What doesn't kill you will always make you risk loving? CEO multiple crisis imprints and firm cash holdings

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Abstract

Rather than focus on early-life natural disasters (Bernile *et al.*, 2017), this study investigates how multiple pandemic imprints throughout a CEO's career affect their behaviours. Drawing on imprinting theory, we provide robust evidence that companies led by CEOs who experience SARS tend to have lower cash holdings. However, the imprinting effects become insignificant when CEOs experience more severe and multiple pandemics (i.e., SARS and COVID-19). We document a nonmonotonic relationship between the severity and intensity of CEOs' pandemic imprints throughout their careers and their propensity for adopting aggressive financial strategies. Our study extends Bernile *et al.* (2017) and enriches the literature on CEO imprints by investigating the impact of multiple pandemic experiences at the CEO's career stage rather than early-life on their behaviours.

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

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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., Aktas *et al.*, 2019; Bernile *et al.*, 2017; Chen *et al.*, 2021; Dittmar and Duchin, 2016; Giannetti *et al.*, 2015; Li *et al.*, 2023; Malmendier *et al.*, 2011; Wen *et al.*, 2020). 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).[1] 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, it is not sufficiently investigated how CEOs' fatal imprints throughout the career stage affect their behaviour.[2] Drawing upon the imprinting concept (Hambrick and Mason, 1984; Hambrick, 2007), we extend Bernile *et al.* (2017) and bridge the literature gap by investigating whether and how multiple pandemic imprints at CEOs' career stages affect their risk preferences and whether these impacts are monotonic.

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 lives of human beings. However, it remains unanswered how CEOs' pandemic imprints throughout the career stage affect their behaviours. 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. Meanwhile, 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.

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[1] Higgins (2005) documents the imprinting concept related to career as career imprints.

[2] 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.

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). For instance, firms with extensive access to capital markets, including larger corporations and those boasting high credit ratings, tend to maintain lower cash holdings (Opler *et al.*, 1999). Meanwhile, Denis and Sibilkov (2010) argue that firms with higher financial constraints tend to hold higher cash holdings. Third, cash holdings are relevantly homogeneous compared to diverse corporate investments like research and development (R&D) and capital expenditure (Aktas *et al.*, 2019). Our study, therefore, is motivated to investigate whether and how CEOs' pandemic career imprints affect their risk preferences and, thus, corporate cash holdings.

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 the 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 stock price crashed. Therefore, we predict CEOs who have pandemic imprints throughout the 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. For instance, Bishal and Simpson (2022) discover that corporate exposure to COVID-19 positively impacts cash holdings, suggesting that CEOs adopt more conservative strategies in response to the pandemic experience. 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),[3] indicating a nonmonotonic relationship between posttraumatic stress and subsequent behaviour. Therefore, individuals, including CEOs,

[3] PTSD can arise when an individual experiences one or more instances of traumatic experiences (e.g., actual death, traumatic natural disasters, 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.

may exhibit nonmonotonic shifts in risk preferences due to the severity and intensity of past experiences (e.g., pandemic career imprints).

A consensus is emerging in economic and psychological studies, suggesting that individuals' past experiences, including CEOs, may have either a positive, negative, or nonmonotonic impact on risk preferences and, thus, decision-making, such as corporate cash holdings. Therefore, these are empirical questions about whether CEOs' pandemic career imprints positively or negatively impact corporate cash holdings and whether these impacts are nonmonotonic.

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 Beijing and Guangdong in China exceeded 1,500, constituting approximately 19% of total confirmed cases worldwide.[4] Hence, we posit that CEOs who served as core executives in Beijing and Guangdong during the SARS outbreak in 2023 were exposed to severe pandemic career imprints, and those in other jurisdictions have non-severe pandemic career imprints. In addition, SARS and COVID-19 exhibit substantial similarities in terms of their epidemiological features and societal impacts.[5] 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 employ four measures of corporate cash holdings following Feng and Rao (2018), Harford *et al.* (2008), Liu and Mauer (2011), Opler *et al.* (1999), and Zhang and Zhou (2022) to ensure robustness. We also follow Bishal and Simpson (2022), Chen *et al.* (2021), and Wen *et al.* (2020) to employ two-way fixed effects regression models to explore our research questions and hypotheses.

Foreshadowing the main results, 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. Figure 1 shows the impact of CEOs' pandemic career imprints on corporate cash holdings.

[Insert Figure 1 Here]

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

[4] These data come from World Health Organization, https://www.who.int/csr/sars/country/table2004_04_21/en/

[5] 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.

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 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 negatively significant (-0.0539) 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 those 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 cater for potential endogeneity issues as follows. First, we redefine CEOs' pandemic career imprints and investigate alternative variable tests to address measurement bias. We redefine our dependent variables by employing CEOs who served as non-core executives during the pandemic as CEOs' pandemic career imprints. In addition, we redefine the independent variables using three additional definitions of corporate cash holdings.

Second, we employ the propensity score matching (PSM) approach to address sample-selection bias. That is, firms managed by CEOs with pandemic career imprints fundamentally differ from those managed by others. Accordingly, we follow Drucker and Puri (2005) and Heckman *et al.* (1998) to employ the PSM approach to match our treatment and control groups for balancing their systematic differences.

Third, we use the instrumental variables (IV) approach to mitigate issues related to reverse causality. Specifically, endogeneity may arise if our results are driven by firms with lower cash holdings that are more inclined to employ CEOs with pandemic career imprints. According to the 2012 China Securities Regulatory Commission (CSRC) Industry Classification, we use the proportion of firms in the same industry that employed CEOs with pandemic career imprints in the preceding year as instruments.

Moreover, we adopt the difference-in-differences (DiD) approach to deal with the omitted variable bias. Our study also exploits the placebo test to ensure that incidental factors or spurious correlations do not drive the results. We further examine the mechanism tests for agency problems and financial asset investments 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 our findings of the monotonic relationship between CEOs' pandemic career imprints and corporate cash holdings 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., Aktas *et al.*, 2019; Bernile *et al.*, 2017; Chen *et al.*, 2021; Dittmar and Duchin, 2016; Giannetti *et al.*, 2015; Li *et al.*, 2023; Malmendier *et al.*, 2011; Wen *et al.*, 2020). Bernile *et al.* (2017), Chen *et al.* (2021), and Malmendier *et al.* (2011) 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 (i.e., earthquakes, hurricanes, and floods). 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, we contribute to the literature on corporate cash holdings by investigating whether CEOs' pandemic imprints throughout their career affect their risk preferences and, thus, corporate cash holdings. Previous studies have inferred the relationships between corporate cash holdings and corporate governance (Chen *et al.*, 2020; Dittmar and Mahrt-Smith, 2007; Harford *et al.*, 2008), precautionary motive (Bates *et al.*, 2009), corporate financial constraints (Denis and Sibilkov, 2010; Faulkender and Wang, 2006), 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.

Third, 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.

Fourth, our findings 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.

