM approach. Specifically, firms managed by CEOs with pandemic career imprints (treatment

groups) may fundamentally differ from those led by CEOs without pandemic career imprints (control groups). This introduces the selection bias since non-random mutual selection and other functional misspecification. Therefore, we follow Drucker and Puri (2005) to employ the PSM approach to match the firm characteristics between control and treatment groups to mitigate the systematic differences between them (Heckman *et al.*, 1998). Specifically, we utilize control variables to match at both the firm and CEOs' levels. Panel A in Table 6 shows that the differences in the control variables between the treatment and control groups after matching are eliminated, the total number of firm-year observations however shrunk to 7,508.

Panel B of Table 6 reports the results for the matched sample. In Column (1), pandemic career imprints continue to lower corporate cash holdings regardless of whether the matched sample has been implemented. In addition, in Column (2), after distinguishing the pandemic career imprints into severe and non-severe, only the non-severe pandemic career imprints significantly decrease the corporate cash holdings at the 1% level. This finding confirms the robustness of our results.

#### 4.3.2 Heckman selection model

Furthermore, another potential endogeneity issue of self-selection bias may influence our results and findings. This bias is introduced by the possibility that firms with lower cash holdings may be more likely to hire CEOs with pandemic career imprints. Thus, the selection of CEOs with pandemic career imprints may not be a random choice for firms, potentially leading to self-selection bias (Certo *et al.*, 2016). Thus, we adopt the Heckman selection model (Heckman, 1979) to address this potential endogeneity issue. We utilize the proportion of firms in the same industry that employed CEOs with pandemic career imprints in the preceding year (t-1) as the instrumental variable (*Historic Peer CEO Pandemic*). Panel C of Table 6 presents the results. In Column (1), the coefficient of the impact of *Historic Peer CEO Pandemic* on *CEO Pandemic* (2.0052) is positive and significant at the 1% level using the Probit regression model. We then generate the selection parameters, representing the Inverse Mills ratio (*IMR*).<sup>10</sup> After incorporating *IMR* into Model (1), the results in Column (2) show that the coefficient on *CEO*

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<sup>10</sup> IMR is the ratio of the probability density function to the distribution's complementary cumulative distribution function.

*Pandemic* (-0.0202) is negative and significant at the 5% level. These results shed light on that our baseline results are robust and not driven by self-selection bias.

#### 4.3.3 Difference-in-Differences

To mitigate the potential endogeneity issue arising from reverse causality and other unobservable variables impacting our estimates, we further utilize the DiD approach. Specifically, we define the firm indicator variable *Treat*, which equals one if a firm is managed by a CEO with pandemic career imprints (treatment group), and zero otherwise (control group). We also define the year indicator variable *Post*, which equals one in the year a firm hires a CEO with pandemic career imprints and thereafter, and zero otherwise. Panel D of Table 6 reports the results. We find that the coefficient on *Treat* is insignificant, while the coefficient on the interactional term *Treat*×*Post* (-0.0284) is negative and significant at the 5% level. This implies that the corporate cash holdings are significantly lower after firms hire CEOs with pandemic career imprints, suggesting that our results are still robust.

[Please Insert Table 6 Here]

#### 4.3.4 Placebo test

To address the potential concerns that confounding and accidental factors drive our estimates and findings, we adopt the placebo test. Specifically, we randomly allocate the fictitious CEOs' pandemic career imprints to consolidate causality and sensitivity and examine whether incidental factors and spurious correlations drive our results. We employ the placebo test by randomly extracting the fictitious CEOs' pandemic career imprints from the total sample according to the proportion of the treatment group in the original sample. The pseudo-treatment group equals one when CEOs have pandemic career imprints and zero otherwise. We then construct the regression model using the randomly defined sample size.

We expect the impact of fictitious CEOs' pandemic career imprints on corporate cash holdings to no longer be significant after the randomization treatment, when repeated 500 times. Figure 1 visualizes the coefficients on the CEO's pandemic career imprints and the distribution of p-values after the randomization process 500 times. The pseudo-estimated coefficients on CEOs' pandemic career imprints are concentrated around zero, complying with normalization. In addition, the actual coefficients (-0.0396 in Column (4) of Table 4) are as an outlier, markedly

diverging from this distribution. This result validates our baseline results, showcasing that they are not driven by confounding and accidental factors.

[Please Insert Figure 1 Here]

## 5. Additional analyses

### 5.1 Multiple-pandemic career imprints

Ru *et al.* (2021) observe that delayed attention and actions against COVID-19 in 2019 occurred in jurisdictions without SARS in 2003. By contrast, citizens and governments in jurisdictions that suffered from SARS in 2003 were instantly alarmed and took action against COVID-19 in 2019 (Ru *et al.*, 2021). This shows that SARS had imprinted on individuals' decision-making for alarming and responding to COVID-19. Besides severity, our study considers the number of pandemic career imprints. We explore how COVID-19 affects CEOs with SARS career imprints.

We represent COVID-19 by the proxy variable *COVID*, which equals one when the sample years are 2020 and 2022, and zero otherwise. We do not choose 2019 as the initial year of the COVID-19 shock because people did not recognize COVID-19 back then, and it did not spread widely until the beginning of 2020. In Columns (1) and (2) of Table 7, the negative effect of the pandemic career imprints on the corporate cash holdings is significant at a 1% level before COVID-19 (*COVID*=0) but becomes insignificant after COVID-19 occurred (*COVID*=1). This finding indicates that multiple pandemic career imprints (i.e., SARS and COVID-19) can suppress the negative impact of SARS career imprints on CEOs' risk preferences. In Columns (3) and (4) of Table 7, the negative impacts of non-severe SARS career imprints on corporate cash holdings are still significant at a 1% level before COVID-19 (*COVID*=0) but become insignificant after COVID-19 (*COVID*=1). Thus, we find that firms tend to maintain lower cash holdings only when they are managed by CEOs with SARS-pandemic career imprints. Our results show that the severity and the number of pandemic career imprints must be maintained within an adequate range. The impact of pandemic career imprints on corporate cash holdings is insignificant when CEOs experience severe SARS, severe pandemic career imprints, or after additionally experiencing COVID-19 (i.e., multiple pandemic career imprints). We, therefore, document a nonmonotonic relationship between the severity and intensity of CEOs' pandemic career imprints and corporate cash holdings.