The remainder of this paper is organized as follows. Section 2 discusses the theoretical mechanism and develops our hypotheses. Section 3 establishes the model specifications and presents the data and samples. Section 4 presents our empirical results and conducts the robustness tests. Section 5 investigates the results of multiple pandemic career imprints and implements additional analyses of the cross-sectional tests of CEOs and firms. Section 6 examines the mechanism analyses to ensure that our results are not driven by agency problems but by the impact of CEOs' risk preferences. Finally, Section 7 presents the conclusions of this study.

2. Theoretical Mechanism and 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 (Chen *et al.*, 2021; Eckel *et al.*, 2009; Hanaoka *et al.*, 2018; Page *et al.*, 2014; Voors *et al.*, 2012).

Similarly, SARS in 2003 and COVID-19 in 2019 were viral pandemic disasters that caused painful memories for humans and the economy. SARS and COVID-19 were unanticipated and may have affected CEOs who have experienced these pandemics. This encourages them to believe that future dangers are easier to tackle than SARS and COVID-19. 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, COVID-19, or both 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:

***H1a**: CEOs with pandemic imprints throughout their careers tend to have lower corporate cash holdings.*

By contrast, Opler *et al.* (1999) establish a trade-off model that indicates that firms acquire more cash for precautionary motives. Firms have significant incentives to keep more cash when they have more substantial development prospects, commercial transactions, and higher costs associated with slashing dividends or losing access to financing (Almeida *et al.*, 2004; Opler *et al.*, 1999). Because cash is created for wealth building, the value of significant cash holdings is unquestionably higher for both transactional and precautionary motivations (Bates *et al.*, 2009; Denis and Sibilkov, 2010; Faulkender and Wang, 2006; Han and Qiu, 2007). Han and Qiu (2007) demonstrate that firms tend to raise their cash holdings as cash flow volatility increases. Bates *et al.* (2009) find that precautionary motives for cash holdings play a significant role in explaining US industrial firms' growth in cash ratios between 1980 and 2006.

Meanwhile, Harford (1999) demonstrates that the acquisition value of cash-rich firms is diminishing. Dittmar and Mahrt-Smith (2007) provide evidence that firms with poor corporate governance have lower cash values. Harford *et al.* (2008) infer that firms with inadequate corporate governance in the US do not seek to maintain cash holdings; instead, they spend it rapidly on acquisitions and capital expenditures. Moreover, Gao *et al.* (2013) find that listed firms keep more cash than private firms, which can be attributed to agency problems in listed firms.

In summary, CEOs who have pandemic career imprints have higher risk awareness. Depending on precautionary motivations, studies provide empirical evidence that when CEOs' perceptions of risk increase, their negative career experiences make them more conservative. For instance, Kong *et al.* (2021) provide evidence that natural disasters cause analysts to produce pessimistic earnings forecasts. Bishal and Simpson (2022) find that corporate exposure to COVID-19 positively affected corporate cash holdings, indicating that firms became more conservative. Numerous studies reveal that CEOs who have experienced adversity in their careers tend to be more conservative in their subsequent decision-making (Dittmar and Duchin, 2016; Faulkner and García-Feijóo, 2022; Schoar and Zuo, 2017), with similar results for experiencing adversity in life (Bertrand and Schoar, 2003; Feng and Johansson, 2018; Malmendier *et al.*, 2011). CEOs may be inspired to retain more cash to address potential uncertainties. As such, CEOs with pandemic career imprints may overestimate potential risks and underestimate future rewards compared with their counterparts who do not have these imprints. Hence, we propose the following hypothesis:

***H1b**: CEOs with pandemic imprints throughout their careers tend to have more corporate cash holdings.*

Figure 2 illustrates our theoretical framework.

[Insert Figure 2 Here]

3. Research Design and Data

3.1 Model specification

To examine the impacts of CEOs' pandemic career imprints on corporate cash holdings, we follow Bishal and Simpson (2022), Chen *et al.* (2021), and Wen *et al.* (2020) to employ a two-way fixed effects regression as the baseline model:

$$Cash_{i\,t}=\alpha+\beta EC_{i,t}+\gamma X_{i,t}+\mu_j+\nu_t+\varepsilon_{i,t} \quad (1)$$

where the subscripts *i*, *j* and *t* represent the firm, industry, and year, respectively. Corporate cash holdings are proxied by $Cash_{i,t}$; the more aggressive CEOs tend to reserve lower cash holdings (Bernile *et al.*, 2017). Specifically, we adopt four measures for the dependent variable, using *Cash1* to the regression in the baseline models and the remaining three (*Cash2*, *Cash3*, and *Cash4*) for robustness test. We define *Cash1* as the ratio of the sum of cash and marketable securities to non-cash assets,[6] following Feng and Rao (2018), Harford *et al.* (2008), Liu and Mauer (2011), Opler *et al.* (1999), and Zhang and Zhou (2022). The treatment variable $EC_{i,\,t}$ is proxied as the CEOs' pandemic career imprints. The imprinting effects are captured by β, which is the focal coefficient of our study and measures the impact of CEOs' pandemic career imprints on corporate cash holdings.

$X_{i,\,t}$ 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 (*Size*), leverage (*Lev*), profitability and return on assets (*ROA*), cash flow from operating activities (*CFO*), sales growth (*Grow*), capital expenditure ratio (*Capex*), net working capital ratio (*NWC*), book-to-market ratio (*BM*), whether cash dividends are paid (*Pay*er), whether the company is a state-owned enterprise (*SOE*), management shareholding ratio (*Manager*), board size (*Bordsize*), and the proportion of independent directors (*Independent*). We also control for CEOs' characteristics, including age (*Age*), gender (*Gender*), and education (*Degree*). μ_j and ν_t denote the industry- and year[7]-fixed effects, respectively. Table A1 in the Appendix provides detailed variable definitions.

3.2 Data source

First, we manually construct individual-level datasets of all executives of all A-share listed firms on the Shanghai and Shenzhen Stock Exchanges.[8] 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 2021 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.

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[6] Non-cash assets are equivalent to total assets minus the sum of cash and marketable securities.

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

[8] We employ this order to collect executives' data in our datasets: *CEO* > *President* > *General Manager* > *General Manager (agency)*.

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.

3.3 Measure of CEOs' pandemic career imprints (EC)

We define the CEOs' pandemic career imprints (*EC*) 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 dummy variable *EC* to one when CEOs have the SARS career imprint, and zero otherwise.

We further categorize CEOs' pandemic career imprints into severe (*high*) and non-severe imprints (*low*) based on the cumulative number of confirmed cases in each jurisdiction during SARS in 2003. As noted, the cumulative number of confirmed SARS cases in Beijing and Guangdong in 2003 exceeded 1,500. Therefore, CEOs who served as core executives in Beijing and Guangdong in 2003 are defined as having a severe pandemic career imprint, with the *high* 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 (*low*) equals one, and zero otherwise.

3.4 Sample selection

Data on CEOs' characteristics, CEOs' pandemic career imprints, corporate financial information, and official addresses are collected from the CSMAR database. Our initial sample comprises all A-share listed firms, resulting in 46,848 firm-year observations from 2004 to 2021. Our sample starts in 2004 because SARS was not eliminated until the middle of 2003. We end the sample in 2021 because the firm-level data for firms in 2021 are more accurate and complete than those in 2022 and 2023; 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 final sample. First, we removed 1,323 firm-year observations without CEOs' characteristics. Second, we also exclude 3,395 firm-year observations due to the lack of financial information. Third, we exclude 925 firm-year observations because these companies have been delisted in the statistical year, and financial firms have different financial structures and regulations. Fourth, we eliminate 13,498 firm-year observations without crucial data to compute the control variables. We cluster standard errors by firms and winsorize all continuous variables at 1st and 99th percentiles to eliminate the effects of outliers on our results.

[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* shows that the cash holdings of firms are 29%, with the smallest being 1.5% and the largest being 196.1%, which is analogous to previous studies (Chang *et al*., 2021; Chen *et al*., 2021; Jebran *et al*., 2019). The mean

of *EC* indicates that CEOs with SARS career imprint manage approximately 20.5% of firms in our sample. Other firm characteristics are consistent with previous studies (Chang *et al.*, 2021; Lin *et al.*, 2023; Wen *et al.*, 2020). The average leverage ratio (*Lev*) in our sample is 43.1%, the average return on assets (*ROA*) is 3.6%, and the average operating cash flow ratio (*CF*) 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.

[Insert Table 2 Here]

Table 3 presents a univariate comparison based on a subsample of CEOs with SARS career imprints. The number of firms in the treatment group, managed by CEOs with SARS career imprints, is 5,681, while the number of firms in the control group is 22,026. 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 (*Lev*) and net working capital ratio (*NWC*) differ considerably based on mean and median difference tests. Firms managed by CEOs with SARS 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 SARS career imprints. In addition, Table 3 shows that the treatment firms pay a lower proportion of cash dividends. Clearly, firms managed by CEOs with SARS career imprints are riskier and more aggressive.

[Insert Table 3 Here]

4.2 Baseline results

The results of the baseline regression model are presented in Table 4. When control variables and fixed effects are excluded from column (1), the estimated coefficient on *EC* is negatively significant (-0.0914) 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 *EC* is again negatively significant (-0.0409) at the 1% level. When we control for CEOs' individual-level variables in column (4), the coefficient on EC is also negatively significant (-0.0411) at the 1% level. Therefore, the estimated coefficients on *EC* are all negative and significant at the 1% statistical level. In addition, column (5) shows that only the estimated coefficient on *low* is negatively 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.

[Insert Table 4 Here]

Our baseline results show that CEOs with pandemic career imprints report a 4.11 % decline in corporate cash holdings compared to those without. In addition, our sample's mean value of cash holdings is 0.309; thus, CEOs with pandemic career imprints are associated with a 13.30%[9] decrease in corporate cash holdings. This indicates that the deterrent effects of pandemic career imprints on corporate cash holdings are statistically and economically significant. These results support *H1a*. Among control variables, corporate leverage (*Lev*), firm capital expenditure rate (*Capex*), net working capital ratio (*NWC*), and book-to-market ratio (*BM*) are negatively related to cash holdings. In contrast, corporate return on assets (*ROA*) and operating cash flow ratio (*CF*)

[9] (0.0411 / 0.309) * 100% = 13.30%

are positively related to cash holdings, acknowledging prior findings (Aktas *et al.*, 2019; Chang *et al.*, 2021; Jebran *et al.*, 2019; Lin *et al.*, 2023).

4.3 Redefine the CEOs' pandemic career imprints

To investigate whether our findings are driven by the definition of CEOs' pandemic career imprints, we redefine these imprints. We define *EC1* as equal to one when CEOs served as non-core executives during SARS and zero otherwise. We anticipate that while CEOs have higher risk-taking and aggression while managing their firms, such effect is less significant than that of CEOs who served as core executives. CEOs who serve as core executives are more knowledgeable and self-assured about firm operations, which can encourage them to be more aggressive. In Table 5, the coefficient on *EC* becomes -0.0483, and the coefficient on *EC1* is -0.0560. In addition, both estimated coefficients are negatively significant at the 1% level, but the coefficient on *EC* (t-statistic = -4.99) is more significant than that of *EC1* (t-value = -4.54), which is consistent with our expectations.

[Insert Table 5 Here]

4.4 Robustness tests

4.4.1 Alternative measures of cash holdings

We employ three alternative cash holdings measures to address measurement bias. First, *Cash2* is proxied by the ratio of the sum of cash and marketable securities to total assets, referring to Chen *et al.* (2019), Gu (2017), Harford (1999), and Ntantamis and Zhou (2022). Second, *Cash3* is defined as the ratio of cash and cash equivalents to non-cash assets, following Chang *et al.* (2021) and Chen *et al.* (2012). Third, *Cash4*, as defined by Han and Qiu (2007), is the ratio of cash and cash equivalents to total assets.

Panel A of Table 6 reports the results. In columns (1), (2), and (3), all coefficients on CEOs' pandemic career imprints are negative and significant at the 1% level. In columns (4), (5), and (6), we further classify CEOs' pandemic career imprints into severe and non-severe groups; the coefficients on severe pandemic career imprints (*high*) are all insignificant. In contrast, the coefficients on non-severe pandemic career imprints (*low*) are all negatively significant at the 1% level. Therefore, our results are robust even after using alternative measures of corporate cash holdings.

[Insert Table 6 Here]

4.4.2 Propensity score matching (PSM)

Firms managed by CEOs with pandemic career imprints (treatment groups) may fundamentally differ from those are not managed by CEOs with pandemic career imprints (control groups). Therefore, we follow Drucker and Puri (2005) to employ the PSM approach to match the control and treatment groups to mitigate the systematic differences between our treatment and control groups (Heckman *et al.*, 1998). Specifically, we utilize control variables to match at both the firm- and CEOs' levels. Panel B 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 7,376.

Panel C of Table 6 reports the results for the matched sample of firms. 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.

4.4.3 Reverse causality

Our results may also be affected by firms with lower cash holdings being more likely to hire CEOs with pandemic career imprints. To address the endogeneity regarding reverse causality, 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 (*EC2*). Panel D of Table 6 presents the results. In column (1), the coefficient of the impact of *EC2* on *EC* is positively significant at the 1% level. After computing the Inverse Mills ratio (*imr*)[10] and incorporating it into Model (1), the results in column (2) show that the coefficient on pandemic career imprint (*EC*) is negative and significant at the 5% level. This indicates that our results are robust after considering reverse causality issues.

4.4.4 Difference-in-difference (DiD)

We further utilize the DiD approach to ensure that our results are robust and mitigate endogenous issues related to omitted variables. We define firms that hired CEOs with pandemic career imprints that have changed during the sample period as the treatment group and firms that hired CEOs without pandemic career imprints during the sample period as the control group. *Post* equals one when CEOs have pandemic career imprints in the current year, and zero otherwise. Panel E of Table 6 reports the results. The coefficient on *Treat* is insignificant, while the coefficient on the interactional term *Treat*Post* is negatively significant at the 1% level. This implies that the corporate cash holdings are significantly lower after firms hire a CEO with pandemic career imprints, suggesting that our results are still robust.