[Please Insert Table 7 Here]

## 5.2 Cross-sectional tests of CEOs

We further investigate cross-sectional tests of CEOs. Berger *et al.* (2014) observe that highly educated CEOs are more confident in employing external financing for risk management and maintaining lower cash holdings. CEOs with high education levels may attribute the safe passage of firms suffering from the shock of the pandemic to themselves. Therefore, more confident CEOs in dealing with risks are more inclined to maintain lower cash holdings. CEOs with a low education level may attribute this safe passage to all employees who need more confidence in dealing with risks and are more inclined to increase corporate cash holdings. We substitute the pandemic career imprint variable with two dummy variables to examine the impact of CEOs' educational levels.

*Degree\_high* (*Degree\_low*) equals one when the educational background of CEOs (*CEO Degree*) is above (below) the median, and zero otherwise. Column (1) of Table 8 reports the results. Only the coefficient on *Degree\_high*  $\times$  *CEO Pandemic* (-0.0363) is negative and significant at the 1% level. The coefficient on *Degree\_low*  $\times$  *CEO Pandemic* is insignificant. These results suggest that CEOs with pandemic career imprints and higher educational backgrounds are more inclined to maintain lower cash holdings. This suggests that CEOs with higher education levels are more confident and, therefore, become more aggressive.

In addition to CEOs' education level, previous studies have also examined differences in corporate policies by the gender of leaders (Francis *et al.*, 2015; Dittmar and Duchin, 2016; Faccio *et al.*, 2016), with most showing that female executives are more conservative than male executives. Thus, male CEOs may be more aggressive, perceive a lower probability of pandemic recurrence and tend to reduce cash holdings. Meanwhile, female CEOs are more conservative and may fear the recurrence of the pandemic and increase cash holdings to prevent future crises. To examine the effect of CEOs' gender, we employ two dummy variables to replace the pandemic career imprint variable. *CEO\_male* (*CEO\_female*) equals one when CEOs are male (female), and zero otherwise. The results are presented in Column (2) of Table 8. We find that only the coefficient on *CEO\_male*  $\times$  *CEO Pandemic* (-0.0429) is negative and significant at the 1% level. Therefore, male CEOs with pandemic career imprints are more likely to reserve lower cash holdings.

[Please Insert Table 8 Here]

### 5.3 Cross-sectional tests of firms

According to the pecking order theory, firms subject to financial constraints are more inclined to invest in capital at lower costs (Frank and Goyal, 2003). Hence, financially constrained firms tend to maintain cash holdings more than non-financially constrained firms. Although CEOs with pandemic career imprints behave more aggressively (as in our results), they are still constrained by the firms' financial circumstances. CEOs are more conservative when a firm's financial constraints are severe. Accordingly, we anticipate that the degree of firms' financial constraints alters the impact of pandemic career imprints on corporate cash holdings. To test this hypothesis, we employ the Size-Age (SA) index<sup>11</sup> developed by Hadlock and Pierce (2010) to examine firms' financial constraints. The SA index is more robust and plausible because it is constructed from two relatively exogenous indicators (i.e., total firm assets and firm age). Furthermore, its calculation is not influenced by endogenous characteristic variables, such as the financing method and operating conditions.

After calculating each firm's financing constraints (SA), we take the absolute value, with a larger value representing higher financial constraints. We then calculate the median of the financial constraints of the industry. If financial constraints exceed the industry median, the variable *SA\_high* equals one, and zero otherwise. In Columns (1) and (2) of Panel A of Table 9, the relationship between pandemic career imprints and corporate cash holdings is negative and significant (-0.0500) at the 1% level when the financial constraints are low (*SA\_high* = 0). However, this relationship is insignificant when financial constraints are high (*SA\_high* = 1), as Column (2) shows. In addition, the empirical p-value of this subsample analysis is lower than 0.01, indicating that the coefficient on *CEO Pandemic* for *SA\_high* = 0 (-0.0500) is significantly lower than that for *SA\_high* = 1 (-0.0123).

After further differentiating the *CEO Pandemic* into severe and non-severe, the results are reported in Columns (3) and (4) of Panel A of Table 9. Specifically, the negative effect of non-severe pandemic career imprints on corporate cash holdings is significant only when financial constraints are low (*SA\_high* = 0). The coefficient on *CEO Pandemic*<sup>Non-Severe</sup> (-0.0575) is negative and significant at the 1% level, implying that even after classifying the pandemic career

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<sup>11</sup>  $SA = -0.737 * \text{Size} + 0.043 * \text{Size}^2 - 0.040 * \text{Age}$

imprints, financial constraints still suppress the negative effect of non-severe pandemic career imprints on the corporate cash holdings.

From an enterprise ownership perspective, SOEs are essential to economic development, and state-owned banks play an essential role in China's financial system (Allen *et al.*, 2005). Therefore, SOEs are more likely to have access to bank loans from the same controller. Furthermore, unlike non-SOEs, SOEs tend to keep lower cash holdings (Megginson *et al.*, 2014). We anticipate the impacts of the pandemic career imprints on corporate cash holdings to be less significant for SOEs and more significant for non-SOEs, as state-owned firms inherently tend to hold less cash.

Accordingly, we examine heterogeneity by classifying the sample into SOEs and non-SOEs using the variable *SOE*. This is a dummy variable that equals one if the firm is an SOE, and zero otherwise. We run grouping regressions to examine the role of firm ownership in the impact of pandemic career imprints on corporate cash holdings. The results are presented in Panel B of Table 9. Columns (1) and (2) show that the negative impacts of pandemic career imprints on corporate cash holdings are significant for both SOEs and non-SOEs. We also find that the negative impact of pandemic career imprints on corporate cash holdings is more pronounced among non-SOEs.