4.4.5 Placebo test

We randomly allocate the 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 pseudo-treatment group from the total sample according to the proportion of the treatment group in the original sample. The 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 CEOs' pandemic career imprints on corporate cash holdings to no longer be significant after the randomization treatment after repeating this randomization 500 times. Figure 3 shows the coefficients on the CEO's pandemic career imprints and the distribution of *p*-values after the randomization process 500 times. The coefficients on CEOs' pandemic career imprints are concentrated around zero. In addition, the absolute values are much smaller than the absolute value of the estimated true value of 0.0411 (column (4) of Table 4). Only a few *p*-values after the ensuing treatments are similar to those in the primary test. Most are much larger than the true values, suggesting that some incidental factors do not drive our results. Therefore, we provide

[10] Inverse Mills ratio is the ratio of the probability density function to the distribution's complementary cumulative distribution function.

convincing evidence that pandemic career imprints affect CEOs' risk preferences rather than other confounding issues.

[Insert Figure 3 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 2021, 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 become 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*). These results suggest that CEOs tend to maintain lower cash holdings without multiple pandemic career imprints. More specifically, CEOs with SARS career imprints also experience COVID-19 when they are core executives who have multiple pandemic career imprints of SARS and COVID-19. 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.

[Insert Table 7 Here]

5.2 Cross-sectional tests of CEOs

We further investigate the impact of pandemic career imprints on CEOs' risk preferences based on their characteristics. 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 who have pandemic career imprints is above (below) the median, and zero otherwise. Column (1) of Table 8 reports the results. Only the coefficient on *Degree_high* is significant and negatively significant at the 1% level. 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.

[Insert Table 8 Here]

In addition to CEOs' education level, previous studies have also examined differences in corporate policies by the gender of leaders (Dittmar and Duchin, 2016; Faccio *et al.*, 2016; Francis *et al.*, 2015), with most showing that female executives are more conservative than male executives. Therefore, male CEOs may be more aggressive, perceive a lower probability of pandemic reoccurrence and tend to reduce cash holdings. Meanwhile, female CEOs are more conservative and may fear the reoccurrence 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_man* (*CEO_woman*) equals one when CEOs with pandemic career imprints are male (female), and zero otherwise. The results are presented in column (2) of Table 8. We can see that only the coefficient on *CEO_man* is negatively significant at the 1% level. Therefore, male CEOs with pandemic career imprints are more likely to reserve lower cash holdings.

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 SA index[11] 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 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 negatively significant (-0.0539) at the 1% level when the financial constraints are low (*SA_high* = 0). However, this relationship is insignificant when financial constraints are high, as column (2) shows.

[11] SA = -0.737*Size + 0.043*Size^2 - 0.040*Age

[Insert Table 9 Here]

The coefficient on the *EC* variable in column (1) is negatively significant at the 1% level, indicating that financial constraints can suppress the negative effect of pandemic career imprints on corporate cash holdings. After further differentiating the *EC* into severe (*high*) and non-severe (*low*), 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 the *low* (-0.0606) is negatively significant at the 1% level, implying that even after classifying the pandemic career 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 a 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. Nevertheless, the absolute value of the coefficient on *EC* in column (1) for non-SOEs is larger than that in column (2) for SOEs. This indicates 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 negatively significant at the 1% level for both SOEs and non-SOEs. The absolute value of the coefficient on *EC* in column (3) for non-SOEs is larger than that in column (4) for SOEs. In addition, the empirical *p*-values equal 0.000, indicating that the analyses of distinguishing sub-samples 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.

6. Mechanism Tests

6.1 Exclusion of agency problems

Agency problems are one of the significant motivations for CEOs to manipulate cash holdings. Agency problems are the misalignment of interests between executives and shareholders (Jensen and Meckling, 1976). For instance, CEOs may prefer to keep lower cash holdings and invest them in nonprofit projects because of their interests rather than using surplus cash for shareholder dividends (Li and Lan, 2022). Similarly, CEOs with pandemic career imprints are more inclined to reduce cash holdings due to agency problems between CEOs and shareholders. We establish the following regression model to test this:

$$AC_{i,t}=\alpha+\beta EC_{i\,t}+\gamma X_{i,t}+\mu_j+\nu_t+\varepsilon_{i,t} \quad (2)$$

According to Ang *et al.* (2000), the agency cost variable *AC* is measured using the management expense ratio (*MFR*) and total asset turnover ratio (*TO*). *AC* with larger *MFR* values and smaller *TO* values indicate higher agency costs. Besides the control variables in Model (1), we include additional firm-level variables: the shareholding of the largest shareholder (*First*), whether the chairperson and CEO are the same (*Dual*), and the number of years the firm has been listed (*FirmAge*). Other control variables are consistent with the definitions in Table A1 in the Appendix. Table 10 presents the results. Columns (1) and (2) show the results after replacing the dependent variable *AC* with *MFR* and *TO*, respectively. The coefficients on *EC* in columns (1) and (2) are insignificant. This implies that pandemic career imprints do not affect agency costs. Columns (3) and (4) show the results of replacing the independent variable *EC* with the severity of pandemic career imprints (*high* and *low*). The effects of *high* and *low* on *AC* remain insignificant. This demonstrates that replacing the dependent variable with pandemic career imprints had an insignificant impact on firms' agency costs, indicating that the agency problem does not drive our results.

[Insert Table 10 Here]

6.2 Investment in financial assets

So far, 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*)[12] as a dependent variable in the baseline model. Columns (1) and (2) of Table 11 present the results. In column (1), the coefficient on the impact of pandemic career imprints (*EC*) on the firms' financial assets (0.0281) is positively significant at the 1% level. Besides pandemic career imprints, the results are consistent after CEOs' career imprints are defined as severe or non-severe. In column (2), both severe and non-severe pandemic career imprints positively affect a firm's financial assets at a 1% level.

[Insert Table 11 Here]

Moreover, 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 with *Cash_Fah*[13] and incorporate it into Model (2). The results are reported in columns (3) and (4) of Table 11. The coefficients on *EC*, *high*, and *low* on *Cash_Fah* are all insignificant, indicating that reduced cash is fully invested in financial assets. Our results provide robust 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.

[12] *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.

[13] *Cash_Fah* is the proportion of corporate cash and financial assets to its total assets.

7. Conclusion

We investigate the impact of CEOs' pandemic career imprints on corporate cash holdings. CEOs with pandemic career imprints are more aggressive in managing their firms and, thus, keep lower cash holdings and invest the reduced cash holdings in financial assets with greater returns and higher risks. Our results are consistent with previous studies on CEOs' military (Malmendier *et al.*, 2011), natural disasters (Bernile *et al.*, 2017), and early-life experiences (Chen *et al.*, 2021). We find the nonmonotonic pandemic imprinting effects are only significant on non-severe pandemic and SARS career imprints rather than severe and multiple-pandemic career imprints. Moreover, 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. 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. 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 some 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.