Furthermore, in Columns (3) and (4) of Panel B of Table 9, the negative impacts of non-severe pandemic career imprints on corporate cash holdings are negative and significant at the 1% level for both SOEs and non-SOEs. The coefficient on *CEO Pandemic<sup>Non-Severe</sup>* in Column (3) for non-SOEs is significantly lower than that in Column (4) for SOEs. In addition, the empirical p-values equal 0.000, indicating that the analyses of distinguishing subsamples are significant. These results demonstrate that the negative impacts are still more pronounced among non-SOEs, even after distinguishing between severe and non-severe pandemic career imprints.

[Please Insert Table 9 Here]

## 6. Mechanism of investment in financial assets

In previous sections, we find that cash holdings decrease when firms employ CEOs with pandemic career imprints because these CEOs are more aggressive. Alternatively, one may argue that these CEOs are likely to invest in financial assets with greater returns and higher risks

instead of cash with no or lower returns. Therefore, we test whether firms' financial assets expand proportionally when they appoint CEOs with pandemic career imprints. Specifically, we employ the proportion of financial assets ( $Fah$ )<sup>12</sup> as a dependent variable in the baseline model. Columns (1) and (2) of Table 10 present the results. In Column (1), the coefficient on the impact of the *CEO Pandemic* on  $Fah$  (0.0298) is positive and significant at the 1% level. Besides pandemic career imprints, the results are consistent after CEOs' career imprints are defined as severe or non-severe. Column (2) shows that both severe and non-severe pandemic career imprints positively affect a firm's financial assets at a 1% level.

Furthermore, we examine whether firms managed by CEOs with pandemic career imprints invest the entire decreased cash holdings in financial assets. We replace the dependent variable of  $Fah$  with *Cash\_Fah*.<sup>13</sup> The results are reported in Columns (3) and (4) of Table 10. The coefficients on *CEO Pandemic*, *CEO Pandemic*<sup>Severe</sup>, and *CEO Pandemic*<sup>Non-Severe</sup> are all insignificant, indicating that reduced cash is fully invested in financial assets. Our results provide evidence that CEOs with pandemic career imprints become more aggressive in subsequent decision-making because they reduce cash holdings and fully invest their cash holdings in financial assets.

[Please Insert Table 10 Here]

## 7. Conclusion

Whereas extant literature has predominantly examined how CEOs' early-life experiences shape their managerial decisions, this study extends this line of inquiry by systematically investigating whether and how CEOs' professional pandemic imprints influence corporate cash holdings. Taking the 2003 SARS outbreak in China as an exogenous shock, we identify CEOs' pandemic experience based on whether they served as corporate executives during the SARS period. We find that CEOs with pandemic career imprints demonstrate more aggressive corporate management and consequently maintain lower cash holdings. Moreover, our findings demonstrate that CEOs' pandemic imprinting effects are statistically significant only for those with non-severe pandemic exposure and single SARS episode experiences, while showing no

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<sup>12</sup>  $Fah$  is defined as the proportion of the sum of the corporate various financial assets, consists of trading financial assets, derivative financial assets, available-for-sale financial assets, held-to-maturity investments, long-term equity investments, investment properties, funds on loan, receivable interest, and long-term debt investments to total assets.

<sup>13</sup>  $Cash\_Fah$  is the proportion of corporate cash and financial assets to its total assets.

significance for severe or multiple-pandemic career imprints. This pattern confirms the presence of nonlinear characteristics in pandemic imprinting effects. In addition, the negative impacts are only significant when CEOs are male and have higher educational backgrounds and when firms have lower financial constraints and are non-SOEs. Finally, the study finds that CEOs with pandemic imprints tend to allocate the reduced cash holdings toward financial assets. This investment behavior further substantiates how pandemic experiences shape their risk preferences.

Overall, our results support the career imprinting concept on corporate strategies and align with the upper echelons theory and hubris hypothesis. Our findings have crucial implications for corporate governance and strategies. Numerous studies investigate the determinants of corporate governance and strategies contingent on firm characteristics and markets. We find that CEOs' pandemic career imprints affect corporate cash holdings, which are crucial factors in corporate governance and strategies. This indicates that, as one of the CEOs' experiences, pandemic career imprints are an additional explanation for a firm's aggressive or conservative investment strategies. In addition, our study extends the growing literature on the impact of CEOs' experiences and backgrounds on corporate governance and strategies. Moreover, we contend that the influence of pandemic imprints on CEOs' risk preferences exhibits nonlinear characteristics. Our findings can also guide investors to consider CEOs' pandemic career imprints while deciding whether the focal investment object is aggressive or conservative.

Our study has several practical limitations. First, we focus on listed firms because CEOs have more public exposure, making their individual information more transparent and reliable. However, private firms and medium-sized enterprises (SMEs) have important economic and market positions. Future studies can employ a survey-based research approach to infer the results for private firms and SMEs. Second, although we investigate whether and how CEOs' pandemic career imprints affect corporate cash holdings, we do not infer whether the negative impacts of CEOs' pandemic career imprints on corporate cash holdings benefit firms. Future studies can extend our analyses to examine whether the results of CEOs' pandemic career imprints favour corporate financial and environmental performance. Our findings also provide crucial insights for investors and practitioners. Previous studies contribute to the investment concerns of CEOs' attributes for investors, such as CEOs' power (Al Mamun et al., 2020), gender (Li and Zeng, 2019), and overconfidence (Aktas *et al.*, 2019). However, we differ from them by providing suggestions for investors from the perspective of CEOs' pandemic career imprints. We suggest

that investors consider CEOs' pandemic-related career imprints when deciding whether the focal investment object is aggressive or conservative.

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**Table 1. Construction of sample data**

Total number of firm-year observations from 2004-2022	51,792
Removal of observations without data on CEO characteristics	(1,430)
Removal of the current year delisting and the financial sector	(3,175)
Removal of key variables with missing values	(16,274)
Final sample	30,940

Note: We retrieve 51,792 firm-year observations from 2004 to 2022 from the CSMAR database. We remove 1,430 of these 51,792 observations as they do not exist in the CSMAR data on executive characteristics. In addition, 3,175 observations are omitted because the corporations were either delisted during the year or were incorporated into the financial sector statistics. We remove 16,274 observations because the essential control variables evaluated had missing values, the ultimate sample comprised data for a sample of 30,940 observations. To prevent outliers from impacting our results, we winsorize all continuous variables at the 1st and 99th percentiles.

**Table 2. Descriptive statistics**

Variables	N	Mean	Min	P25	Median	P75	Max	SD
<i>Cash1</i>	30,940	0.303	0.015	0.107	0.189	0.354	2.068	0.343
<i>CEO Pandemic</i>	30,940	0.186	0.000	0.000	0.000	0.000	1.000	0.389
<i>Size</i>	30,940	22.069	19.831	21.175	21.886	22.755	26.083	1.247
<i>Leverage</i>	30,940	0.428	0.054	0.267	0.425	0.580	0.888	0.202
<i>ROA</i>	30,940	0.036	-0.259	0.013	0.036	0.066	0.196	0.064
<i>Cash Flow</i>	30,940	0.048	-0.159	0.008	0.047	0.089	0.249	0.070
<i>Growth</i>	30,940	0.174	-0.572	-0.019	0.117	0.286	2.287	0.384
<i>Capital Expenditure</i>	30,940	0.051	-0.019	0.015	0.037	0.073	0.241	0.051
<i>Net Working Capital</i>	30,940	0.059	-0.454	-0.072	0.059	0.189	0.569	0.201
<i>Book-to-Market</i>	30,940	0.372	0.055	0.232	0.336	0.477	0.991	0.193
<i>Cash Dividends</i>	30,940	0.709	0.000	0.000	1.000	1.000	1.000	0.454
<i>SOE</i>	30,940	0.361	0.000	0.000	0.000	1.000	1.000	0.480
<i>Manager Sharholding</i>	30,940	0.130	0.000	0.000	0.004	0.239	0.678	0.192
<i>Board Size</i>	30,940	8.644	3.000	7.000	9.000	9.000	18.000	1.773
<i>Indep Director</i>	30,940	0.373	0.286	0.333	0.333	0.429	0.571	0.053
<i>CEO Age</i>	30,940	3.911	3.258	3.829	3.932	4.007	4.419	0.140
<i>CEO Degree</i>	30,940	3.447	1.000	3.000	4.000	4.000	6.000	0.864
<i>CEO Gender</i>	30,940	0.931	0.000	1.000	1.000	1.000	1.000	0.254

Note: This table exhibits the details of summary statistics for our sample. Table A1 in Appendix details the definitions of variables.

**Table 3. Univariate comparison**

Variables	<i>CEO Pandemic = 0</i> (Number = 25,199)		<i>CEO Pandemic = 1</i> (Number = 5,741)		Difference	
	Mean	Median	Mean	Median	t-statistic	Wilcoxon Z
<i>Cash1</i>	0.323	0.200	0.218	0.152	21.023***	22.688***
<i>Size</i>	22.082	21.892	22.012	21.874	3.835***	2.793***
<i>Leverage</i>	0.411	0.402	0.504	0.519	-32.254***	-33.004***
<i>ROA</i>	0.036	0.038	0.032	0.029	5.100***	12.113***
<i>Cash Flow</i>	0.047	0.046	0.052	0.050	-4.677***	-4.546***
<i>Growth</i>	0.176	0.116	0.167	0.120	1.640	0.803
<i>Capital Expenditure</i>	0.052	0.037	0.051	0.036	0.553	3.040***
<i>Net Working Capital</i>	0.081	0.082	-0.039	-0.039	41.793***	41.296***
<i>Book-to-Market</i>	0.380	0.342	0.338	0.312	14.704***	12.823***
<i>Cash Dividends</i>	0.729	1.000	0.624	1.000	15.901***	15.837***
<i>SOE</i>	0.292	0.000	0.663	1.000	-55.434***	-52.871***
<i>Manager Sharholding</i>	0.157	0.033	0.013	0.000	53.760***	55.014***
<i>Board Size</i>	8.488	9.000	9.330	9.000	-33.030***	-30.914***
<i>Indep Director</i>	0.375	0.357	0.361	0.333	18.893***	19.865***
<i>CEO Age</i>	3.910	3.932	3.913	3.932	-1.208	0.198
<i>CEO Degree</i>	3.463	4.000	3.380	3.000	6.546***	7.982***
<i>CEO Gender</i>	0.926	1.000	0.950	1.000	-6.327***	-6.323***

Note: This table reports the univariate comparison contingent upon the subsample of CEOs' SARS pandemic career imprints. \*\*\*, \*\*, and \* denote significance at the 1%, 5% and 10% levels, respectively.

**Table 4. The pandemic career imprints and corporate cash holdings**

Variables	<i>Corporate Cash Holdings (Cash1)</i>				
	(1)	(2)	(3)	(4)	(5)
<i>CEO Pandemic</i>	-0.1047*** (-21.02)	-0.0798*** (-7.84)	-0.0394*** (-4.25)	-0.0396*** (-4.23)	
<i>CEO Pandemic</i> <sup>Severe</sup>					-0.0121 (-0.42)
<i>CEO Pandemic</i> <sup>Non-Severe</sup>					-0.0440*** (-4.66)
<i>Size</i>		-0.0021 (-0.59)	-0.0033 (-0.91)	-0.0035 (-0.97)	
<i>Leverage</i>		-0.7418*** (-21.80)	-0.7354*** (-21.48)	-0.7352*** (-21.48)	
<i>ROA</i>		0.3674*** (7.11)	0.3696*** (7.17)	0.3696*** (7.17)	
<i>Cash Flow</i>		0.3821*** (10.34)	0.3830*** (10.40)	0.3832*** (10.41)	
<i>Growth</i>		-0.0035 (-0.61)	-0.0037 (-0.66)	-0.0037 (-0.65)	
<i>Capital Expenditure</i>		-1.0064*** (-17.72)	-1.0014*** (-17.67)	-1.0016*** (-17.67)	
<i>Net Working Capital</i>		-0.2422*** (-8.39)	-0.2405*** (-8.32)	-0.2413*** (-8.32)	
<i>Book-to-Market</i>		-0.1392*** (-5.92)	-0.1336*** (-5.64)	-0.1334*** (-5.63)	
<i>Cash Dividends</i>		0.0429*** (7.44)	0.0432*** (7.52)	0.0431*** (7.52)	
<i>SOE</i>		0.0120 (1.53)	0.0107 (1.36)	0.0114 (1.44)	
<i>Manager Sharholding</i>		0.1914*** (8.82)	0.1920*** (8.85)	0.1919*** (8.85)	
<i>Board Size</i>		-0.0003 (-0.15)	-0.0003 (-0.15)	-0.0003 (-0.18)	
<i>Indep Director</i>		-0.0538 (-0.88)	-0.0594 (-0.97)	-0.0604 (-0.99)	
<i>CEO Age</i>			0.0150 (0.73)	0.0151 (0.74)	
<i>CEO Degree</i>			0.0101*** (2.87)	0.0099*** (2.79)	
<i>CEO Gender</i>			-0.0235 (-1.57)	-0.0236 (-1.58)	
Year FE	No	Yes	Yes	Yes	Yes
Industry FE	No	Yes	Yes	Yes	Yes
Observations	30,940	30,940	30,940	30,940	30,940
Adjusted R <sup>2</sup>	0.014	0.110	0.291	0.291	0.292