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Tables

Table 1: Construction of sample data

Total number of firm-year observations from 2004-2021	46,848
Removal of observations without CEO feature data	(1,323)
Removal of the current year delisting and financial sector	(925)
Removal of key variables with missing values	(16,893)
Final sample	27,707

Note: We retrieve 46,848 firm-year observations from 2004 to 2021 from the CSMAR database. We remove 1,323 of these 46,848 observations as they do not exist in the CSMAR data on executive characteristics. We then delete an additional 3,395 observations since they are not incorporated into the financial data. In addition, 925 observations are omitted because the corporations were either delisted during the year or were incorporated into the financial sector statistics. We remove 13,498 observations because the essential control variables evaluated had missing values—the ultimate sample comprised data for a sample of 27,707 observations. To prevent outliers from impacting our results, we winsorize all continuous variables at the 1st and 99th percentiles.

Table 2: Descriptive statistics

Variable	*N*	*Mean*	*Min*	*P25*	*Median*	*P75*	*Max*	*SD*
Cash1	27,707	0.290	0.015	0.104	0.183	0.338	1.961	0.325
EC	27,707	0.205	0.000	0.000	0.000	0.000	1.000	0.404
Size	27,707	22.039	19.824	21.140	21.863	22.727	26.064	1.244
Lev	27,707	0.431	0.053	0.271	0.428	0.583	0.880	0.202
ROA	27,707	0.036	-0.273	0.014	0.037	0.066	0.195	0.064
CF	27,707	0.048	-0.159	0.008	0.047	0.089	0.248	0.071
Grow	27,707	0.186	-0.550	-0.008	0.125	0.295	2.336	0.388
Capex	27,707	0.052	-0.019	0.015	0.037	0.073	0.244	0.051
NWC	27,707	0.053	-0.454	-0.078	0.053	0.184	0.563	0.201
BM	27,707	0.340	0.051	0.222	0.317	0.437	0.782	0.159
Payer	27,707	0.712	0.000	0.000	1.000	1.000	1.000	0.453
SOE	27,707	0.375	0.000	0.000	0.000	1.000	1.000	0.484
Manager	27,707	0.126	0.000	0.000	0.003	0.228	0.676	0.191
Boardsize	27,707	8.698	3.000	7.000	9.000	9.000	18.000	1.789
Independent	27,707	0.372	0.286	0.333	0.333	0.429	0.571	0.053
Age	27,707	3.906	3.258	3.829	3.912	4.007	4.407	0.138
Degree	27,707	3.443	1.000	3.000	4.000	4.000	6.000	0.861
Gender	27,707	0.933	0.000	1.000	1.000	1.000	1.000	0.251

Note: This table exhibits the details of summary statistics for our sample. The mean of *Cash1* demonstrates that the cash holdings of companies in our sample are 29%, with the smallest being 1.5% and the largest being 196.1%. The mean of *EC* illustrates that CEOs with pandemic career imprints, approximately 20.5% of the sample of firms managed by CEOs with pandemic career imprints. The average leverage (*Lev*) in our sample is 43.1%, the average return on assets (*ROA*) is 3.6%, and the average operating cash flow ratio (*CF*) is 4.8%. Most CEOs in our sample are male, with an average education level between a bachelor's degree and a master's degree.

Table 3: Univariate comparison

Variable	*EC* = 0 (Obs = 22,026)		*EC* = 1 (Obs = 5,681)		Difference	
	Mean	*Median*	*Mean*	*Median*	*t-statistic*	*Wilcoxon Z*
Cash1	0.309	0.193	0.218	0.152	19.03***	20.04***
Size	22.050	21.862	21.998	21.865	2.83***	1.65*
Lev	0.412	0.403	0.505	0.519	-31.42***	-32.05***
ROA	0.037	0.039	0.031	0.029	5.95***	13.05***
CF	0.047	0.046	0.052	0.050	-5.03***	-4.76***
Grow	0.190	0.126	0.169	0.121	3.70***	2.04**
Capex	0.052	0.037	0.051	0.036	0.77	3.01***
NWC	0.076	0.079	-0.040	-0.040	39.94***	39.53***
BM	0.341	0.319	0.333	0.311	3.54***	3.69***
Payer	0.736	1.000	0.622	1.000	16.93***	16.85***
SOE	0.300	0.000	0.666	1.000	-53.20***	-50.68***
Manager	0.155	0.027	0.012	0.000	52.67***	52.05***
Boardsize	8.533	9.000	9.337	9.000	-30.71***	-28.90***
Independent	0.375	0.333	0.361	0.333	17.99***	18.82***
Age	3.905	3.912	3.911	3.912	-2.90***	-1.62
Degree	3.460	4.000	3.377	3.000	6.46***	7.82***
Gender	0.928	1.000	0.949	1.000	-5.72***	-5.72***

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

	(1)	(2)	(3)	(4)	(5)
	Cash1	*Cash1*	*Cash1*	*Cash1*	*Cash1*
EC	-0.0914***	-0.0772***	-0.0409***	-0.0411***	
	(-19.03)	(-7.58)	(-4.42)	(-4.41)	
high					-0.0120
					(-0.42)
low					-0.0457***
					(-4.84)
Size			-0.0042	-0.0053	-0.0056
			(-1.15)	(-1.45)	(-1.52)
Lev			-0.6954***	-0.6884***	-0.6881***
			(-18.53)	(-18.20)	(-18.19)
ROA			0.4005***	0.4018***	0.4018***
			(8.08)	(8.12)	(8.12)
CF			0.3442***	0.3447***	0.3449***
			(9.40)	(9.45)	(9.46)
Grow			-0.0063	-0.0065	-0.0065
			(-1.18)	(-1.22)	(-1.22)
Capex			-0.9424***	-0.9372***	-0.9373***
			(-16.40)	(-16.34)	(-16.34)
NWC			-0.2757***	-0.2738***	-0.2747***
			(-9.55)	(-9.49)	(-9.48)
BM			-0.1085***	-0.1023***	-0.1019***
			(-3.63)	(-3.39)	(-3.38)
Payer			0.0420***	0.0422***	0.0421***
			(7.25)	(7.32)	(7.32)
SOE			0.0105	0.0093	0.0101
			(1.33)	(1.18)	(1.26)
Manager			0.1771***	0.1774***	0.1772***
			(8.14)	(8.15)	(8.14)

Boardsize			0.0002	0.0002	0.0002
			(0.09)	(0.11)	(0.08)
Independent			-0.0393	-0.0461	-0.0473
			(-0.64)	(-0.75)	(-0.78)
Age				0.0158	0.0159
				(0.77)	(0.77)
Degree				0.0094***	0.0091**
				(2.65)	(2.57)
Gender				-0.0269*	-0.0270*
				(-1.73)	(-1.74)
cons	0.3090***	0.2283***	0.6933***	0.6502***	0.6581***
	(142.15)	(7.43)	(9.13)	(5.99)	(6.08)
Year FE	No	Yes	Yes	Yes	Yes
Industry FE	No	Yes	Yes	Yes	Yes
N	27,707	27,707	27,707	27,707	27,707
Adj. R^2	0.013	0.112	0.286	0.287	0.287

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 *EC* are all negatively significant at the 1% statistical level, indicating that CEOs with pandemic career imprints are more inclined to keep lower cash holdings. For instance, according to column (4), the coefficient of *EC* is -0.0411, which is statistically significant at the 1% level. Column (5) demonstrates 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. Values in parentheses are the *t-statistic*. ***, **, and * represent the significance at the 1%, 5% and 10% levels, respectively.