Note: This table shows the impacts of CEOs' pandemic career imprints on corporate cash holdings. Control variables and fixed effects are excluded from Column (1), which solely examines the impacts of pandemic career imprints on CEOs' corporate cash holdings. Columns (2) to (4) exhibit the consequences of control year- and industry-fixed effects, firm-level control variables, and CEOs' individual-level control variables. The coefficients of *CEO Pandemic* are all negatively significant at the 1% statistical level, indicating that CEOs with pandemic career imprints are more inclined to keep lower cash holdings. Column (5) shows the impacts of severe and non-severe pandemic career imprints on corporate cash holdings. It shows that only the impacts of non-severe pandemic career

imprints on corporate cash holdings are significant. This indicates that CEOs are more aggressive and inclined to keep lower cash holdings when the pandemic career imprints are non-severe. Table A1 in Appendix details definition of variables. The t-statistics are reported in parentheses. We employ robust standard errors clustered at the firm level. \*\*\*, \*\*, and \* represent the significance at the 1%, 5% and 10% levels, respectively.

**Table 5. Redefined pandemic career imprints**

Variables	<i>Corporate Cash Holdings (CashI)</i>
<i>CEO Pandemic</i>	-0.0460*** (-4.74)
<i>CEO Pandemic<sup>Non-Core</sup></i>	-0.0523*** (-4.00)
<i>Control</i>	Yes
Year FE	Yes
Industry FE	Yes
Observations	30,940
Adjusted R <sup>2</sup>	0.292

Note: This table exhibits the consequences of redefined CEOs' pandemic career imprint and corporate cash holdings. CEOs who served as non-core executives in A-share listed firms during SARS as redefined pandemic career imprints proxied as *CEO Pandemic<sup>Non-Core</sup>*. After adding the variable *CEO Pandemic<sup>Non-Core</sup>* into our regression model, the coefficient of *CEO Pandemic* becomes -0.0460, and the coefficient of *CEO Pandemic<sup>Non-Core</sup>* is -0.0523. In addition, both coefficients are negative and significant at the 1% level. Table A1 in Appendix details definition of variables. The t-statistics are reported in parentheses. We employ robust standard errors clustered at the firm level. \*\*\*, \*\*, and \* represent the significance at the 1%, 5% and 10% levels, respectively.

**Table 6. Robustness tests**

<b>Panel A. Control variables after matching</b>			
	Mean in the treatment group	Mean in the control group	t-value
<i>Size</i>	22.214	22.211	0.08
<i>Leverage</i>	0.497	0.500	-0.81
<i>ROA</i>	0.034	0.033	0.19
<i>Cash Flow</i>	0.049	0.048	0.96
<i>Growth</i>	0.153	0.161	-0.94
<i>Capital Expenditure</i>	0.051	0.052	-0.64
<i>Net Working Capital</i>	-0.019	-0.020	0.42
<i>Book-to-Market</i>	0.319	0.322	-0.81
<i>Cash Dividends</i>	0.662	0.655	0.66
<i>SOE</i>	0.611	0.621	-0.83
<i>Manager Sharholding</i>	0.019	0.021	-1.02
<i>Board Size</i>	9.219	9.228	-0.19
<i>Indep Director</i>	0.367	0.368	-0.95
<i>CEO Age</i>	3.921	3.922	-0.23
<i>CEO Degree</i>	3.453	3.450	0.14
<i>CEO Gender</i>	0.949	0.956	-1.30

<b>Panel B. PSM results</b>			
Variables	<i>Cash1</i>		
	(1)	(2)	
<i>CEO Pandemic</i>	-0.0427*** (-4.20)		
<i>CEO Pandemic<sup>Severe</sup></i>			-0.0158 (-0.58)
<i>CEO Pandemic<sup>Non-Severe</sup></i>			-0.0470*** (-4.54)
<i>Control</i>	Yes		Yes
Year FE	Yes		Yes
Industry FE	Yes		Yes
Observations	7,508		7,508
Adjusted R <sup>2</sup>	0.238		0.239

<b>Panel C. Heckman selection model</b>			
Variables	Probit ( <i>CEO Pandemic</i> )	<i>Cash1</i>	
	(1)	(2)	
<i>CEO Pandemic</i>			-0.0202** (-2.09)
<i>Historic Peer CEO Pandemic</i>	2.0052*** (6.80)		
<i>IMR</i>			0.0016 (0.06)
<i>Control</i>	Yes		Yes
Year FE	Yes		Yes
Industry FE	Yes		Yes

Observations	24,766	22,172
Pseudo R <sup>2</sup>	0.401	
Adjusted R <sup>2</sup>		0.254

#### Panel D. DiD results

Variables	Cash1
Treat	-0.0126 (-1.30)
Treat×Post	-0.0284** (-2.40)
Control	Yes
Year FE	Yes
Industry FE	Yes
Observations	28,794
Adjusted R <sup>2</sup>	0.297

Note: Panel A demonstrates the differences in control variables between the treatment and control groups after matching. Panel B exhibits the results of Model (1) using the matched sample. Column (1) shows that CEOs' pandemic career imprints continue to lower corporate cash holdings regardless of whether the matched sample has been implemented. Column (2) reports the consequences after classifying the pandemic career imprints into severe and non-severe. The non-severe pandemic career imprints significantly decrease the corporate cash holdings and are still significant at the 1% level. This demonstrates that employing a matched sample does not affect our results. Panel C demonstrates the consequences of utilizing the Heckman test. We employ the proportion of firms in the same industry that employed CEOs with pandemic career imprints in the preceding year as the instrumental variable. Panel D utilizes the DiD approach to ensure our results are robust. Table A1 in Appendix details definition of variables. The t-statistics are reported in parentheses. We employ robust standard errors clustered at the firm level. \*\*\*, \*\*, and \* represent the significance at the 1%, 5% and 10% levels, respectively.

**Table 7. The impacts of SARS and COVID-19 career imprints on corporate cash holdings**

Variables	Cash1			
	(1) COVID = 0	(2) COVID = 1	(3) COVID = 0	(4) COVID = 1
CEO Pandemic	-0.0460*** (-4.80)	-0.0331 (-1.29)		
CEO Pandemic <sup>Severe</sup>			-0.0140 (-0.48)	-0.0307 (-0.46)
CEO Pandemic <sup>Non-Severe</sup>			-0.0509*** (-5.23)	-0.0337 (-1.26)
Control	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes
Empirical p-value		0.104		0.244 0.051*
Observations	23,172	7,768	23,172	7,768
Adjusted R <sup>2</sup>	0.292	0.310	0.293	0.310

Note: This table demonstrates the impacts of the number of pandemic career imprints on CEOs' risk preferences. In Columns (1) and (2), the deterrent effect of the pandemic career imprint on the corporate cash holdings is statistically significant at a 1% level before COVID-19 but insignificant after COVID-19 occurred, indicating that multiple pandemic career imprints can suppress this negative effect. In Columns (3) and (4), the negative effect of non-severe pandemic career imprints on corporate cash holdings is significant at 1% before COVID-19. In contrast, this effect is insignificant after CEOs also experience COVID-19, which is multiple-pandemic career imprints of CEOs. In Columns (1) and (2), the empirical p-value for the difference in subsamples test is 0.104, indicating marginal significance. In Columns (3) and (4), the empirical p-values for the difference in subsamples tests are 0.244 and 0.051, respectively; the difference in the *CEO Pandemic<sup>Non-Severe</sup>* coefficients between the two

subsamples is significant. Table A1 in Appendix details definition of variables. The t-statistics are reported in parentheses. We employ robust standard errors clustered at the firm level. \*\*\*, \*\*, and \* represent the significance at the 1%, 5% and 10% levels, respectively.

**Table 8. Cross-sectional tests of CEOs**

Variables	<i>Cash1</i>	
	(1)	(2)
<i>Degree_high</i> × <i>CEO Pandemic</i>	-0.0363*** (-3.19)	
<i>Degree_low</i> × <i>CEO Pandemic</i>	0.0089 (0.52)	
<i>CEO_male</i> × <i>CEO Pandemic</i>		-0.0429*** (-4.64)
<i>CEO_female</i> × <i>CEO Pandemic</i>		0.0247 (0.47)
<i>Control</i>	Yes	Yes
Year FE	Yes	Yes
Industry FE	Yes	Yes
Observations	30,940	30,940
Adjusted R <sup>2</sup>	0.291	0.292

Note: This table demonstrates that the CEOs' characteristics categorize CEOs' pandemic career imprints to investigate clearly which CEOs with pandemic career imprints are more inclined to reduce cash holdings. In Column (1), we substitute the pandemic career imprints with two dummy variables regarding CEOs' educational backgrounds to examine the impact of CEOs' education levels. Only the coefficient of CEOs with pandemic career imprints with higher educational backgrounds (*Degree\_high*) is significant. In Column (2), we further utilize two dummy variables regarding CEOs' gender to replace the pandemic career imprints. It shows that only the coefficient of CEOs with pandemic career imprints and the gender is male (*CEO\_male*) is significant. Table A1 in Appendix details definition of variables. The t-statistics are reported in parentheses. We employ robust standard errors clustered at the firm level. \*\*\*, \*\*, and \* represent the significance at the 1%, 5% and 10% levels, respectively.

**Table 9. Cross-sectional tests of firms**

<b>Panel A. Firms' financial constraints</b>		<i>CashI</i>			
Variables		(1) <i>SA_high = 0</i>	(2) <i>SA_high = 1</i>	(3) <i>SA_high = 0</i>	(4) <i>SA_high = 1</i>
<i>CEO Pandemic</i>		-0.0500*** (-2.98)	-0.0123 (-1.17)		
<i>CEO Pandemic<sup>Severe</sup></i>				0.0080 (0.10)	0.0086 (0.34)
<i>CEO Pandemic<sup>Non-Severe</sup></i>				-0.0575*** (-3.77)	-0.0157 (-1.47)
<i>Control</i>	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes	Yes
Empirical p-value		0.000***			0.000***
Observations	15,583	15,357	15,583	15,357	
Adjusted R <sup>2</sup>	0.362	0.211	0.362	0.211	