Table 5: Redefined pandemic career imprints and corporate cash holdings

	(1)
	Cash1
EC	-0.0483***
	(-4.99)
EC1	-0.0560***
	(-4.54)
Control	Yes
Year FE	Yes
Industry FE	Yes
cons	0.6476***
	(5.98)
N	27,707
Adj. R^2	0.288

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 *EC1*. After adding the variable *EC1* into our regression model, the coefficient of *EC* becomes -0.0483, and the coefficient of *EC1* is -0.0560. In addition, both coefficients are negatively significant at the 1% level, but the t-statistic of *EC* (-4.99) is more significant than the t-statistic of *EC1* (-4.54). Values in parentheses are the *t-statistic*. ***, **, and * represent the significance at the 1%, 5% and 10% levels, respectively.

Table 6: Robustness tests

Panel A: Alternative measures of cash holdings

	(1)	(2)	(3)	(4)	(5)	(6)
	Cash2	*Cash3*	*Cash4*	*Cash2*	*Cash3*	*Cash4*
EC	-0.0168***	-0.0442***	-0.0196***			
	(-3.94)	(-5.73)	(-5.06)			
high				-0.0086	-0.0237	-0.0136
				(-0.74)	(-1.12)	(-1.38)
low				-0.0181***	-0.0474***	-0.0205***
				(-4.16)	(-5.94)	(-5.14)
Control	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes
cons	0.3583***	0.7094***	0.4030***	0.3605***	0.7150***	0.4046***
	(7.32)	(8.13)	(9.12)	(7.38)	(8.19)	(9.16)
N	27,707	27,707	27,707	27,707	27,707	27,707
Adj. R^2	0.316	0.336	0.353	0.316	0.336	0.353

Panel B: Control variables after matching

	Mean in the treatment group	Mean in the control group	T-value
Size	22.186	22.171	0.44
Lev	0.497	0.498	-0.15
ROA	0.033	0.033	-0.01
CF	0.049	0.048	0.19
Grow	0.161	0.163	-0.31
Capex	0.051	0.052	-0.77
NWC	-0.019	-0.020	0.24
BM	0.312	0.314	-0.68
Payer	0.658	0.644	1.22
SOE	0.614	0.621	-0.57
Manager	0.018	0.022	-1.95*
Boardsize	9.203	9.213	-0.21

Independent	0.366	0.367	-0.81
Age	3.917	3.920	-1.07
Degree	3.443	3.459	-0.80
Gender	0.950	0.957	-1.27

Panel C: PSM results

	(1)	(2)
	Cash1	*Cash1*
EC	-0.0465***	
	(-4.55)	
high		-0.0214
		(-0.85)
low		-0.0504***
		(-4.80)
Control	Yes	Yes
Year FE	Yes	Yes
Industry FE	Yes	Yes
cons	0.5368**	0.5562**
	(2.41)	(2.51)
N	7,376	7,376
Adj. R^2	0.238	0.239

Panel D: Heckman test

	(1)	(2)
	EC	*Cash1*
EC		-0.0217**
		(-2.23)
EC2	1.9815***	
	(6.77)	
imr		-0.0028
		(-0.11)
Control	Yes	Yes
Year FE	Yes	Yes

Industry FE	Yes	Yes
cons	-13.5113***	0.6001**
	(-10.88)	(2.00)
N	22,172	22,172
PseudoR²	0.389	
Adj. R²		0.251

Panel E: DiD results

	(1)
	Cash1
Treat	-0.0130
	(-1.32)
*Treat*Post*	-0.0357***
	(-3.25)
Control	Yes
Year FE	Yes
Industry FE	Yes
cons	0.7159***
	(6.41)
N	25,378
Adj. R²	0.294

Note: Panel A reports the results with three alternative measures of cash holdings to mitigate the issues with measurement bias on our consequences. In addition to *Cash1*, *Cash2* is the ratio of cash and cash equivalents to total assets; Cash3 is the ratio of monetary funds and trading financial assets to total assets; *Cash4* is the proportion of liquid assets to non-cash assets. Panel B demonstrates the differences in control variables between the treatment and control groups after matching. After matching, the differences between the treatment and control groups are mitigated, and the total number of firm-year observations shrunk to 7,376 simultaneously. Panel C 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 D 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 (*EC2*). Panel E utilizes the DiD approach to ensure our results are robust. The coefficient of the interactional term *Treat*Post* is negative and significant at the 1% level, indicating that the treatment group is different before and after the change in the CEOs' pandemic career imprints and that the corporate cash holdings are significantly lower after the firms hire CEOs with pandemic career imprints, suggesting that our results are still robust. Values

in parentheses are the *t-statistic*. ***, **, 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

	(1) COVID=0	(2) COVID=1	(3) COVID=0	(4) COVID=1
	Cash1	*Cash1*	*Cash1*	*Cash1*
EC	-0.0454***	-0.0074		
	(-4.79)	(-0.26)		
high			-0.0142	-0.0132
			(-0.50)	(-0.21)
low			-0.0502***	-0.0057
			(-5.20)	(-0.19)
Control	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes
cons	0.6566***	0.6849***	0.6660***	0.6845***
	(5.72)	(3.23)	(5.81)	(3.23)
Empirical p-value	0.001***		0.000***	
N	23,193	4,514	2,3193	4,514
Adj. R^2	0.292	0.296	0.293	0.296

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. Values in parentheses are the *t-statistic*. ***, **, and * represent the significance at the 1%, 5% and 10% levels, respectively.

Table 8: Cross-sectional tests of CEOs

	(1)	(2)
	Cash1	*Cash1*
Degree_high	-0.0380***	
	(-3.35)	
Degree_low	0.0079	
	(0.47)	
CEO_man		-0.0441***
		(-4.79)
CEO_woman		0.0176
		(0.33)
Control	Yes	Yes
Year FE	Yes	Yes
Industry FE	Yes	Yes
cons	0.6804***	0.6469***
	(6.25)	(5.96)
N	27,707	27,707
Adj. R^2	0.286	0.287

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_man*) is significant. Values in parentheses are the *t-statistic*. ***, **, and * represent the significance at the 1%, 5% and 10% levels, respectively.

Table 9: Cross-sectional tests of firms

Panel A: Firms' financial constraints

	(1) SA_high=0	(2) SA_high=1	(3) SA_high=0	(4) SA_high=1
	Cash1	*Cash1*	*Cash1*	*Cash1*
EC	-0.0539***	-0.0108		
	(-3.21)	(-1.02)		
high			-0.0012	0.0126
			(-0.02)	(0.50)
low			-0.0606***	-0.0146
			(-3.89)	(-1.35)
Control	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes
cons	0.5670***	0.4740***	0.5757***	0.4820***
	(3.87)	(3.20)	(3.92)	(3.27)
Empirical p-value	0.000 ***		0.000 ***	
N	13,949	13,758	13,949	13,758
Adj. R^2	0.359	0.203	0.359	0.204

Panel B: Firms' natural of ownerships

	(1) SOE=0	(2) SOE=1	(3) SOE=0	(4) SOE=1
	Cash1	*Cash1*	*Cash1*	*Cash1*
EC	-0.0616***	-0.0256**		
	(-4.38)	(-2.18)		
high			-0.0469	0.0268
			(-1.45)	(0.63)
low			-0.0645***	-0.0326***
			(-4.46)	(-2.72)
Control	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes
cons	0.8505***	0.3514**	0.8550***	0.3606**
	(5.53)	(2.26)	(5.56)	(2.32)
Empirical p-value	0.000 ***		0.000 ***	
N	17,309	10,398	17,309	10,398
Adj. R^2	0.312	0.255	0.312	0.257

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 *EC* 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* and insignificant when the firm's financial constraint is *high*. 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 (*EC*=-0.0616 and *low*=-0.0645) are larger than those of SOEs (*EC*=-0.0256 and *low*=0.0326). 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. Values in parentheses are the *t-statistic*. ***, **, and * represent the significance at the 1%, 5% and 10% levels, respectively.

Table 10: Exclusion of agency problems

	(1)	(2)	(3)	(4)
	MFR	*TO*	*MFR*	*TO*
EC	0.0008	-0.0179		
	(0.27)	(-0.94)		
high			-0.0036	0.0056
			(-0.58)	(0.13)
low			0.0014	-0.0213
			(0.46)	(-1.08)
Control	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes
cons	0.4411***	0.2153	0.4403***	0.2194
	(15.28)	(1.11)	(15.28)	(1.13)
N	27,217	27,217	27,217	27,217
Adj. R^2	0.281	0.256	0.281	0.256

Note: This table reports the results, which rule out that CEOs with pandemic career imprints are more inclined to reduce cash holdings as driven by agency problems between CEOs and shareholders. Columns (1) and (2) are the results after replacing the dependent variable *Cash* with *MFR* and *TO*. The coefficients of *EC* in columns (1) and (2) are both insignificant. It indicates that the CEOs' pandemic career imprints do not affect the firms' agency costs. Columns (3) and (4) are the results after replacing the independent variable *EC* with the severity of the pandemic career imprints (*high* and *lo*w). It demonstrates that replacing the independent variable still has insignificant impacts on the firms' agency cost, indicating that the agency problem does not drive our results. Values in parentheses are the *t-statistic*. ***, **, and * represent the significance at the 1%, 5% and 10% levels, respectively.

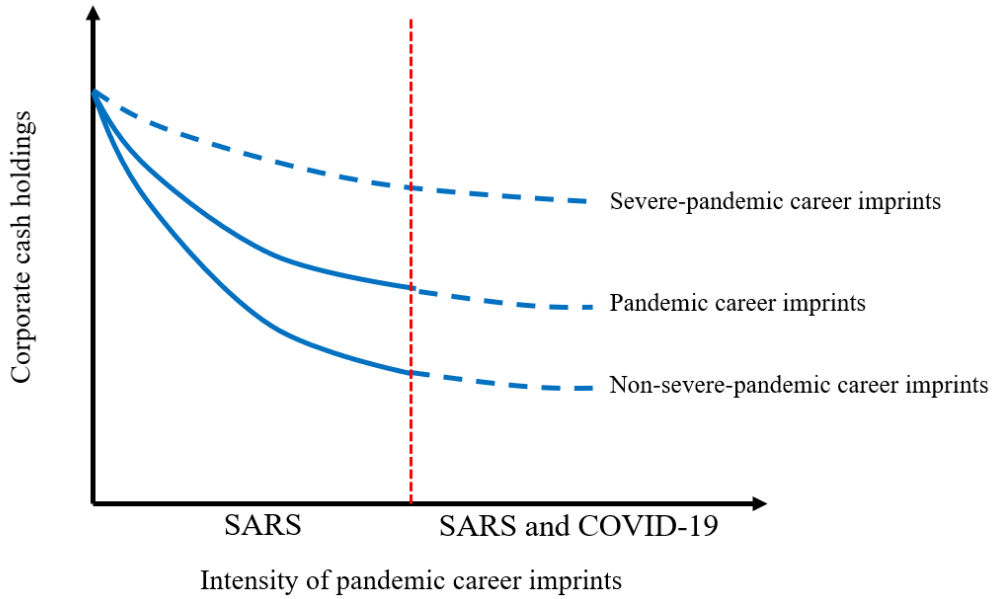
Table 11: The investment in financial assets

	(1)	(2)	(3)	(4)
	Fah	*Fah*	*Cash_Fah*	*Cash_Fah*
EC	0.0281***		0.0062	
	(6.18)		(1.13)	
high		0.0276***		0.0156
		(3.54)		(1.25)
low		0.0281***		0.0048
		(5.76)		(0.83)
Control	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes
cons	0.0601	0.0600	0.4253***	0.4278***
	(1.48)	(1.48)	(7.39)	(7.44)
N	27,707	27,707	27,707	27,707
Adj. R^2	0.166	0.166	0.338	0.338

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 *EC* 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.

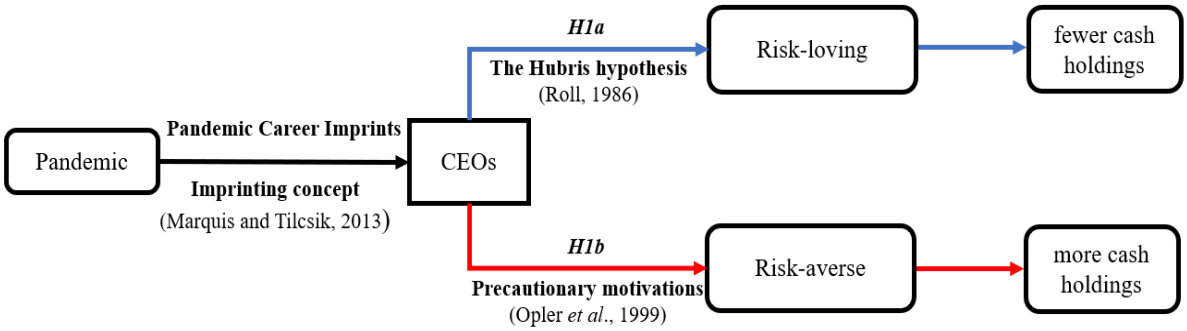
Figures

Figure 1: The impact of CEOs' pandemic career imprints on corporate cash holdings