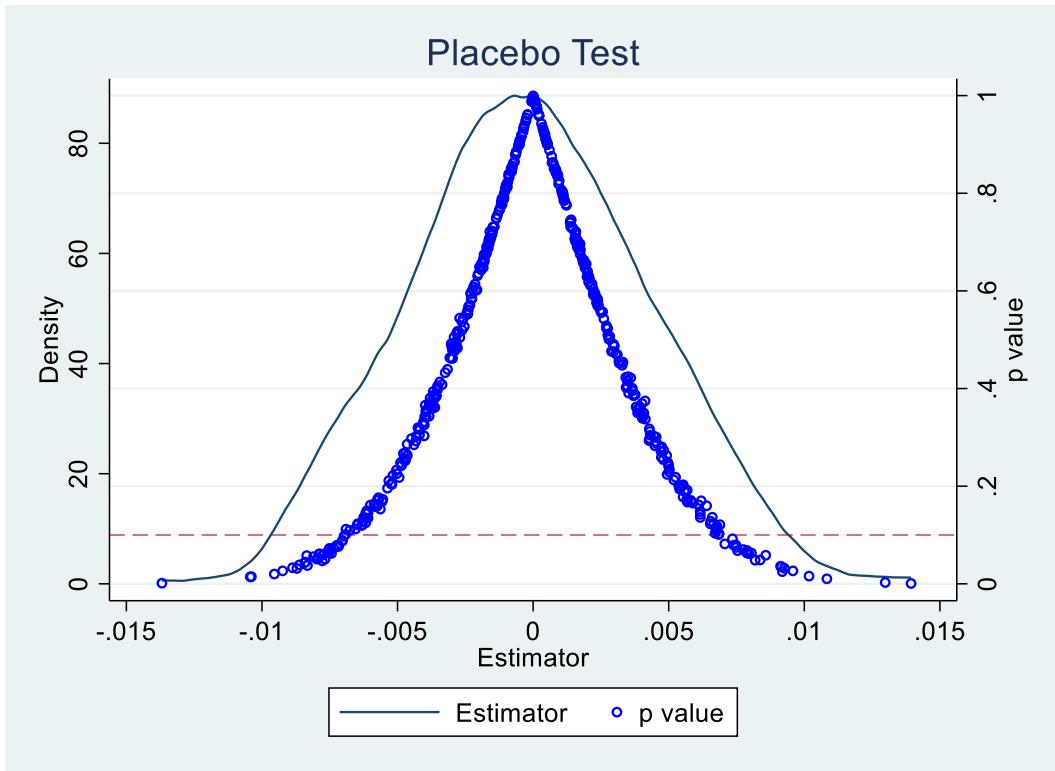
<b>Panel B. Firms' natural of ownerships</b>		<i>CashI</i>			
Variables		(1) <i>SOE = 0</i>	(2) <i>SOE = 1</i>	(3) <i>SOE = 0</i>	(4) <i>SOE = 1</i>
<i>CEO Pandemic</i>		-0.0597*** (-4.20)	-0.0266** (-2.26)		
<i>CEO Pandemic<sup>Severe</sup></i>				-0.0461 (-1.40)	0.0264 (0.61)
<i>CEO Pandemic<sup>Non-Severe</sup></i>				-0.0624*** (-4.46)	-0.0338*** (-2.72)
<i>Control</i>	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes	Yes
Empirical p-value		0.000***			0.000***
Observations	19,784	11,156	19,784	11,156	
Adjusted R <sup>2</sup>	0.312	0.264	0.312	0.266	

Note: This table shows the cross-sectional tests of firms. In Columns (1) and (2) of Panel A, the relationship between pandemic career imprints and corporate cash holdings remains negatively significant when the firm's financial constraint is low (*SA\_high = 0*). After further differentiating the CEO pandemic career imprints into severe and non-severe, the consequences are shown in Columns (3) and (4) of Panel A. The negative effect of non-severe pandemic career imprints on corporate cash holdings is significant only when the firm's financial constraint is low (*SA\_high = 0*) and insignificant when the firm's financial constraint is high (*SA\_high = 1*). In Panel B, columns (1) and (2) demonstrate that the negative impacts of pandemic career imprints on corporate cash holdings are significant in both SOEs and non-SOEs. In Columns (3) and (4), the negative impacts of non-severe pandemic career imprints on corporate cash holdings are significant in both state-owned and non-state-owned firms after dividing the pandemic career imprints into severe and non-severe. In addition, the absolute value of coefficients of non-SOEs are larger than those of SOEs. It indicates that the imprinting impacts are more pronounced among non-SOEs. In addition, the empirical p-values of these sub-sample tests are entirely less than 0.01, indicating that these sub-sample tests are all significant. Table A1 in Appendix details definition of variables. The t-statistics are reported in parentheses. We employ robust standard errors clustered at the firm level. \*\*\*, \*\*, and \* represent the significance at the 1%, 5% and 10% levels, respectively.

**Table 10. The investment in financial assets**

Variables	<i>Fah</i>		<i>Cash_Fah</i>
	(1)	(2)	(3)
			(4)
<i>CEO Pandemic</i>	0.0298*** (6.42)		0.0076 (1.38)
<i>CEO Pandemic</i> <sup>Severe</sup>		0.0292*** (3.63)	0.0166 (1.32)
<i>CEO Pandemic</i> <sup>Non-Severe</sup>		0.0298*** (6.00)	0.0062 (1.08)
<i>Control</i>	Yes	Yes	Yes
Year FE	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes
Observations	30,940	30,940	30,940
Adjusted R <sup>2</sup>	0.161	0.161	0.344

Note: This table reports the results, substituting the proportion of financial assets (*Fah*) for the dependent variable in the Model (1). Columns (1) and (2) show that pandemic career imprints positively affect firms' financial assets and are significant at the 1% level. Columns (3) and (4) present the results after replacing the dependent variable with *Cash\_Fah*. The coefficient of *CEO Pandemic* on *Cash\_Fah* is insignificant, indicating that the reduced cash is fully invested in financial assets. After classifying the pandemic career imprints into severe and non-severe, the coefficients are still insignificant, indicating that CEOs with non-severe pandemic career imprints are also entirely investing the reduced cash in financial assets. Table A1 in Appendix details definition of variables. The t-statistics are reported in parentheses. We employ robust standard errors clustered at the firm level. \*\*\*, \*\*, and \* represent the significance at the 1%, 5% and 10% levels, respectively.



**Figure 1. The placebo test**

Note: This figure shows the regression coefficients of CEO's pandemic career imprint and the distribution of P-values after 500 random treatments, and it can be found that the regression coefficients of CEOs' pandemic career imprint are concentrated around zero, as well as the absolute values are much smaller than the absolute value of the estimated true value of 0.0396, focus on Column (4) of Table 5, and only a few of the P-values after the ensuing treatment are similar to those in the main test, and most of them are much larger than the true value, which soundly suggests that some incidental factors do not drive our results.