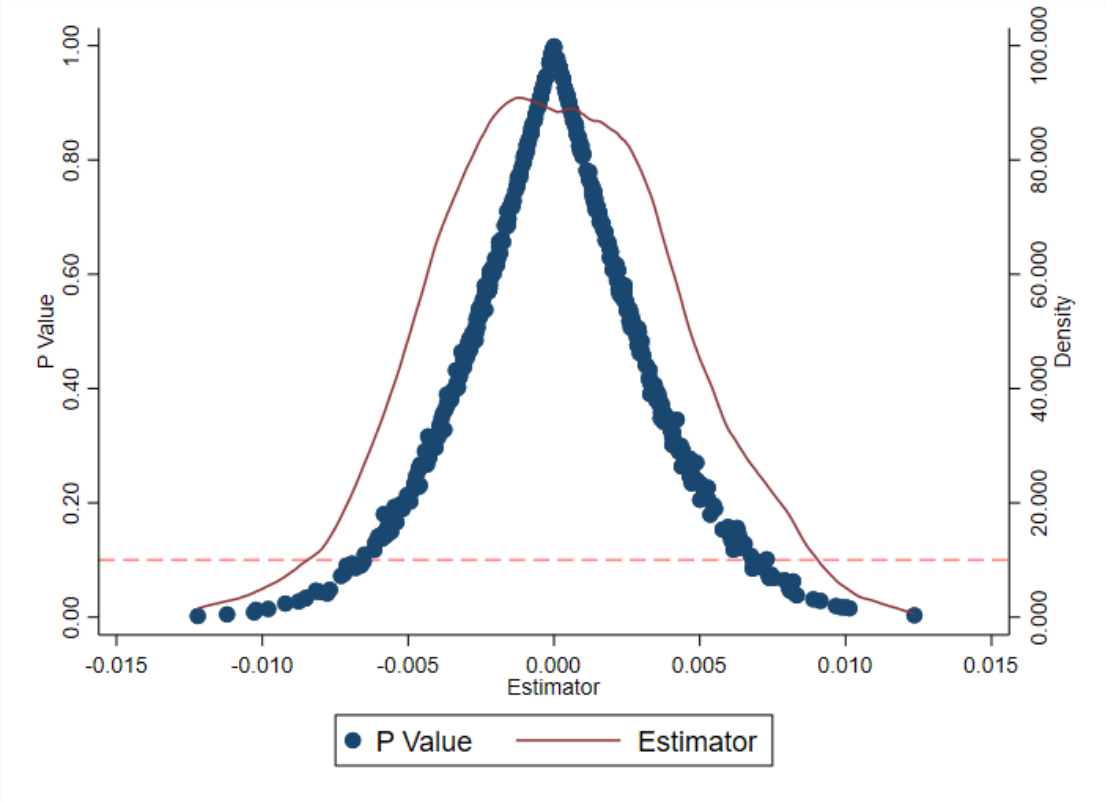
Note: Figure 1 sketches the impact of CEOs with severe- and non-severe-pandemic career imprints on corporate cash holdings. Solid lines indicate significant impacts, and dashed lines indicate insignificant impacts. The *SARS* area (a grey area) in Figure 1 represents CEOs with only SARS career imprints. The *SARS and COVID-19* area (a deep grey area) in Figure 1 demonstrates that CEOs have multiple pandemic career imprints (i.e., SARS and COVID-19). The impacts of CEOs with SARS career imprints are significant when we do not classify the severity of SARS career imprints into severe and non-severe. The impacts are insignificant when the effects of COVID-19 career imprints are added. After distinguishing the severity of SARS career imprints into severe and non-severe, only the impacts of CEOs with non-severe-SARS career imprints are significant. In addition, the impacts of CEOs with non-severe-pandemic career imprints on corporate cash holdings (-0.0457) are greater than the impacts of no classification with the severity of pandemic career imprints on corporate cash holdings (-0.0411) (results from columns (4) and (5) in Table 4). Our results show that the impacts of CEOs with SARS and COVID-19 career imprints on corporate cash holdings are significant, and neither the impacts of CEOs with severe- nor non-severe-pandemic career imprints. It shows that severe-pandemic career imprints (severity) and multiple-pandemic career imprints (quantity) have insignificant impacts on corporate cash holdings. Only non-severe-pandemic career imprints significantly impact corporate cash holdings, which indicates that non-severe-pandemic career imprints negatively affect CEOs' risk preferences.

Figure 2: Theoretical framework



Note: This figure sketches the theoretical framework of our study. Marquis and Tilcsik (2013) reveal the imprinting concept, which infers that individuals form imprints adapted to the environment and have lasting and profound impacts on their subsequent decision-making and behaviours. Therefore, CEOs, the crucial core executives in firms, would establish the pandemic career imprints and then affect their risk preferences. However, whether and how pandemic career imprints affect CEOs' risk preferences and further affect corporate cash holdings is inconclusive to date. Therefore, we propose the competing hypotheses to address this question. We establish the first hypothesis based on the hubris hypothesis (Roll, 1986). CEOs with pandemic career imprints would become more aggressive and keep lower cash holdings. On the contrary, we propose the second hypothesis according to precautionary motivations (Opler *et al.*, 1999). CEOs with pandemic career imprints would become more conservative and keep higher cash holdings.

Figure 3: 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 0.0411, 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
Panel A: Dependent Variables		
Cash1	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)
Cash2	Ratio of the sum of monetary funds and financial assets for trading to total assets	(Monetary funds + financial assets held for trading) / Total assets
Cash3	Ratio of cash and cash equivalents to non-cash assets	Cash and cash equivalents / (Total assets - Cash and cash equivalents)
Cash4	Ratio of cash and cash equivalents to total assets	Cash and cash equivalents / (Total assets)
Panel B: Treatment Variables		
EC	Whether CEO was a core executive (Chairman, CEO, General Manager, President, or CFO) in 2003	The dummy variable equals one if CEO was a core executive, and zero otherwise, in 2003
EC1	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
Panel C: Control Variables		
Size	Logarithmic value of total assets at the end of the period	ln (total assets of firms)
Lev	The leverage ratio of firms	Total liabilities at the end of the period / Total assets at the end of the period
ROA	Return on assets	Net profit / Total assets at the end of the period
CF	Corporate cash flow in operating activities	Net cash flow in operating activities / total assets at the end of the period

Grow	Corporate sales growth	(Operating revenue for the period - operating revenue for the previous period) / Operating revenue for the previous period
Capex	Capital expenditure scaled by total assets	Capital expenditure[14] / Total assets at the end of the period
NWC	Net working capital ratio	(Current assets - current liabilities - cash and cash equivalents) / Total assets at the end of the period
BM	Book to market ratio	Shareholders' equity/market capitalization

[14] 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.