**Appendix**  
**Table A1. The definition of variables**

Variables	Definition	Calculation
<b>Dependent Variables</b>		
<i>Cash1</i>	Ratio of the sum of monetary funds and financial assets for trading to non-cash assets	(Monetary funds + financial assets held for trading) / (Total assets - Monetary funds - financial assets held for trading)
<i>Cash2</i>	Ratio of the sum of monetary funds and financial assets for trading to total assets	(Monetary funds + financial assets held for trading) / Total assets
<i>Cash3</i>	Ratio of cash and cash equivalents to non-cash assets	Cash and cash equivalents / (Total assets - Cash and cash equivalents)
<i>Cash4</i>	Ratio of cash and cash equivalents to total assets	Cash and cash equivalents / (Total assets)
<b>Treatment Variables</b>		
<i>CEO Pandemic</i>	Whether CEO was a core executive (Chairman, CEO, General Manager, President, or CFO) in 2003, which is the year of SARS	The dummy variable equals one if CEO was a core executive, and zero otherwise, in 2003
<i>CEO Pandemic<sup>Sever</sup></i>	Whether CEO served as a core executives in Guangdong and Beijing in 2003	The dummy variable equals one if CEO was a core executive in Guangdong and Beijing, and zero otherwise, in 2003
<i>CEO Pandemic<sup>Non-Sever</sup></i>	Whether CEO served as a core executives in regions other than Guangdong and Beijing in 2003	The dummy variable equals one if CEO was a core executive in regions other than Guangdong and Beijing, and zero otherwise, in 2003
<i>CEO Pandemic<sup>Non-Core</sup></i>	Whether CEO was not a core executive in 2003	The dummy variable equals one if CEO was not a core executive, and zero otherwise, in 2003
<b>Control Variables</b>		
<i>Size</i>	Logarithmic value of total assets at the end of the period	In (total assets of firms)
<i>Leverage</i>	The leverage ratio of firms	Total liabilities at the end of the period / Total assets at the end of the period
<i>ROA</i>	Return on assets	Net profit / Total assets at the end of the period
<i>Cash Flow</i>	Corporate cash flow in operating activities	Net cash flow in operating activities / total assets at the end of the period
<i>Growth</i>	Corporate sales growth	(Operating revenue for the period - operating revenue for the previous period) / Operating revenue for the previous period
<i>Capital Expenditure</i>	Capital expenditure scaled by total assets	Capital expenditure <sup>14</sup> / Total assets at the end of the period
<i>Net Working Capital</i>	Net working capital ratio	(Current assets - current liabilities - cash and cash equivalents) / Total assets at

<sup>14</sup> Capital expenditure represents cash paid for the construction of fixed assets, intangible assets, and other long-term assets minus cash recovered from the disposal of the above assets.

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<i>Book-to-Market</i>	Book to market ratio	the end of the period Shareholders' equity/market capitalization
<i>Cash Dividends</i>	Whether cash dividends are paid	The dummy variable equals one if the enterprise pays cash dividends in the year, and zero otherwise
<i>SOE</i>	Whether the company is a state-owned enterprise	The dummy variable equals one if the firm belongs to a state-owned enterprise, and zero otherwise
<i>Manager Sharholding</i>	Ratio of management shareholding	Management shareholding / Total shareholding
<i>Board Size</i>	Corporate board size	Number of board members
<i>Indep Director</i>	Ratio of independent director	Independent director / the number of board members
<i>CEO Age</i>	Logarithmic value of CEO's age	$\ln(1 + \text{CEO's age})$
<i>CEO Degree</i>	CEO's education level	CEO's education ( <i>Degree</i> ) where 1 = secondary school and below, 2 = college, 3 = bachelor's degree, 4 = master's degree, 5 = doctoral degree, and 6 = other
<i>CEO Gender</i>	CEO's gender	The dummy variable equals one if the CEO is male, and zero otherwise.

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**Table A2. The number of confirmed SARS cases in different regions**

Date	Regions with confirmed SARS cases	SARS cases (>0)
16th August 2003	Beijing	2,521
16th August 2003	Sichuan Province	20
16th August 2003	Liaoning Province	7
16th August 2003	Hebei Province	215
16th August 2003	Shanxi Province	448
16th August 2003	Inner Mongolia Autonomous Region	282
16th August 2003	Shanghai	8
16th August 2003	Hubei Province	7
16th August 2003	Guangxi Zhuang Autonomous Region	22
16th August 2003	Tianjin	175
16th August 2003	Jilin Province	35
16th August 2003	Guangdong Province	1,512
16th August 2003	Jiangsu Province	7
16th August 2003	Gansu Province	8
16th August 2003	Anhui Province	10
16th August 2003	Shaanxi Province	12
16th August 2003	Zhejiang Province	4
16th August 2003	Henan Province	15
16th August 2003	Chongqing	3
16th August 2003	Jiangxi	1
16th August 2003	Ningxia Hui Autonomous Region	5
16th August 2003	Shandong Province	1
16th August 2003	Fujian Province	3
16th August 2003	Hunan Province	6

Note: This table only include regions with confirmed SARS cases (SARS cases > 0). Other regions either do not have confirmed SARS cases or lack available data.



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19 December 2025

Dear Editorial Board of ***The International Review of Financial Analysis***,

We wish to submit an original research article entitled “CEO Multiple Crisis Imprints and Firm Cash Holdings” for consideration by ***The International Review of Financial Analysis (IRFA)***.

We confirm that our work is original and has not been published elsewhere, nor is it currently under consideration for publication elsewhere. We also confirm that all authors agree with the content of the manuscript and authorship order.

This study was submitted to the IRFA and received a rejection and revision opportunity. We have addressed all reviewers’ comments with confidence. We sincerely appreciate all valuable comments and constructive suggestions that help us significantly strengthen this study. The revised manuscript and response letter have been submitted separately. We look forward to your favourable consideration and your further advice.

We have no conflicts of interest to disclose.

Please address all correspondence concerning this manuscript to us at [j.cao@soton.ac.uk](mailto:j.cao@soton.ac.uk).

Thank you for your consideration of this manuscript.

A handwritten signature in black ink, appearing to read "June Cao".

Sincerely,

**Associate Professor June Cao (on behalf of all authors)**

Department of Accounting, Southampton Business School

University of Southampton, UK